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MINISTRY OF ROAD TRANSPORT & HIGHWAYS
Government of India

Karnataka
Public Works, Ports &
Inland Water Transport Department

Project:

Consultancy Services for "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.000 to 261.450 on NH-48 in the State of Karnataka"

Subject:

KD-6- Draft Detailed Project Report for Final Approved Alignment for Bypass

Vol III: Materials Report

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INTRODUCTION

This report is prepared under Contract Agreement clause 2.8; "Key Date No: KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)" after incorporation of Client's observations on earlier submitted "KD5: Kucha Draft Detailed Project Report (KDDPR)" vide letter no. NH/PIU-Tunnel/NH-48/KD-3/2015-16/383-386 dated 14.12.2015.
.
The present submission (10 Hard Bound Sets and 5 Soft Copies of each) is as detailed below:

(i) Volume-I Main Report :

- *Executive summary*
- *Project Description*
- *Socio Economic Profile*
- *Materials Surveys and Investigation*
- *Traffic Surveys and Analysis*
- *Design Standards and Specifications*
- *Alignment Proposals*
- *Summary of EIA/IEE and Action Plan*
- *Summary of Resettlement Plan*
- *Preliminary Cost Estimates*
- *Preliminary Economic Analysis*
- *Preliminary Financial Analysis*
- *Suggested Methods of procurement and packaging*
- *Conclusions and Recommendations*
- *Acknowledgement*
- *Compliance of the Observations*

The basic data obtained from the field studies and investigations and input data used for the detailed engineering design (if any) shall be submitted in a separate volume as an Appendix to Main Report.

(ii) Volume - II Design Report :

Part - I: Traffic Study, Analysis and Forecast

- *Description of Existing Road in Ghat Section*
- *Road and Bridge Inventory*
- *Traffic Surveys, analysis and forecast*
- *Proposed Pavement Design*

Part-II: Design of Tunnels

- *Proposed Tunnel Design, Standards*
- *Structural Analysis- Primary Lining*

Part-III: Design of Bridges and Cross-Drainage Structures

- *Proposed Bridges and Structures Design Basis and*
- *Bridges Dimensioning*

Part-IV: Geological Design and Geotechnical Report

- *Geological Survey and Analysis*
- *Geotechnical Investigations Report*

(iii) Volume - III Materials Report :

(iv) Volume - IV (a) Environmental Assessment Report including Environmental Management Plan (EMP) :

(v) Volume - IV (b) Resettlement Action Plan (RAP) :

(vi) Volume - V Technical Specifications :

(vii) Volume - VI Rate Analysis :

(viii) Volume - VII Cost Estimates :

(ix) Volume - VIII Bill of Quantities :

(x) Volume - IX Drawings (A3 Size) :

a. *Location map*
b. *Layout plans*
c. *General Drawings*
d. *Plan and Profile of Refined Alignment "A"*
e. *Typical Cross Sections showing Pavement details of Cut & Fill Section*
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h. *Tunnels- General Arrangement Plan and L-Sections (L&R)*
i. *Viaducts – General Arrangement Plan and L-Section*
j. *Cut & Fill and Viaducts – General Arrangement Plan and L-Section*
k. *GAD for proposed RoB at Railway km 54+650*
l. *Standard Drawings*
m. *Miscellaneous Drawings*
n. *Indicative Land Acquisition Plans*
o. *Detailed Cross Sections @ 100m interval*

(xi) Volume - X Civil Work Contract Agreement :
(xii) Volume - XI Project Clearances :

VOLUME – III: MATERIALS REPORT

1. GENERAL

This Volume -III: Materials Report, a part of KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)" is submitted in accordance with the Contract Agreement and as per requirement specified in Terms of Reference (ToR) for preparation of Materials Report of "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH-48 in the State of Karnataka".

2. REFERENCES

[1] Regional Geological Map of 1:50,000 scale (Topo Sheet No. 48P/9) from Geological Survey (GSI) of India Bangalore

[2] Published and unpublished Geological & Engineering Geological Reports and Maps of GSI related to Shiradi Ghat Area downloaded from GSI portal and other site in internet.

[3] "Technical Note on Alignment Choice" – Geoconsult Report dated 30-09-15

[4] Letter from Office of the Director, Groundwater Directorate, No. 49, Khanija Bhavana, Race Course Road, Bangalore (No: Cd¤/vÁAwæPÀ /FGS/14 /2015-16 dated 06-11-2015

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[6] Test Results of the Materials used for construction of rigid pavement of existing road NH-48 section from km 238 to km 250.

[7] Meteorological data of Hassan and Dakshina Kannada districts.

[8] Geology and Mineral Resources of Karnataka and Goa. Miscellaneous Publication No 30. Part VII (3rd Revised Edition) 2014. Geological Survey of India.

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3. PRELIMINARY STUDIES

3.1 General

This Chapter covers the general geology, topography and landscape characteristics of the project road area based on desk study of the secondary data.

3.2 Landscape Characteristics and Physiography

The project and surrounding area are bounded by latitudes 12° 45' 00'' and 13° 00' 00'' and longitudes 75° 30' 00' and 75° 45' 00'' covering parts of Sakhleshpur Taluka of Hassan, Belthangadi Taluk of South Kanara and MudigereTaluk of Chikmagalur districts, Karnataka. Major villages present in the area are Maranhally, Kadmane, Attihalli, Hongadahalla, Makangadde, Gundya.

The project area falls within the Western Ghats. The surrounding area is hilly and covered with thick forest. Some prominent peaks are Hosahalli betta 1133m, Devarbetta 1281m, Jankalbetta 1388m, highest being 1388 in the north central portion.

The lowest point is about 110m in the western part near Gundya. The rivers present are Gundiahole and Sislahole with their tributaries and Hemavathi. With dendritic to sub dendritic drainage patterns.

3.3 Climate

In Hassan District, highest day temperature is in between 27 °C to 38 °C in summers. Average temperatures of January is 23 ° C , February is 23 ° C , March is 26 °C , April is 27 °C , May is 27 °C. The average annual rainfall is about 1040 mm. In Chikmagalur the climate is hot to pleasant in summer and winter respectively with average rainfall of about 1990mm. In south Kanara the climate is humid with temperatures rising up to 30°C and average rainfall of about 3930mm.

As per Information provided by DMG [4] the proposed project area lies in the watershed bearing code 5A3B2. The average rainfall data for the last 10 years is 5548 mm.

3.4 Geology

Geological aspects are covered in next chapter of this report.

3.5 Desk Study

Detailed reconnaissance survey of the project area along the NH-48 road and along the existing SW Rail route rail between Maranhally and Gundya have been conducted during two to three site visits to assess the site conditions prior to detailed site investigations and topographic survey. Information obtained during this initial survey was studied in conjunction with the requirements of the TOR to prepare a detailed plan on the site investigations to be carried out. The different tests and scope of work are covered in Volume –I: Main Report.

3.6 Tests and Specifications

The various in-situ tests and laboratory tests that shall be included in the testing program (refer section 6) and will be according to the requirements laid out in the Terms of Reference (TOR). Relevant Bureau of Indian Standard (BIS)/Indian Roads Congress (IRC) etc shall be adopted for these tests.

4. GEOLOGICAL OVERVIEW

General Geology and project Geology had been covered in earlier submission of KD4 Report "KD 4 - Field Report/ Preliminary Project Report/ Interim Progress Report Part B: Preliminary Project Report Volume – II : Design Report". Some of these aspects are covered in detail herewith briefly.

4.1 General Geology

Karnataka lies within Peninsular India (Southern part of Indian Sub Continent) which is part of the Indian Shield. The shield portions are remnant of the original earth crust formed during the early stage of earth's geological history (Precambrian). They are large areas of tectonically stable, relatively flat regions of continental crust that have not been subsequently submerged (under the ocean) after their formation.

The geology of Karnataka lies widespread in the major eras, namely the Archean, Proterozoic, Mesozoic and the Cenozoic (refer Fig. 4.1). It consists of rock formations ranging in age from as early as 3400 m.y. to recent 5 m.y. The geology of Karnataka is largely confined to the two oldest eras; the Archean and the Proterozoic. The period from Cambrian to recent are represented by minor sediments of recent age (Tertiary and Quaternary) exposed along the coastal margin to the West covering about 5000 sq km and parts of North Karnataka covered by Deccan trap, representing large and voluminous outburst of volcanic activity at the dawn of the Cenozoic era (65-67 m.y.) covering about 28,000 sq km.

The state has exposed oldest rocks in Gorur area, Hassan district, Karnataka date back to about 3300 million years. The Precambrian craton of Karnataka is made up of western and eastern segments (refer Tables 1 & 2). The Precambrians of Karnataka have been divided into older Sargur supracrustals (about 3300 to 3000 million year old) and younger Dharwar supracrustals (about 3000 to 2600 million year old. The Dharwar supracrustals Supergroup has been further divided into older Bababudan Group (ca.3000 to 2700 million years) and younger Chitradurga Group (ca.2700 to 2500 million years).

The Karnataka craton has been extensively intruded by granites and granitoids of ranging in age from 2600 to 2500 million years. The eastern Karnataka abounds in these granites and granitoids. The northern part of Karnataka is made up of Kaladgi and Badami and Bhima Group of sediments, approximately of Proterozoic age. Further north the terrain is covered by extensive volcanic flows known as Deccan traps of Cretaceous -Tertiary age.

Geological aspects for Karnataka are presented in geological maps (Fig. 4.1) and Tables 4.1. The general geology for Karnataka is briefly described as follow:

Figure 4.1 : Geological Map of Karnataka and Goa

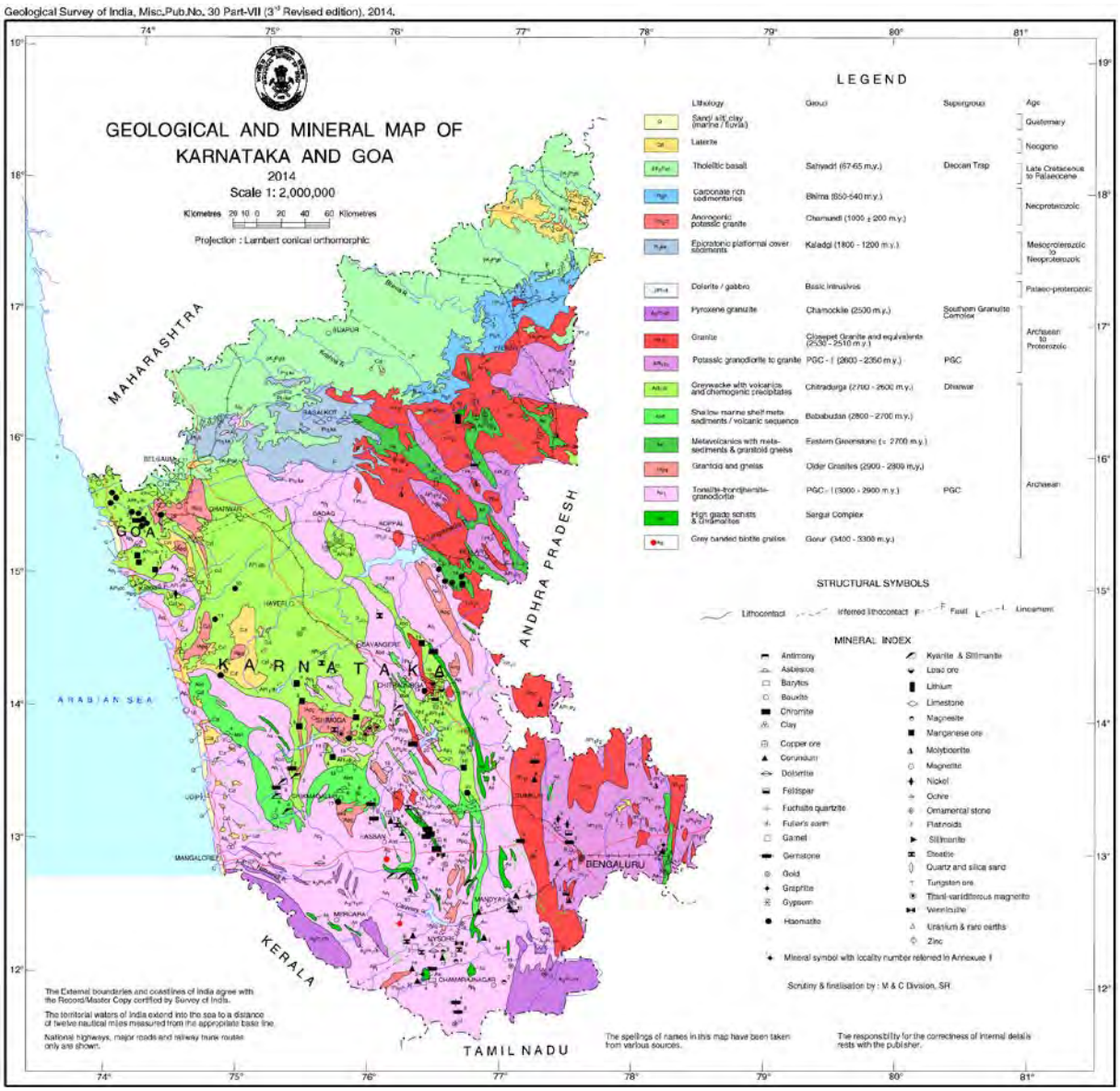


Table 4.1. GENERALISED STRATIGRAPHY OF KARNATAKA WESTERN BLOCK

(AFTER GSI 2013)

Eon/Era/Epoch	*Suite / Assemblage Supergroup*	*Group/Formation and other lower ranks*	*Lithology*
Quaternary(<2m.y.)		Coastal and fluvial	Undifferentiated fluvial sediments coastal sediments: transported red soil/alluvium
Neogene			Laterite
Mio-Pliocene		Warkalli Beds	Sandstone, clay, marl and limestone
Upper CretaceousTo Palaeocene(67-65 m.y)	Deccan Trap	Sahyadri Group	Continental flood basalt of tholeiitic chemistry with inter-trappean beds of chert and marl
Neoproterozoic (650-540 m.y.)		Bhima Group	Predominantly Mg poor carbonate sequence with shale: sandstone and conglomerate at the base
Mesoproterozoic to Neoproterozoic (1000±200 m.y.)		Chamundi Granite	Anorogenic K-rich porphyritic granite to homophanous granite
Mesoproterozoic (1800-1200 m.y.)		Kaladgi Group	Two mega cycles of repeated sequence of argillite followed by chemogenic precipitates
			predominantly of limestone and dolomite: quartzites and conglomerates forming the base
Palaeoproterozoic		Intrusives	Dolerite/gabbro, pegmatite and quartz veins
Neoarchaean (2500 m.y.)	Southern Granulite Complex	Charnockite Suite	Pyroxene granulite
Neoarchaean (2530-2510 m.y.)	Younger Granitoids	Closepet Granite	Granites, monzogranite/ adamellite to granodiorite
		Chitradurg Group (2700-2600 m.y.) / Ranebennur Subgroup	Greywacke/BIF/ Polymict conglomerates/ volcanics (Mardihalli, Bellara, Medur)
Neoarchaean (2800-2600 m.y.)	Dharwar Supergroup	Vanivilas Subgroup	Polymict conglomerate, cross beddedquartzites, pelites, stromatolitic carbonates, biogenic cherts, BIF & manganese formations (Ingaldhal volcanics-thoeliitic basalt-rhyolite suite (Tekkalvatti, Jagalur)
		Bababudan Group (2800-2700 m.y.)	BIF & carbonaceous phyllites, basalt-dacite suite (locally pillowed) with minor ultramafics/alterations of amygdular basalts/cross bedded quartzites, pelites/ minor BIF/ basal quartz pebble conglomerate
Neoarchaean to Mesoarchaean (2800-2900 m.y.)		Older Granites	Granitoids and gneiss
Mesoarchaean (3000-2900 m.y.)	Peninsular Gneissic Complex	PeninsularGneissic Complex-I	Tonalite-trondhjemite-granodiorite
Mesoarchaean (3200-3100 m.y.)	Ancient Supracrustals	Sargur Complex	Mafic-ultramafic intrusive complex (Holenarsipur-

			Nuggihalli)/serpentinized komatiites, komatiitic and thoeliitic amphibolites, cherts, BIF/garnet biotite schists (with kyanite, sillimanite and staurolite)/local marbles and calc silicates/fuchsite quartzites with chromite and baryte layers
Palaeoarchaean] (3400-3300 m.y.)	Basement Gneiss	Gorur Gneiss	Trondjhemite, granodiorite, grey coloured banded biotite orthogneiss

Eon/Era/Epoch	*Suite / Assemblage Supergroup*	*Group/Formation and other lower ranks*	*Lithology*
Neoarchaean (2530-2510 m.y.)	Closepet Granite		Granites, monzogranite/ adamellite to granodiorite
Neoarchaean to Palaeoproterozoic (2600-2350 m.y.)	Peninsular Gneissic Complex	Peninsular Gneissic Complex-II	Potassic granodioritic to granitic material
Neoarchaean (H"2700 m.y.)		Greenstone belts.viz. Kolar Sandur Raichur Hutti Mangalur Hungund-Kushtagi-Hagari	Metamorphosed grits/arenites, pelites/ BIF Bimodal mafic-felsic volcanics, pyroclasts, agglomerates, BIF, local komatiites (main unit in all belts).Quartzites (locally cross bedded), manganese marble, stromatolitic carbonate, calc-silicate, cordierite bearing pelites, amphibolite, BIF (Sakarasanahalli, Lepakshi)

4.2 Site Geology

The geological map of project area has been prepared using latest updated geological map (Fig. 4.2) from Geological Survey of India (2015). The major rock belong to Peninsular Gneissic complex (PGC-I) and cover about 80% of area. Also represented are rocks from Sargur group and Charnockite suite which occur as enclaves or lensoidal bodies within the PGC. Besides these there are also numerous intrusions of dykes (dolerites).

The PGC consist of granitic gneiss (migmatitic at places). Granitic gneiss are coarse grained, leucocratic to mesocratic, and mostly composed of quartz, plagioclase and minor amounts of mafics. Within the PGC are several enclaves or lensoidal bodies of intrusive comprising of sillimantite schist, amphibolite, charnockite and granulites.

The Sargur group consist of sillimanite schist (sometimes with garnet and graphite), amphibolites (massive /schistose) and banded magnetite quartzite.

The Charnockite suite comprises charnockite and pyroxene granulite which are massive to foliated and occur as small to large lensoidal bodies within PGC. Charnockites are fine to coarse grained, quartz rich to quartz poor with hypersthenes, feldspar and ferromagnesian minerals and with or without biotite.

Dolerite dykes are basic intrusives which occur as numerous linear features within the PGC and trend N-S to NNW-SSE with mostly in the eastern parts

Primary structure consists of colour banding and bedding observed in Banded magnetite quartzite. The foliation in schists and gneisses trends NE-SW and NNW-SSE with dips varying from 60-75° on either side.

4.3 Geology Along Alignment

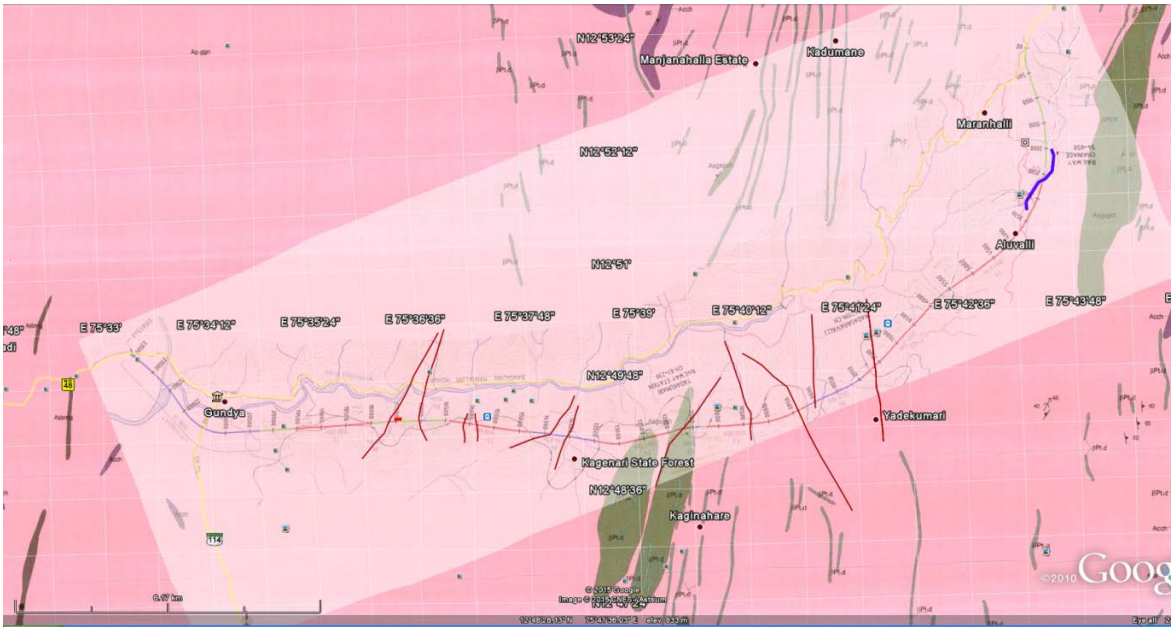
The location of proposed alignment is shown superimposed on the geological map (Fig. 4.2). The proposed alignment starts at Gundya (at the NH-48) in the western side and follows a path approximately parallel to NH-48 (and river Kempu Hole) on the southern side extends through the portions of Shiradi Ghat and finally ends at Maranhally on the eastern side. It consists of several tunnels (6 nos), bridges (6 nos), viaduct (1 no), flyover (1 no.), ROB (2 nos) and road approaches (cut & fill) sections (10 nos).

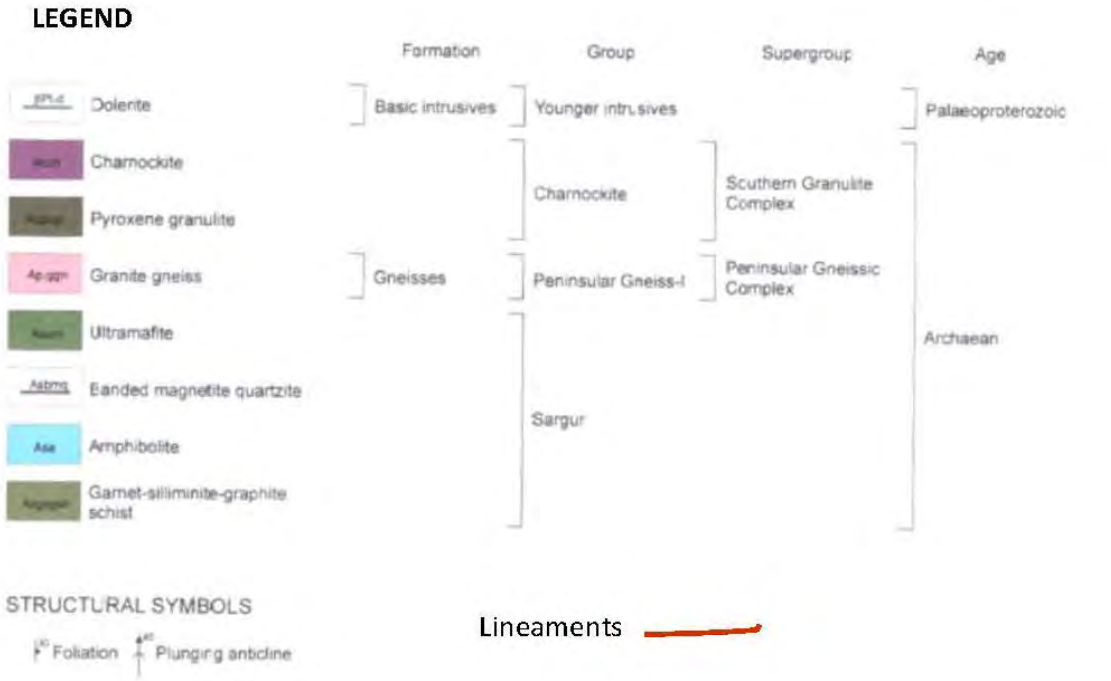
As can be seen the alignment passes though most sections within the PGC (consisting of granite gneiss). There are some portions of tunnel (approximately between 11500 to 12000m, and 12300 to 12700m chainage) where garnet-sillimanite-graphite schist is encountered (Sargur group).

There are other rock types in the vicinity which are currently not seen along the alignment like the numerous dolerite dykes and others like granulites, amphibolites, banded magnetite quartzites etc. These can possibly be encountered along the alignment. This would become more clear after geological mapping and geotechnical investigation study results become available at a later stage.

There are several lineaments which are seen intersecting the alignment. These could possibly be faults or weakness zones. Some of these are encountered in the tunnel sections. There are also numerous streams in the project area which cross the alignment. These are also potential weakness zones and may extend vertically to deeper levels and may be encountered in the tunnels.

Fig. 4.2 Geological Map of Project Area From GSI Map




LEGEND
Formation
Group
Supergroup
Age
Dolerite
Basic intrusives
Younger intrusives
Palaeoproterozoic
Charnockite
Charnockite
Scuthern Granulite Complex
Pyroxene granulite
Granite gneiss
Gneisses
Peninsular Gneiss-I
Peninsular Gneissic Complex
Ultramafite
Archaean
Banded magnetite quartzite
Sargur
Amphibolite
Garnet-silliminite-graphite schist
STRUCTURAL SYMBOLS
Foliation
Plunging anticline
Lineaments

5. RECONNAISSANCE AND SITE VISITS

5.1 General

Site visits and Reconnaissance surveys have been conducted by key project personnel to understand and familiarize the geographic, geologic and geomorphologic domain of the project area. The details are given below

First site visit was carried out along the NH-48 road (11th and 12th June) by Team Leader & Tunnel Design Engineer. A Reconnaissance Traverse Survey between 8th July, 15 to 11th July, 2015 has been conducted by Team Leader cum Sr. Highway Engineer (Mr. A K Gupta), Engineering Geologist/ Geotechnical Engineer (Dr. Ateeq Khateeb), Hydrologist (Mr. Sudip Ganguly) and Project Coordinator cum Civil Engineer (Ms Ashisha Mohanty) along with Executive Engineer (Authority) and other Government officials for preliminary assessment of geological condition along the alignments (Tunnels. Bridges and cut & fill sections), collect preliminary geological data for planning of geotechnical site investigation, geological mapping and geophysical and hydrological studies. Results of these are in following report.

KD4 Report "KD 4 - Field Report/ Preliminary Project Report/ Interim Progress Report Part B: Preliminary Project Report Volume – II : Design Report".

Subsequently, more site visits have been carried out by Tunnel Design Engineer (Mr. B. R. Sharma), Structure Design Engineer (Mr. Atanu Dhara) and Environmental Engineer (Mr. Mayank Kumar) on 5th August, 2015 to plan and conceptualize the design and environmental study.

One site visit was conducted between 21st to 25th Sept 2015 by Dr. Florian Krenn, International Tunnel Expert, Mr. A. K. Gupta, Mr. Sudip Ganguly, Mr. Mayank Kumar Sinha and Mr. Atanu Dhara for finalising alignment and acquiring additional information on the site and geological conditions. The results of this site visit have been produced as ***"Technical Note on Alignment Choice"*** submitted to the Authority and MoRTH officials by Dr Florian Krenn vide letter nos I6060-2015-L-10/040 & L-11/055 dated 01.10.15 & 09.11.15 respectively.

A site visit and inspection had been conducted by Shri D O Tawde, MoRTH Delhi along with NH Division KPWD and Consultant's Team on 21.11.2015.

5.2 Geological Mapping

Preliminary Geological mapping has been done during site visits mentioned above. The results of this and geological section prepared are provided in the drawing and report (Latest Drawing No and Report to be specified).

Detailed Geological mapping has been has been planned simultaneously with topographical survey work at site. For geological mapping base map is being prepared in 1:2000 to 1:5000 scale using 5m interval contour map from Cartosat-1 satellite image.

Geological Plan and cross sections along the tunnel alignment, bridge locations and cut & fill sections shall be further refined after this and results from geotechnical investigation and geophysical survey become available.

6. MATERIALS SURVEYS AND GEOTECHNICAL INVESTIGATIONS

6.1 General

The material investigation for road construction will be carried out to identify the potential sources of construction materials and to assess their general availability, mechanical properties and quantities. This is one of the most important factors for stable, economic and successful implementation of the road program within the stipulated time. For new carriageway / bypass the list of materials includes the following:

- Granular material for lower sub-base works
- Crushed stone aggregates for upper sub-base,
- Base of dry lean concrete, surfacing by PQC and cement concrete works
- Sand for filter material and cement, concrete works, sub-base and filling material
- Borrow material for embankment, subgrade and filling
- Manufactured material like cement, steel, bitumen, geo-textiles etc. for other related works

6.2 Objectives and Information Sources

The information on material sources will be carried out with the following basic objectives.

- Source location, indicating places, kilometerage, availability and the status whether in operation or new source.
- Access to source, indicating the direction and nature of the access road i.e. left / right of project road, approximate lead distance from the gravity centre and type of access road.
- Ownership of land / quarries, either government or private.
- Test results, indicating the quality of materials along with their classification in details.
- Probable uses indicating the likely use of materials at various stages of construction work i.e. fill materials, sub-grade, sub-base, base and wearing course and cross drainage structures.
- During the process of investigation, due consideration will be given to the locally available materials for reducing the cost of construction. The samples from various identified sources will be collected for laboratory testing as per IRC / MoSRT&H / BIS standards.

6.3 Material For Embankment And Sub-Grade

Potential sources of earth for the construction of embankment and sub-grade for New Carriageway will be identified as the excavated materials obtained from tunnels and cut & fill sections. The details of all the borrow areas investigated with their respective locations, corresponding chainage, description of material are tabulated in Table 6.1.

Table 6.1 Details of Borrow area along the Existing Road Section of NH-48

Sl. No.	Chainage	Distance From Road	Side	Adequacy
Borrow Soil				
1	210+000	12 km	LHS	Identified borrow soil are suitable for construction of embankment, subgrade and filling
2	293+000	0.2 Km	LHS	
3	301+000	20 Km	LHS	
4	325+000	20 Km	LHS	

The following tests will be conducted to check the suitability of the fine-grained materials:

- Grain size analysis
- Atterberg limits
- Maximum laboratory dry unit weight (Heavy Compaction)
- Optimum moisture content
- CBR (4 days soaked) at three energy levels.

6.4 Stone Aggregates

The availability and quality of material as coarse and fine aggregate will be explored and samples collection from the nearest quarry where large quantities of stone aggregates available.

Representative samples from the above stone quarries will be collected for testing in the laboratory for following tests on the samples collected.

- Los Angeles Abrasion Test : As per IS: 2386 (Part-4)
- Aggregate Impact value : As per IS: 2386 (Part-6)
- Combined flakiness and elongation indices : As per IS: 2386 (Part-7)
- Soundness : As per IS: 2386 (Part-5)
- Water absorption : As per IS: 2386 (Part-3)

MoRT&H requirement of stone aggregates for their use in base / surfacing courses of pavement are as follows:

- Los Angeles Abrasion Value < 40%
- Aggregate Impact Value < 30%
- Flakiness and Elongation indices (combined) < 30%
- Water absorption < 2%

The formats for various tests and data recording sheets for materials have been submitted with earlier submissions of KD1 & KD4. The same are provided herewith in Annexure 1 for ready reference.

Table 6.2 Details of Aggregate Quarry along the Existing Road of NH-48

Sl. No.	Chainage	Distance From Road	Side	Adequacy
Aggregate Quarry				
1	175+000	9.0 Km	LHS	Identified aggregate quarries are suitable for construction of upper sub-base, base, surfacing and cement concrete works
2	211+000	8.0 Km	LHS	
3	280+000	25.0 Km	RHS	
4	300+000	11.0 Km	RHS	

6.5 Fine Aggregates

The bed of the following river flowing in the vicinity of the project road is the only potential source for good quality coarse sand in sufficient quantities. The details of quarry and Properties will be given in **Table 6.3**.

Table 6.3 Details of Natural Sand Quarries

Sl. No.	Chainage	Distance From Road	Side	Adequacy
Sand Quarry				
1	218+000	10.0 Km	LHS	Identified sand quarries are suitable for filter material and concrete works
2	300+500	0.20 Km	LHS	
3	327+000	0.20 Km	LHS	

6.6 Availability of Bitumen, Steel and Cement

Bitumen (IS 73- 1961) is available at MRPL in Mangalore, which is around 100 km from the proposed bypass alignment.

The steel to be used as reinforcement for cross drainage structures shall be Deformed Steel Bars conforming to IS 1786 from Mangalore/ Bangalore.

The cement of various types like Ordinary Portland Cement - 43 Grade, 53 Grade and Pozzolana Cement is required for the construction. The steel and Cement are available in Mangalore, Hassan, Bangalore and will be supplied to the nearest railway stations (Sakleshapura & Subramanya Road stations) project site directly.

Table 6.4 Availability of Bitumen, Steel and Cement

Sl. No.	Chainage	Distance From Road	Side	Adequacy
Bitumen				
1	Available at MRPL in Mangalore, 100 km away from Project road			Required grades in sufficient quantity are available at MRPL
Steel				
2	Available at Mangalore city. Will be supplied at nearest railway stations (Sakleshapur and Subramanya Road), 30 km away from Start/ End of the Project road			Required grades in sufficient quantity are available at Mangalore, Hassan and Bangalore Cities.
Cement				
3	Available at Mangalore city. Will be supplied at nearest railway stations (Sakleshapur and Subramanya Road), 30 km away from Start/ End of the Project road			Required grades in sufficient quantity are available at Mangalore, Hassan and Bangalore Cities.

7. GEOTECHNICAL FIELD INVESTIGATIONS

7.1 Drilling of Boreholes

Boreholes shall be drilled at specified locations to obtain information about the sub-surface soil, and to collect soil and rock samples for strata identification and laboratory testing. The minimum diameter of borehole shall be 150 mm in soil and NX size (75 mm dia) in rock and the boring shall be carried out in accordance with the provisions of IS 1892. Rotary drilling rigs shall be used for advancing the boreholes. Bore holes shall be advanced using water or bentonite. Temporary casing may be necessary to maintain the sides of the boreholes in a stable condition. Rock boring shall be carried out using a double core barrel / triple tube having a diamond bit to get higher / proper core recovery.

Temporary casing shall be used in boreholes to support its sides, if required. When temporary casing is used it shall be ensured that its bottom is at all times less that 150mm above the bottom of borehole. In case of cohesion less soil, the advancement of the temporary casing shall be such that it does not disturb the soil to be tested or sampled. The temporary casing shall be advanced by slowly turning the temporary casing pipe and not by driving.

In-situ tests shall be conducted and undisturbed samples shall be obtained at specified intervals in the boreholes. Representative disturbed samples shall be preserved for conducting various identification tests in the laboratory. Water level shall be determined in the boreholes and shall be carefully recorded on the drilling log.

All bore holes shall be referenced to the survey control points in plan and elevation.

All daily field observations shall be recorded on formats in accordance with IRC:78 and/or relevant BIS codes.

7.2 Scope of Work

Bore holes shall be carried out as per the schedules given below. All schedules are indicative only, and shall be finalized in consultation with the client. List of probable structures is given hereunder.

Table 7.1 Guidelines of Tests

Item	***Objective***	***Contents***	***Quantity***
(i) Geo-technical Survey for Bridge Design	*Preliminary design of bridges/structure*	• *Depth assumed to be 15-25m.* • *SPT.* • *Laboratory tests.*	*As required (spacing as per IRC standards)**
(ii)Geo-technical surveyfor Roads	*Confirmation of bearing capacity of road ground and existence of un-suitable materials*	• *Test pit, 1km to 3km interval as per site suitability.* • *Auger Boring, 1km to 3km interval (to be done for embankment section.*	*As required (spacing as per IRC standards and ground conditions)**
(iii)Geo-technical Survey for Tunnel Profile and Design	*Determining geological and geotechnical conditions in tunnel. Determining geotechnical parameters for tunnel design.*	• *Drilling depth 3m to 5m below invert level if same hard rock strata continues and maximum up to 1.5 times tunnel diameter below tunnel invert;* • *In-Situ Testing* • *Laboratory Testing*	*As per AASHTO, Guidelines **

***** The spacing of boreholes shall be determined based on assessment of site conditions, difficulty of access and time frame required for conducting these, as well as fulfilling the ToR.

- Sub-soil investigations will be done as per IRC 78-2000 / IS 1892.
- The scheme for the boring locations and the depth of boring shall be prepared by the Consultant and submitted to CLIENT for approval. These may be finalized in consultation with CLIENT.
- The scheme for laboratory testing shall be prepared by Consultants and submitted to CLIENT for approval. These may be finalized in consultation with CLIENT.

7.3 Standard Penetration Test and Disturbed Soil Samples

SPT tests shall be conducted in all types of deposits at 1.5 to 3 m or at change of strata intervals or as per I.S. Code of practice. The tests shall be carried out by driving a standard split spoon by means of 63.5 kg (140 Ibs) hammer having a free fall of 76 cms (30 inches). Detailed procedure for testing as specified in IS 2131 shall be followed. The samples obtained in this split spoon shall be placed in an airtight jar or equivalent, labelled and preserved for identification tests in the laboratory.

7.4 In-Situ Field Tests

Other In-Situ Field tests that are shall be conducted during geotechnical investigation works shall be permeability tests in soil /rock. Pressuremeter tests in rock. The codes for these tests are described below.

IN-SITU TESTING

- Permeability Test in Soil (IS 5529 Part 1)
- Packer Test (single / double) in Rock (IS 5529 part 2)
- Pressure meter test in Rock (IS 12955)

7.5 Undisturbed Soil Samples

In each borehole, undisturbed soil samples shall be collected at a regular interval of 3 m or at every change of strata subject to a minimum of two samples in each borehole. Un-Disturbed Samples shall be of 100 mm dia and 450 mm length. Samples shall be collected in such a manner that the structure of the soil and the moisture content do not get altered. The collection of Undisturbed Samples may be stopped if SPT N > 60. The specifications for the accessories required for sampling and the sampling procedure shall conform to IS: 1892 and IS: 2132. The Un-Disturbed Sample shall be immediately followed by SPT test, after the borehole has been cleaned.

7.6 Rock Core Samples

Drilling in rock shall be carried out using a diamond-coring bit. The core shall be of NX size. The cores shall be collected using Double tube/ triple tube core barrel depending upon the condition of the rock.

The rock cores shall be examined for geological features such as joints and bedding, weathering, hardness, cores recovery and RQD as per IRC: 78 (latest revision). The rock cores shall be placed lengthwise in a wooden box of suitable size with compartments for 1.5m core runs. Wooden spacer cores shall be used where there are gaps in core-runs due to core losses. The samples and the cores shall be labeled and shall identify the borehole number, sampling depth, soil/rock type etc. samples of only one borehole shall be stored in one core box.

7.7 Measurement of Static Water Level and Collection of Water Samples

Water level in each borehole shall be measured and recorded during drilling and 24 hours after completion of the boreholes.

Before taking water samples, the borehole must be cleaned from the drilling fluid by flushing the hole and then allowing the groundwater level to stabilize. Ground water samples shall be collected using down-the-hole bailer or other suitable technique. The water samples shall be kept in transparent containers and their lid tightened. Appropriate labels shall be pasted for identification.

7.8 Laboratory Testing

Unless otherwise specified, all laboratory testing shall be carried out in accordance with the relevant IS Codes.

The soil/rock/ & water samples collected during the investigation program shall be transported to an approved laboratory for testing. The Firm shall furnish in their tender the details of credentials of the laboratory facilities they intend to use with full address.

The following tests shall be performed on these samples:

7.8.1 Tests on Soil Samples:

- Visual and Engineering Classifications-IS:1498
- Natural moisture contents (IS 2720, Part II)
- density (2720-Parts XXVIII, and XXIX. check)
- Specific gravity (IS 2720 Part III)
- Atterberg limits. IS-2720, Part V
- Sieve Analysis and Hydrometer Analysis IS:2720, Part IV
- Unconfined compression IS 2720, Part X
- Direct shear IS : 2720, Part XIII
- Tri axial shear tests
  - Unconsolidated Undrained (UU) Test – IS:2720, Part XI
  - Consolidated Undrained (CU) Test – IS:2720, Part XII
- Consolidation Tests IS:2720, Part XV
- Determine of free swell index of soils – IS:2720, PART 40
- Silt factor Determination
- Chemical tests on soil as per relevant Indian Standards (IS 2720 Part 26, 27, etc)

7.8.2 Tests on Rock Cores:

- Moisture Content (IS 13030)
- Tensile strength (Brazilian) IS 10082
- Density IS 13030 / IS 1124
- Porosity IS: 13030 / IS 1124
- Durability-IS: 10050
- Specific gravity IS 13030 / IS 1124
- Water absorption IS:1124
- Abrasivity Test
- Unconfined compression IS: 9143
- Point load tests IS: 8764
- Triaxial compressive strength
- Youngs Modulus and Poisson ratio (IS 9221)

- Petrographic Study (Including Thin Sections)

7.8.3 Tests on Water Samples:

Chemical Analysis of water shall be carried out for each structure to evaluate effects of sub-soil water on concrete and steel. Recommendations in this respect shall be clearly mentioned in the report. The tests will be essentially include pH value, sulphate and chloride contents (percentages).

- pH (IS 3025)
- Sulphate (IS 3025)
- Chloride (IS 3025)
- Carbonate content

The soil samples in plastic zip lock bags and rock samples in the form of cores in wooden boxes with locking arrangement shall be finally submitted to the Client after completion of all types of tests as specified above.

8. QUARRY MATERIALS FOR CONSTRUCTION

8.1 General

Quarry materials commonly used in highway and tunnel construction comprise hard stone metal (coarse aggregates) and sand (fine aggregates). Common sources of coarse aggregate include rock excavated from mountain sides (Quarries) and boulders from rivers. Sand is typically obtained from river sources. Stone dust is also used when sand of suitable quality is not available within reasonable lead.

8.2 Objectives

It is a prime task to identify the potential source of these materials near the project site so as to economize the cost of construction besides early completion of the project.

8.3 Location And Description Of Aggregate Quarries

Four (4) stone quarries were identified as the potential sources of coarse aggregates and one gravel source required for road and tunnel construction. A total of three (3) sources were identified as potential sources for sand. Details of these and also for borrow material with Lead Charts of these identified sources is shown in Annexure 2

8.4 Aggregate From Project Work

The project work entails excavation works for tunnels and some slopes.

8.5 Laboratory Tests

Currently detailed geotechnical investigation has not yet been carried out. Some test results obtained of materials from quarries and sources close to project area [5] and test results of materials used for construction of rigid pavement from km 238 to km 250 in 2014-2015 [6]. The tests are tabulated in Table 8.1 which describes the sampling criteria and laboratory tests conducted representative samples of the coarse and fine aggregate samples.

Table 8.1: Site Sampling and Testing Criteria for Construction Material

Sl. No.	Type of Samples	Sampling Criteria	Testing Criteria	
			Description of Test	**Standard Code Applicable**
i)	Stone metal samples from crushers/quarries	Test results from Representative samples of various sizes of stone were from **quarries** mentioned in section 10.5	Sieve Analysis	IS:2386 (Part-1)
			Flakiness and Elongation Index	IS 2386 (Part – 1)
			Los Angeles Abrasion	IS 2386 (Part – 3)
			Aggregate Impact Value (AIV)	IS 2386 (Part – 4)
			Alkali Aggregate Reactivity Test	IS 2386 (Part-7)
			Stripping and Coating test	IS 6241

Sl. No.	Type of Samples	Sampling Criteria	Testing Criteria	
			Description of Test	**Standard Code Applicable**
ii)	Fine Aggregates	Sand has been collected from 2 different sources (rivers) located within the vicinity of the project road.	Grain Size Analysis	IS 2386 (Part – 1)
			Designation of zone	IS 383 - 1970
			Specific Gravity and Water Absorption	IS 2386 (Part – 3)
			Fineness Modulus	IS 383 - 1970
			Sand Equivalent Test	ASTM D2419-95

The tests conducted on representative samples were found to be conforming to the test required. However further detailed tests shall be conducted during detailed geotechnical investigation (refer section 6)

8.6 Sand Quarries

Available result for fine aggregates shows that it conforms to zone II stipulation, validated from Field test data KPWD.

8.7 Materials for Bituminous Surfacing, Granular Base and Subbase

Suitability of aggregates produced from the rocks of identified quarries for use in bituminous surfacing, granular base and subbase shall be established based on following tests and format shown below.

- Specific Gravity
- Water Absorption
- Flakiness and Elongation Index
- Aggregate Impact Value
- Stripping Value
- Alkali Silica Reactivity

9. MANUFACTURED MATERIALS

9.1 General

Inquiries were made at site along with desk studies to locate sources for cement, steel and bitumen close to the project road.

9.2 Cement

The cement of various types like Ordinary Portland Cement - 43 Grade, 53 Grade and Pozzolana Cement is required for the construction. The steel and Cement are available in Mangalore and can be made available through Subramanya and Sakhlespur railway stations (refer to Annexure 2 for leads).

9.3 Steel

The steel to be used as reinforcement for cross drainage structures shall be Deformed Steel Bars conforming to IS 1786 from Mangalore/ Bangalore (refer to Appendix 2 for leads).

9.4 Bitumen

Bitumen (IS 73- 1961) is available at MRPL in Mangalore, which is around 100 km from the proposed bypass alignment.

It is recommended to use VG-30 Bitumen conforming to IS: 73 – 2006 or modified bitumen of equivalent stiffness in the bituminous binder course and Polymer Modified Bitumen conforming to the properties for the wearing course as specified in IRC; SP: 53: 2010, in line with climatic condition of the project road. The source of bitumen is identified as Mangalore refinery. However, concrete pavement is proposed for the project road considering long terms advantage and high speed corridor comprising of major share (82.5%) of tunnels & bridges and only 17.5% share of road approaches.

10. OTHER CONSTRUCTION MATERIAL

10.1 Water

Currently it is envisaged that the most of the requirements of water for the project shall be fulfilled from Kempu Hole the river flowing adjacent to NH-48 highway. In addition to these there are several streams/rivulets in the project area which can also be useful if required depending upon the season and proximity to the project.

Some initial processing may be required for treatment of water like filtration etc to make it suitable for construction purpose if it contains suspended particles.

Relevant tests like pH, chloride & sulphate content, acidity, alkalinity, organic content, inorganic matter and suspended particles shall be conducted for the sources of water to check for their suitability of usage.

10.2 Fly Ash

Fly ash is proposed to be used as fill material for the embankments. Also, the use of fly ash potentially reduces the settlement for locations where high embankments are anticipated. It is also suitable for use in any underground structural concrete works, Pavement Quality Concrete (PQC), and Dry Lean Concrete (DLC). Nearest thermal power station of the prject road is Udipi Thermal Power station, which is located about 155km from the proposed Shiradi Ghat bypass alignment. Hence it is not mandatory to use fly ash for the construction work. However, sources of Flyash (if required) are also identified as Vintech India Corporation Harsha Sairam (Manager) Veenu Central Office, Veenu Building, 1st Floor, Near Samaj havan, Mannagudda Mangalore - 575003, Karnataka, India

10.3 Other Materials

The use of other materials like geosynthetics or other non-conventional materials shall be further studied. These materials will be supplied at project site by rail/ road route.

11. DATA REVIEW AND DISCUSSION

11.1 Muck Haulage and Disposal

An estimate of muck haulage and means of disposal [3] below shows that about 1519200 cum of material can be excavated from tunnels in option A (KD5 stage alignment). This would take about 1340 trains with an average 53 wagons of standard RSDO specifications having 54.5 tons payload per wagon or about 2.15 lakh trucks with an average payload of 18 tons. The options to use rail services for this purpose is subject to approval from Rail authorities and is a more environmental friendly option.

Table 11.1 Tentative Quantities of Muck Disposal

	Length	**Volume**	**Mass**
Option A	[m]	[m3]	[ton]
Tunnel 1	2958	354960	922896
Tunnel 2	2129	255480	664248
Tunnel 3	2140	256800	667680
Tunnel 4	1872	224640	584064
Tunnel 5	1660	199200	517920
Tunnel 6	1901	228120	593112
TOTAL	**12660**	**1519200**	**3949920**

Two locations of dumping yards are indicated in the Lead Charts and Summary (refer Annexure 2). These and additional locations shall be sought after further study and in consultation with concerned officials to finalize the proposal for muck disposal.

Concerned railway authorities are also being coordinated for arranging prospects of providing goods train by construction of additional track.

11.2 Suitable Material from Tunnel

More than 80% of the rock encountered in tunnel is expected to be Granite Gneiss of the Peninsular Gniessic Complex. This rock mass is generally expected to be falling in the Good category with high intact strength, though some percentage of the rock is expected to be weathered, fractured and sheared. Based on the observations from site visit and inspection of existing tunnels (rail tunnels) it is expected that after taking the above and the effects of blasting into account more than 30-40% of the rock excavated could be suitable for use as aggregate for concrete for road and tunneling works.

11.3 Ground Water Levels

As per Information provided by DMG [4] the Groundwater static water levels of an Observation Well located in Gundya village of puttur Taluk, Dakshina Kannada District is given below. It ranges between 1.4 to 9m from existing ground level.

Table 11.2 Ground Water Details

SWL at Gundya Puttur Taluk, D.K. District During the year 2005 to 2014													
Sl No.	**Year**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	**2005**	7.23	7.34	8.01	8.32	8.51	5.34	4.68	5.18	4.26	5.34	5.53	6.97
2	**2006**	7.18	7.27	7.53	8.05	6.18	1.50	2.20	**1.38**	4.68	6.26	6.84	7.05
3	**2007**	7.18	7.43	7.48	7.88	8.65	5.08	3.23	4.28	4.07	4.23	6.92	7.04
4	**2008**	7.23	7.32	7.14	6.38	6.51	5.26	3.33	3.68	5.43	5.93	6.28	6.68
5	**2009**	6.83	6.93	8.03	**8.97**	8.18	7.18	2.26	2.10	2.98	3.74	4.19	4.34
6	**2010**	7.13	7.38	7.59	7.83	7.91	6.05	1.55	3.18	5.05	4.70	6.30	6.98
7	**2011**	7.10	7.18	7.26	7.32	7.48	6.38	1.48	1.68	1.80	2.02	2.18	2.48
8	**2012**	5.88	7.38	7.93	8.36	8.48	6.83	1.6	1.52	1.58	2.48	2.70	6.10
9	**2013**	6.20	7.98	8.12	8.32	8.40	5.43	1.50	3.58	4.08	4.13	7.05	7.38
10	**2014**	7.20	7.53	7.58	7.64	7.58	5.18	NR	1.48	1.66	2.33	6.68	7.08

11.4 Rainfall Data

As per Information provided by DMG [4] the proposed project area lies in the watershed bearing code 5A3B2. The average rainfall data for the last 10 years is 5548 mm. The Rain fall data of a nearest Rain gauge station to the purposed project, for the period 2005 to 2014 is given below: Rain Gauge station: Shiradi, Puttur Taluk.

Table 11.3 Summary of Rainfall data

Sl. No.	Year	Rainfall in mm.,	No. of Rainy days
1	**2005**	5247.0	135
2	**2006**	5689.8	151
3	**2007**	5286.0	122
4	**2008**	8144.8	133
5	**2009**	5472.2	149
6	**2010**	6791.2	166
7	**2011**	6329.2	146
8	**2012**	3653.8	109
9	**2013**	4845.4	130
10	**2014**	4023.4	119

11.5 Tests on Available Material

Test results obtained from soil samples from borrow area, coarse and fine aggregate from earlier report [5] are shown in the following tables.

Table 11.4 Summary of Borrow area soil properties

Sl.No	Chainage, km	Side	Grain size Analysis			Atterberg Limits			Soil Classification as per IS	Optimum Moisture Content (%)	Maximum dry Density (g/cm3)	CBR, %		
			Gravel %	Sand %	Silt and Clay %	Liquid Limit	Plastic Limit	Plasticity Index				10 Blows	30 Blows	60 Blows
1	196.5	LHS	25.5	51.5	23	37	25.1	11.9	GM-SM	9	2.16	7.1	12.5	19
2	210	LHS	4.0	24.9	71.1	71.3	45.2	26.1	MH	6.9	2.1	5.3	10.6	18
3	293	LHS	17.8	47.4	34.8	19.3	11.3	8	GM-SM	9.8	1.96	2.8	4.6	7
4	301	LHS	6.7	62.1	31.3	26	19.3	6.7	SM-ML	10.6	2	2.9	5.3	9
5	325, 20km lead	LHS	30.08	24.96	44.96	54.1	42.8	11.3	GM-SM	14.7	1.95	3.9	6.8	11.2
6	325, 28km lead	LHS	66.06	26.46	7.48	41.6	37.6	4.0	GM-SM	8.8	2.12	10.5	19.2	20.5

Results from material from Aggregate quarries located in the vicinity of project area are given below.

Table 11.5 Summary of test results of Stone aggregates

Sl.No	Chainage, Km	Side	Water Absorption, %	Specific Gravity, gm/cc	Combined Index (%)	Impact Value
1	175+00	LHS	0.5	2.62	37.7	28.3
2	211+00	LHS	0.6	2.60	37.0	23.4
3	280+00	RHS	0.7	2.61	38.0	24.0
4	300+00	RHS	1.2	2.63	40.0	34.3

The bed of the following river flowing across the project road is the potential source for good quality coarse sand in sufficient quantities. Summary of the test results of sand has been given in Table below.

Table 11.6 Summary of Laboratory tests of Natural Sand

Sl.No	Chainage (Km)	Grain size Analysis			
		Side	Gravel %	Sand %	Silt and Clay %
1	218+000	LHS	18.8	80.9	0.3
2	300+500	LHS	7.5	92.4	0.1
3	327+000	LHS	6.2	93.1	0.7

-------- End of Main Document --------

12. TABLE OF ANNEXURES

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2	Leads for Aggregates, Borrow and Raw Materials	3
3	Location Map of Quarry, Borrow areas	1

ANNEXURE – 1

Formats for Material Testing

A: FORMAT FOR RECORDING QUARRY/BORRWO ARE DETAILS

Road Name :						Date : _____
Village :		District :				
Location Map with reference to the nearest project road						
Sample No.						
1. Type of Material :						
2. Quarry :				Govt. / Private		
3. Address & Description of Quarry						
Location:						
4. Location on the Project Road nearest to the Quarry :						
5. Lead Distance (from the above location on the project road)						
	BT Road :					
	Gravel Road :					
	Total:					
6. Description of Material & Geological Name :						
7. Quantity of Material (Approx.)						
L	B	D		V =		
8. Quantity of Over burden which is not useful:						
L	B	D		V =		
9. Material presently being used for :						
(RCC/Bit. Works/WBM/ Sub base layers etc.)						
10. Availability of different grades of material:						
11. Approximate basic cost of material :						
12. Type of Taxes/Royalty and amounts :						
Recorded by:						

B: FORMAT FOR SIEVE ANALYSIS OF AGGREGATE:

SIEVE ANALYSIS OF AGGREGATE (IS:2386 Part - I)	
Road Name :	Date:
Location (km) :	Lab No.:
Description of Sample :	Sample No.:
Weight of Oven Dried sample taken (gm):	

Sieve Size (mm)	Material Retained (gm)	Weight retained (%)	Cumulative weight retained (%)	% passing
63.0				
50.0				
40.0				
31.5				
25.0				
20.0				
16.0				
12.5				
10.0				
6.3				
4.75				
2.4				
0.600				
0.425				
0.075				

Lab Technician	Lab-in-charge

C: FORMAT FOR RECORDING COMBINED FLAKINESS AND ELONGATION INDICES OF COURSE AGGREGATES

COMBINED FLAKENESS AND ELONGATION INDICES (IS : 2386 , PART I)

Sample Location : Date Sampled :
Source of Materials : Date Tested :
Material for AC / DBM / BM / CRB / Concrete :

Sieve Size (mm)		Weight Retained		Weight of Agg. Retained on Thickness Guage		Weight of Agg. Passing Thickness Guage		Weight of Agg. Retained on Length Guage after retaining on Thickness Guage	
Passing	Passing	(gm)		(gm)		(gm)		(gm)	
63.0	50.0								
50.0	40.0								
40.0	31.5								
31.5	25.0								
25.0	20.0								
20.0	16.0								
16.0	12.5								
12.5	10.0								
10.0	6.3								
TOTAL		A =	(gm)	B =	(gm)	C =	(gm)	D =	(gm)

Combined Flakeness and Elongation Indices = (C / A) + (D / B) =

Specification Limit		AC	DBM	BM	CRB	Concrete
(Max %)		30%	30%	30%	30%	35%

Remarks :

Test Results are Satisfactory / not satisfactory .

Conducted by : Checked By :

D) FORMAT FOR SPECIFIC GRAVITY AND WATER ABSORPTION OF STONE

SPECIFIC GRAVITY AND WATER ABSORPTION OF STONE (IS:2386 Part - 3)	
Road Name :	Date:
Location (km) :	Lab No.:
Description of Sample :	Sample No.:

Description	Unit/Formula	Trail No. 1	Trail No. 2	Average
Weight of basket and saturated aggregate in water (A_1)	gm			
Weight of basket in water (A_2)	gm			
Weight of saturated surface - dry aggregate in air (B)	gm			
Weight of oven dried sample (C)	gm			
Specific gravity	C/ (B- (A1-A2))			
Water Absorption	100(B-C)/C			
Apparent Specific gravity	C/ (C- (A1- A2))			

Lab Technician **Lab-in-charge**

E) FORMAT FOR RECORDING AGGREGATE IMPACT VALUE

AGGREGATE IMPACT VALUE

(IS:2386 Part - IV)

Road Name :	Date:
Location (km) :	Lab No.:
Description of Sample :	Sample No.:

Test No.	1	2	3
Weight of Stone Pieces (Dry) Passing IS			
Sieve 12.5mm but retained on IS Sieve			
10.0 mm (Wa) gm			
Weight of Fraction Retained on IS Sieve			
2.36 mm after the test (Wc) gm			
Weight of Fraction Passing I S Sieve			
2.36 mm after the test (Wb = Wa-Wc) gm			
A.I.V (%) = (Wb / Wa) * 100			
Average A.I.V. (%)			

Lab Technician	**Lab - in - charge**

F) FORMAT FOR RECORDING STRIPPING VALUE OF COARSE AGGREGATE

STRIPPING VALUE (BITUMEN ADHESION) OF COARSE AGGREGATE (IS : 6241 - 1971)	
Road Name :	Date:
Location (km) :	Lab No.:
Description of Sample :	Sample No.:

Sl. No.	Description	1	2	3
1.	Weight of Aggregate Passing I S Sieve 20 mm, but			
	Retained on I S Sieve - 12.5 mm (gm)			
2.	Weight of Bitumen added (gm)			
3.	Percentage of stripping on aggregate observed			
	after 24 hours immersion in distilled water at 40^{o} C			
4.	Average percentage of stripping			

Lab Technician **Lab-in-charge**

G) FORMAT FOR RECORDING SOUNDNESS OF COARSE AGGREGATE

SOUNDNESS OF COARSE AGGREGATES
(IS:2386 Part - 5)

Road Name :	Date:
Location (km) :	Lab No.:
Description of Sample :	Sample No.:
Date of Starting the Test:	No. of Cycles:
Type of test: Sodium Sulphate/ Magnesium Sulphate:	

I S Sieve Size (mm)			Wt. of Fraction before test (gm)	Wt. of Fraction after test (gm)	Percentage passing through finer sieve (Actual per-cent lost)
Passing	Retained	Used to de-termine loss			
		Average % Loss =			

Lab Technician **Lab-in-charge**

ANNEXURE - 2

Leads for Aggregates, Borrow and Raw Materials

SUMMARY OF LEADS FOR SHIRADI PROJECT (BY PASS NH-48)

GRAVEL / Coarse Aggregate LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source On NH-48	Location of Destination On NH-48	Distance from destination to NH-48	Final Lead	
1	9	175.00	250.00	3.00	87.00	
2	8	211.00	250.00	3.00	50.00	
3	25	280.00	250.00	3.00	58.00	
4	1	296.00	250.00	3.00	50.00	
5	11	300.00	250.00	3.00	64.00	
					309.00	
				Av lead	61.80	

Fine Aggregate LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	8	218.00	250.00	3.00	43.00	
2	0.2	300.50	250.00	3.00	53.70	
3	0.2	327.00	250.00	3.00	80.20	
					176.90	
				Av lead	58.97	

Borrow Material LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	0.2	196.50	250.00	3.00	56.70	
2	12	210.00	250.00	3.00	55.00	
3	0.2	293.00	250.00	3.00	46.20	
4	20	301.00	250.00	3.00	74.00	
5	20	325.00	250.00	3.00	98.00	
6	28	325.00	250.00	3.00	106.00	
					435.90	
				Av lead	72.65	

Bitumen LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	23.4	348.00	250.00	3.00	124.40	
					124.40	
				Av lead	124.40	

Cement and Steel LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	1.5	223.00	250.00	3.00	31.50	
2	30	261.40	250.00	3.00	44.40	
					75.90	
				Av lead	37.95	

Dumping Yard LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	5	208.00	250.00	3.00	50.00	
2	5	300.00	250.00	3.00	58.00	
					108.00	
				Av lead	54.00	

Casting Yard LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	2	216.00	250.00	3.00	39.00	
2	2	290.00	250.00	3.00	45.00	
					84.00	
				Av lead	42.00	

Note: Considering lead from source of material to point at 250 km chainage (about 3 km from here)
All distances are in Kms

LEADS FOR QUARRY, BORROW AND RAW MATERIALS FOR SHIRADI GHAT BY PASS PROJECT

Lead For Aggregate Quarry @175 Km

Quarry to NH-48 (175 km)	9 km
From 175 km to 250 km	75 km
From 250 km to Batching Plant	3 km
	87.00 km

Lead For Borrow @301 Km

Borrow Area to NH-48 (301 km)	20 km
From 301 km to 250 km	51 km
From 250 km to Batching Plant	3 km
	74.00 km

Lead For Borrow @196.5 Km

Borrow Area to NH-48 (196.5 km)	0.2 km
From 196.5 km to 250 km	53.5 km
From 250 km to Batching Plant	3 km
	56.70 km

Lead For Borrow @325 Km

Borrow Area to NH-48 (325 km)	20 km
From 325 km to 250 km	75 km
From 250 km to Batching Plant	3 km
	98.00 km

Lead For Borrow @210 Km

Borrow Area to NH-48 (210 km)	12 km
From 210 km to 250 km	40 km
From 250 km to Batching Plant	3 km
	55.00 km

Lead For Borrow @325 Km

Borrow Area to NH-48 (325 km)	28 km
From 325 km to 250 km	75 km
From 250 km to Batching Plant	3 km
	106.00 km

Lead For Aggregate Quarry @211 Km

Quarry to NH-48 (211 km)	8 km
From 211 km to 250 km	39 km
From 250 km to Batching Plant	3 km
	50.00 km

Lead For Sand @327 Km

Quarry to NH-48 (327 km)	0.2 km
From 327 km to 250 km	77 km
From 250 km to Batching Plant	3 km
	80.20 km

Lead For Sand @218 Km

Quarry to NH-48 (218 km)	8 km
From 218 km to 250 km	32 km
From 250 km to Batching Plant	3 km
	43.00 km

For Dumping Yard No 1 @208 km

Dumping yard to NH-48 (208 km)	5 km
From 208 km to 250 km	42 km
From 250 km to Batching Plant	3 km
	50.00 km

Lead For Cement & Steel @223 Km

Saklespura Station to NH-48 (223 km)	1.5 km
From 223 km to 250 km	27 km
From 250 km to Batching Plant	3 km
	31.50 km

For Casting Yard No 1 @216 km

Casting yard to NH-48 (216 km)	2 km
From 216 km to 250 km	34 km
From 250 km to Batching Plant	3 km
	39.00 km

Lead For Aggregate Quarry @280 Km

Quarry to NH-48 (280 km)	25 km
From 280 km to 250 km	30 km
From 250 km to Batching Plant	3 km
	58.00 km

For Casting Yard No 2 @290km

Casting yard to NH-48 (290 km)	2 km
From 290 km to 250 km	40 km
From 250 km to Batching Plant	3 km
	45.00 km

Lead For Borrow @293 Km

Borrow Area to NH-48 (293 km)	0.2 km
From 293km to 250 km	43 km
From 250 km to Batching Plant	3 km
	46.20 km

For Dumping Yard No 2 @300 km

Dumping yard to NH-48 (300 km)	5 km
From 300 km to 250 km	50 km
From 250 km to Batching Plant	3 km
	58.00 km

Lead For Gravel Quarry @296 Km

Quarry to NH-48 (296 km)	1 km
From 296 km to 250 km	46 km
From 250 km to Batching Plant	3 km
	50.00 km

Lead For Cement Mangalore City (Subramanya Station)

Subramanya Stn to NH-48 (261.40km)	30 km
From 261.4 km to 250 km	11.4 km
From 250 km to Batching Plant	3 km
	44.40 km

Lead For Aggregate Quarry @300 Km

Quarry to NH-48 (300 km)	11 km
From 300 km to 250 km	50 km
From 250 km to Batching Plant	3 km
	64.00 km

100 km from Project Road Bitumen Mangalore

Mangalore Refinery to NH-48 (347.8 km)	23.4 km
From 347.8 km to 250 km	98 km
From 250 km to Batching Plant	3 km
	124.40 km

Lead For Sand @300.5 Km

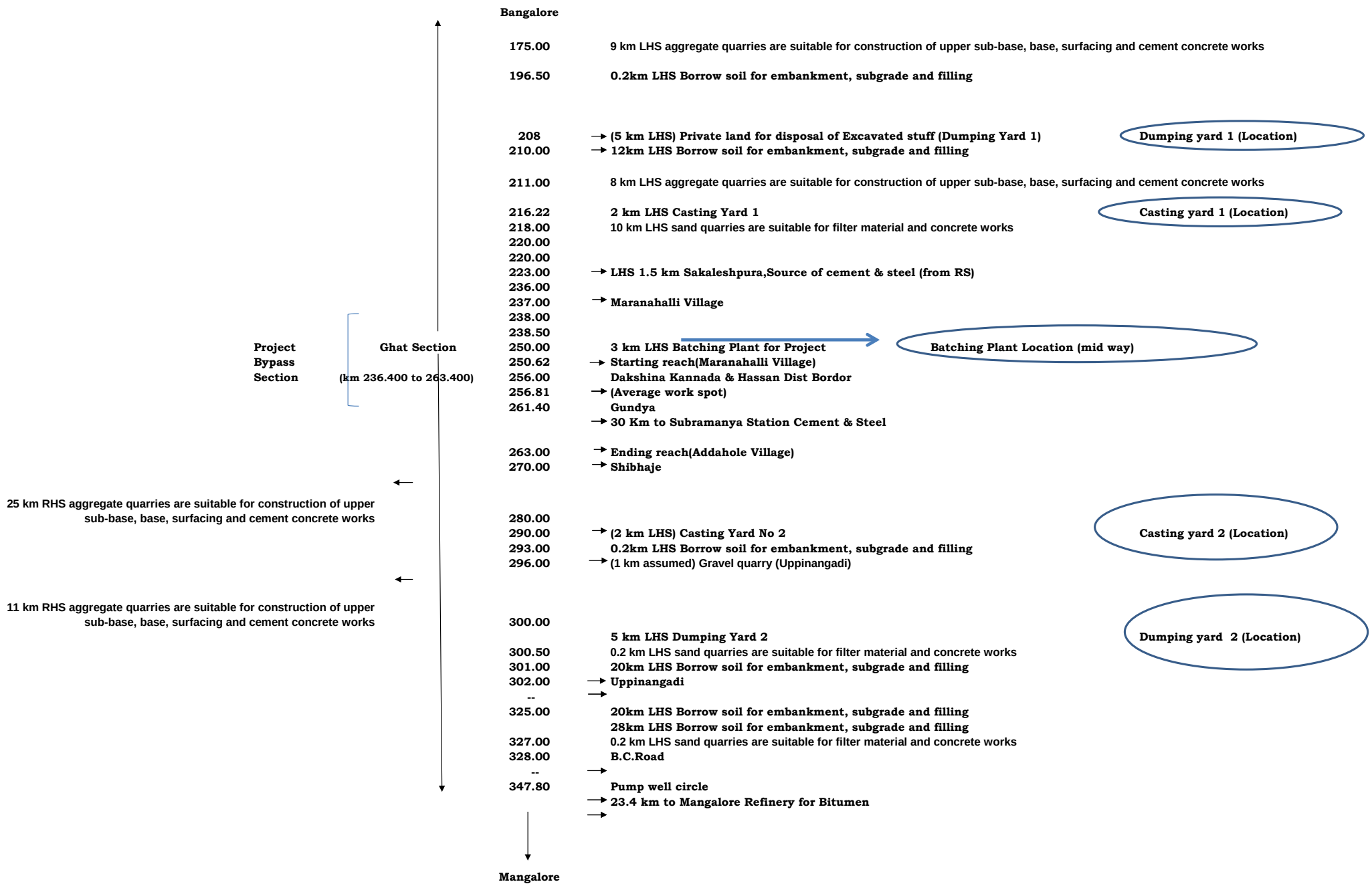
Quarry to NH-48 (300.5 km)	0.2 km
From 300.5 km to 250 km	50.5 km
From 250 km to Batching Plant	3 km
	53.70 km

ANNEXURE – 3

Location Map of Quarry, Borrow areas

LEAD CHART FOR QUARRY, BORROW AND RAW MATERIALS FOR Shiradi Ghat BY PASS PROJECT Bangalore - Mangalore section.

LEAD CHART



Prepared for:

सड़क परिवहन और राजमार्ग मंत्रालय
MINISTRY OF ROAD TRANSPORT & HIGHWAYS

Karnataka
Public Works, Ports & Inland Water Transport Department

Project:

Consultancy Services for "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.000 to 261.450 on NH-48 in the State of Karnataka"

Subject:

KD-6 - Draft Detailed Project Report for Final Approved Alignment for Bypass

Volume-IV(a): Environment Assessment Report including Environmental Management Plan (EMP)

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Revision History

Rev.	Date	Long Description

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INTRODUCTION

This report is prepared under Contract Agreement clause 2.8; "Key Date No: KD 6: Draft De tailed Project Report for Final Approved Alignment for Bypass (DDPR)" after incorpora tion of Client's observations on earlier submitted "KD5: Kucha Draft Detailed Project Report (KDDPR)" vide letter no. NH/PIU-Tunnel/NH-48/KD-3/2015-16/383-386 dated 14.12.2015.

The present submission (10 Hard Bound Sets and 5 Soft Copies of each) is as detailed below:

(i) Volume-I, Main Report:

- *Executive summary*
- *Project Description*
- *Socio Economic Profile*
- *Materials Surveys and Investigation*
- *Traffic Surveys and Analysis*
- *Design Standards and Specifications*
- *Alignment Proposals*
- *Summary of EIA/IEE and Action Plan*
- *Summary of Resettlement Plan*
- *Preliminary Cost Estimates*
- *Preliminary Economic Analysis*
- *Preliminary Financial Analysis*
- *Suggested Methods of procurement and packaging*
- *Conclusions and Recommendations*
- *Acknowledgement*
- *Compliance of the Observations*

The basic data obtained from the field studies and investigations and input data used for the detailed engineering design (if any) shall be submitted in a separate volume as an Appendix to Main Report.

(ii) Volume – II : Design Report;

Part-I Traffic Study, Analysis and Forecast :

- *Description of Existing Road in Ghat Section*
- *Road and Bridge Inventory*
- *Traffic Surveys, analysis and forecast*
- *Proposed Pavement Design*

Part-II Design of Tunnels :

- *Proposed Tunnel Design, Standards*
- *Structural Analysis- Primary Lining*

Part-III Design of Bridges and Cross-Drainage Structures :

- *Proposed Bridges and Structures Design Basis and*
- *Bridges Dimensioning*

Part-IV Geological Design and Geotechnical Report :

- *Geological Survey and Analysis*
- *Geotechnical Investigations Report*

(iii) Volume-III Materials Report :

(iv) Volume - IV(a) Environmental Assessment Report including Environmental Management Plan (EMP) &

(v) Volume - IV(b) Resettlement Action Plan (RAP) :

(vi) Volume - V Technical Specifications :

(vii) Volume - VI Rate Analysis :

(viii) Volume - VII Cost Estimates :

(ix) Volume - VIII Bill of Quantities :

(x) Volume - IX Drawings (A3 Size) :

a. *Location map*
b. *Layout plans*
c. *General Drawings*
d. *Plan and Profile of Refined Alignment "A"*
e. *Typical Cross Sections showing Pavement details of Cut & Fill Section*
f. *Typical Cross Sections of Tunnel*
g. *Typical Cross Sections of Bridges*
h. *Tunnels- General Arrangement Plan and L-Sections (L&R)*
i. *Viaducts – General Arrangement Plan and L-Section*
j. *Cut & Fill and Viaducts – General Arrangement Plan and L-Section*
k. *GAD for proposed RoB at Railway km 54+650*
l. *Standard Drawings*
m. *Miscellaneous Drawings*
n. *Indicative Land Acquisition Plans*
o. *Detailed Cross Sections @ 100m interval*

(xi) Volume - X Civil Work Contract Agreement :
(xii) Volume - XI Project Clearances :

Volume – IV(a) : Environment Assessment Report including Environment Management Plan

A. General

This Volume - IV(a): Environment Assessment Report inlcuding Environment Management Plan, a part of "KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)" is submitted in accordance with the Contract Agreement and as per requirement specified in Terms of Reference (ToR) for prepa ration of Environment Assessment Report inlcuding Environment Management Plan of "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH-48 in the State of Karnataka".

1 ENVIRONMENT ASSESSMENT REPORT

1.1 General

The section of National Highway – 48 Bangalore – Mangalore road between Maranahally (km 238.00) and Gundya (km 261.450) runs in deep mountain and valleys are called Shiradi Ghat. The average rain fall is of 6000 mm to 7000 mm per year. The topography changes up to approximately 700 mtrs over a length of 26.00 km. The Shiradi Ghat of NH-48 is very steep and comprised of many hairpin bends. The road is being closed every year during monsoon for certain period due to earth slips. Due to rugged terrain and difficult Geomorphology the widening of the road is not easy. The tremendous in VPD has been causing strenuous for smooth plying of vehicles and maintenance of the road. Further, Shiradi Ghat is a highly eco-conscious forest reservation are. This stretch of road may be got reduced by constructing 4-lane new Bypass [two tubes of 2+1(emergency lane) tunnels, 4-lane bridges, number of lane and lane width have been designed considering the current traffic intensity and projected traffic volume for 20 years] comprising of four lane road. High rise pier Bridges with long arch span to negotiate deep valleys and Tunnel road to cross mountain ranges. The total length of road between Maranahally and Gundya could be reduced to 23.6km as against 26.0km. It is proposed to link this stretch of 4-lane Bypass to entire Bangalore – Mangalore expressway which is proposed to be widen as 4-lane road throughout.

1.2 Existing Characteristics of the Project Road

The terrain on this Ghat section of 23km can be termed as hilly and mountainous. The abutting land use pattern varies from residential to agricultural and forest area. Sparingly industrial land also is observed along with barren lands. Almost throughout the ghat section of the Project Highway, very few human settlements were observed along the road. They were as semi built-up and completely built-up areas. The settlements are mainly residential, commercial, religious places viz temple, masjid/mosque, church and petrol stations. The river Kempu hole runs almost parallel to the road on left side along the entire Ghat section. Important crops grown are coffee, Black Pepper, Potato, Paddy and Sugarcane. Three mini hydel power station is located at the Ghat section to the left of the highway.

Important places and villages are Heggade, Maranhally, Kempuhole, Gundiya, and Adda hole along the Project stretch. The existing road is having two lane undivided carriageway width of 7.0 m of flexible & newly laid rigid pavement and predominantly gravel/earthen shoulder of 1.0m to 2.0m width.

The existing road is having two lane undivided carriageway width of 7.0 m of flexible pavement with predominantly earthen shoulder and paved shoulder at few locations of width varying from 1.0m to 1.5m. The horizontal geometry of the Project road doesn't meet IRC standards with respect of design speed, pavement surface condition, riding quality etc. It has many sharp and substandard curves; the stretches passing through ghat sections have sharp curves with design speed of less than 30kmph. All major utility providers have cables running throughout the project road on both sides.

The State PWD had successfully completed the improvement and reconstruction work of the badly damaged bituminous pavement by providing cement concrete pavement from km 238 to km 250 in 2015; and taking up balance section from km 228 to km 238 and km 250 to km 263 shortly.

The section of National Highway – 48 Bangalore – Mangalore road between Maranahally (km 238.00) and Gundya (km 261.450) runs in deep mountain and valleys are called Shiradi Ghat. The average rain fall is of 6000 mm to 7000 mm per year. The topography changes up to approximately 700 mtrs over a length of 26.00 km. The Shiradi Ghat of NH-48 is very steep and comprised of many hairpin bends. The road is being closed every year during monsoon for certain period due to earth slips. Due to rugged terrain and difficult Geomorphology the widening of the road is not easy. The tremendous in VPD has been causing strenuous for smooth plying of vehicles and maintenance of the road. Further, Shiradi Ghat is a highly eco-conscious forest reservation are. This stretch of road may be got reduced by constructing new Bypass [# Size of tunnel, bridges, number of lane and lane width shall be designed considering the current traffic intensity and projected traffic volume for 20 years or more] comprising of two lane/four lane road. High rise pier Bridges with long arch span to negotiate deep valleys and Tunnel road to cross mountain ranges. The total length of road between Maranahally and Gundya could be reduced to 23 km as against 26.00 km. It is proposed to link this stretch of 4-lane Bypass to entire Bangalore – Mangalore expressway which is proposed to be widen as 4-lane road throughout.

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The State PWD took up the work of improvement and reconstruction of the badly damaged bituminous pavement with providing cement concrete pavement from km 238 to km 250. The balance section from km 250 to km 265 of the Ghat section is also under rehabilitation of poor bituminous pavement to concrete pavement in this financial year.

1.4 The Project Area

The project road passes to Dakshin Kannada and Hassan District. In this project road, Heggade, Maranhally, Aluvalli, Yadekumari, Kagenari State forest and Gundya village are coming along the proposed road and Tunnel.

1.5 Environmental Impact Assessment

Karnataka state is very rich of flora and fauna. There are many reserved forests, wild life sanctuaries and national parks in Karnataka state. The project road passes through reserve forest areas but does not pass through wild life sanctuaries or National parks as shown below:

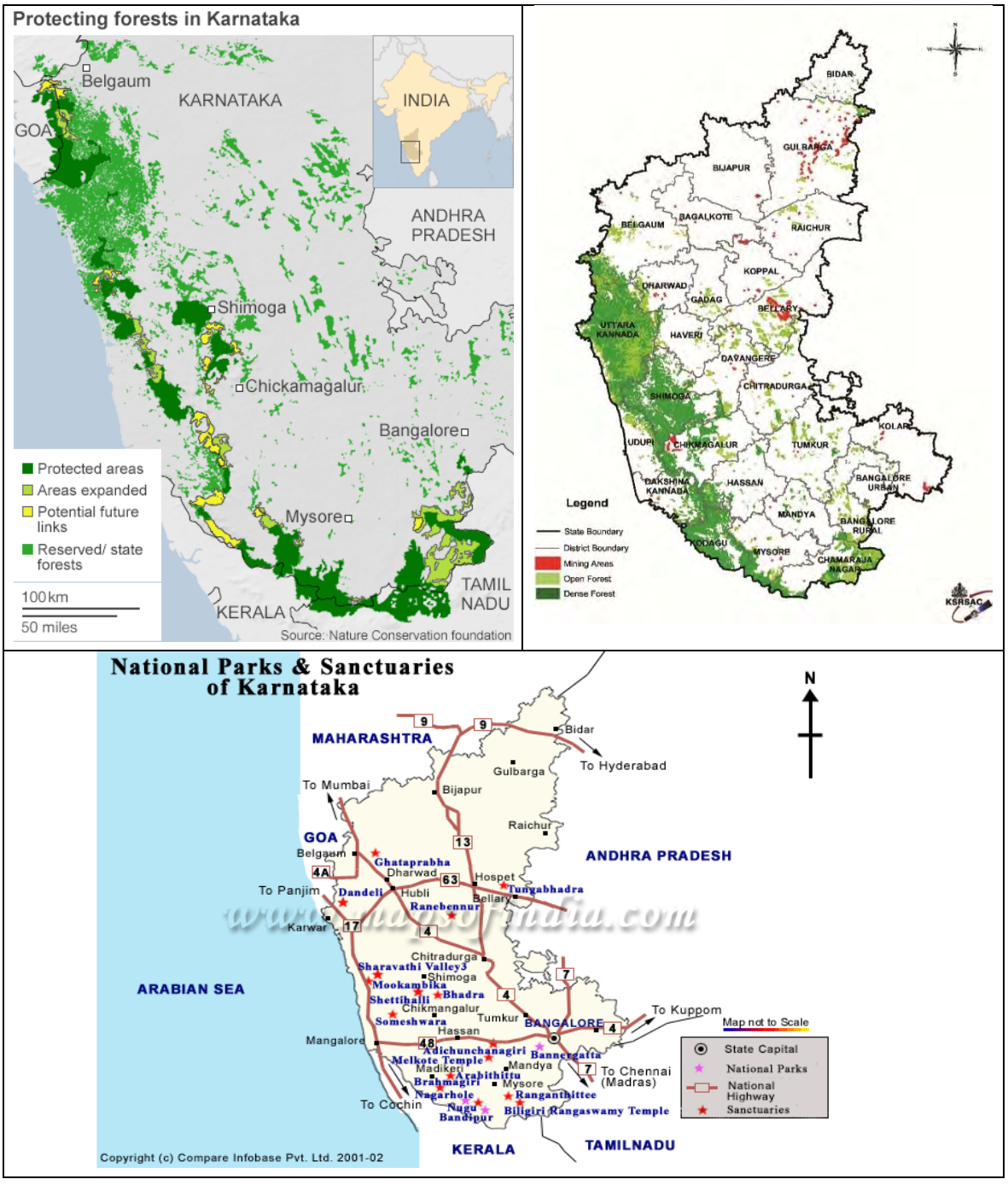

Fig. Forest Maps and Sanctuaries of Karnataka

The project road takes off from Heggade near Maranhally (km 236.400), and merges at Adda hole near Gundya (km 263.400) on existing road section of NH-48.

The State of Karnataka is located in South-West part of India. Karnataka is surrounded by Maharashtra, Goa, Andhra Pradesh, Kerala and Tamil Nadu. The entire stretch of NH-48, length 328km passes through important towns of Nelamangala, Kunigal, Channaraya-patna, Hassan, Sakleshpura, Uppinaangadi and reaches Mangalore city.

1.6 Environmental profile of Project

Lying between 12° 13′ and 13° 33′ North latitudes and 75° 33′ and 76°38′ East longitude, Hassan district has a total area of 6826.15 km². The geography is mixed with the malnad or mountainous region to the west and south west called Bisle Ghat and the maidan or planis regions in the north, south and east. There are some areas of de-graded forest ranges in central portion of the district.

The general level of Hassan district is it slopes with the course of Hemavathi river from the western ghat ranges towards the bed of the Kaveri river near Hampapura in the south east. Its chief tributary is the Yagachi River, from Belur taluka, which joins it near Gorur. Hemavathi passes through Holenarsipur taluq in a southerly direction and joins with the Kaveri near Hampapura close to the border of Hassan district. Hassan and Belur stands around 3,084 and 3,150 feet (960 m) above the sea level respectively.

The district is surrounded by Chikmagalur District to the north west, Chitradurga District to the north, Tumkur District to the east, Mandya Districtto the south east, Mysore to the south, Kodagu District to the south west and Dakshina Kannada district to the west.

1.7 Climate

In Hassan District, highest day temperature is in between 27 °C to 38 °C in sum-mers. Average temperatures of January is 23 ° C , February is 23 ° C , March is 26 °C , April is 27 °C , May is 27 °C.

1.8 Water Hydrology and Drainage

Weathered and fractured gneiss is the predominant aquifer found in the project districts followed by schistose and granitic aquifers, which occur as isolated patches in a few ta-luks. As per CGWB, part of 2 project blocks in each Project District fall under overex-ploited category. Those are 50% of Hassan Block in Hassan district & 40% of Bantawal in Dakshin Kannada. Whereas, part of Belthangadi (10%) and Puttur (10%) Block fall under semi critical category. Water table as per CGWB is 1.39 - 8.32 mbgl (post monsoon in Hassan district) & 0.75 - 8.65 mbgl (post monsoon in Dakshin Kannada district). The ma-jor rivers of the project area are Nethravathi, Kumaradhara, Hemavathi, Yagachi etc.

1.9 Forest Resources

The alignment of the proposed project road passes through the jurisdiction of 2 forest divi-sions i.e. Hassan (Hassan District) and Mangalore (Dakshin Kannada District). The forest land acquisition will be required at the portals.

1.10 National Park, Sanctuary, Biosphere Reserve

The project road section doesn't fall within 10 Km radius of any National Park, Wild life Sanctuary, or Biosphere reserve. No notified animal corridor/migration route is present along the road as per secondary information obtained from Wildlife Trust of India.

1.11 Flora & Fauna

These forests of the project area include unique flora and fauna with rich biological diversity and genetic resources, apart from many medicinal herbs and shrubs.

1.12 Biodiversity Hot Spot

A biodiversity hotspot is a biogeographic region in the world with a significant reservoir of biodiversity that is under threat from humans. It is a method to identify those regions of the world where attention is needed to address biodiversity loss and to guide investments in conservation. Around the world, 25 areas are identified so far with another nine possible candidates. These sites support nearly 60% of the world's plant, bird, mammal, reptile, and amphibian species, with a very high share of endemic species. India has two such major biodiversity hotspots and they belong to the Eastern Himalayas and the Western Ghats, through which the project road section passes.

2 SOCIO-ECONOMIC PROFILE OF AREA

Karnataka is a state in south western region of India. It was formed on 1 November 1956, with the passage of the States Reorganisation Act. Originally known as the State of Mysore, it was renamed Karnataka in 1973. The capital and largest city is Bangalore (Bengaluru). Karnataka is bordered by the Arabian Sea and the Laccadive Sea to the west, Goa to the north west, Maharashtra to the north, Telangana to the North east, Andhra Pradesh to the east, Tamil Nadu to the south east, and Kerala to the south west. The state covers an area of 191,976 square kilometres (74,122 sq mi), or 5.83 per cent of the total geographical area of India. It is the seventh largest Indian state by area. With 61,130,704 inhabitants at the 2011 census, Karnataka is the eighth largest state by population, comprising 30 districts. Kannada is the most widely spoken and official language of the state.

2.1 Socio-Economic Profile of the Hassan District

Hassan District is one of the districts located in the southern part of Karnataka state in India. Hassan, a picturesque town in the heart of Malnad with a pleasant climate, is the district headquarters. It is about 185 KM from Bangalore, the capital city of Karnataka. The Hoysalas brought world-wide acclaim to the district through their unique style of Temple Architecture. The world famous sculptural wonders of Halebeedu, Belur and Shravanabelagola are located in the Hassan District.

2.2 Location & Geographical Area

District Hassan is lying between 12° 13´ and 13° 33´ North latitudes and 75° 33´ and 76 º 38´ East longitudes, Hassan district has a total area of 6826.15 Sq. Kms. The greatest length of the district, from south to north, is about 129 kilometers, and its greatest breadth, from east towest, is about 116 kilometers. The District which has 8 taluks 38 hoblies & 2369 villages. The geographic area of the district of Hassan is 6845 square kilometers. The population is 5.67 lakhs and the average rainfall is about 1031 mms annually. Coffee, Black Pepper, Potato, Paddy and Sugarcane are the major agricultural crops. The District covers 8 taluks in this area. Located southern eastern part of Karnataka.Bounded by Tumkur, Chickmagalur, Dakshina Kannada and Mandya districts Rich producer of spices &condiments. Well known for its tourist & coffee production.

2.2.1 TOPOGRAPHY

- Temperature: 350 C (Max.) and 200 C (Min.)
- Average : Rainfall 1031 mm
- Rivers : Hemavati and Cauvery
- Area : 6826 sqm

Hassan District is covered by metamorphic and igneous rocks, viz., peninsular gneisses close pet granites and Bababudan group scheists. Red loamy, sandy and black mix red soil constitute crust zone. 8.9% of the geographical area is covered by forests.

2.2.2 CLIMATE:

Tropical savanna climates have monthly mean temperature above 18 °C (64 °F) in every month of the year and typically a pronounced dry season, with the driest month having precipitation less than 60mm (2.36 in) of precipitation. The koppen climate Classification subtype for this climate is "Aw" (Tropical Savanna Climate).

Climate data for Hassan													
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Average high °C (°F)	27.8 (82)	30.3 (86.5)	32.7 (90.9)	32.9 (91.2)	31.1 (88)	26.6 (79.9)	24.6 (76.3)	25.2 (77.4)	26.3 (79.3)	27.2 (81)	26.8 (80.2)	26.5 (79.7)	28.17 (82.7)
Average low °C (°F)	12.7 (54.9)	15.2 (59.4)	18.2 (64.8)	20.1 (68.2)	21.1 (70)	19.4 (66.9)	19 (66)	18.8 (65.8)	18.4 (65.1)	18.5 (65.3)	16.9 (62.4)	14.0 (57.2)	17.69 (63.83)
Average rainfall mm (inches)	0 (0)	2 (0.08)	7.0 (0.276)	58 (2.28)	97 (3.82)	84 (3.31)	167 (6.57)	94 (3.7)	85 (3.35)	152 (5.98)	51 (2.01)	9 (0.35)	806 (31.726)
Source: Climate-data.org													

2.2.3 AGRICULTURE

Hassan district is situated at southeren part of the state comprising of 8 blocks. The entire district comes under 4 Agro climatic zones namely, Central dry zone, Southern dry zone, Southern transitional zone & Hilly zone. Arasikere Taluk comes under Central dry zone, Channarayapatna Taluk comes under Southern dry zone, Holenarsipur, Arkalgud, Alur and Belur comes under Southern transitional zone where as Sakleshpur Taluk comes under Hilly zone. 8 taluks divided into 4 agro-climatic zones with geographical areas 6.62 lakh ha. The total cultivable area of the district 4.48 lakh ha. of which 79% of the area is under rainfed agriculture. The four reservoir project in Kaveri basin Hemavathi, Harangi, Vatehole & Yagachi supports irrigation to the extent of 46672 ha in Hassan District.

2.2.4 AVAILABILITY OF MINERALS

Geologically Hassan district forms a part of Precambrian terrain. The Major Litho units are granitic gneiss, granulites, granites, Dharwarian schists and dyke rocks. The most important rock formation of the district are Nuggehalli and Holenarasipura Schist belt,. These two schist belts are the host of number of mineral deposits like Chromite, Titaniferous-magnetite, Chalcopyrite, Kaolin, Asbestos,Quatze etc.

Production Of Mineral 2010-11

S.NO.	NAME OF MINERAL	PRODUCTION in tones 2010-2011
1.	Moulding Sand	53208
2.	Quartz	1024

(SOURCE:- DEPT. OF MINES & GEOLOGY)

2.2.5 FOREST

The types of forests, area covered (ha), administrative units & details of flora & fauna of hassan district are dealt hear under. The total area covered under Forest is 89885.28 acres

2.2.6 **ADMINISTRATIVE SET UP**

The district administration is headed by the Deputy Commisioner, Hassan, who is head quartered at Hassan . Hassan district consists of 2 revenue sub-divisions: Hassan and Sakaleshpur. Hassan Sub-division includes Hassan, Arasikere, Holenarasipura and Channarayapatna Taluks, whereas Sakaleshpur Sub-division Comprises of Alur, Arkalgud,Belur and Sakaleshpur. Hassan Sub-division has its headquarters at Hassan and Sakaleshpur Sub-Division at Sakaleshpur.

Hassan District at a Glance

S. No	Particular	Year	Unit	Statistics
1	**Geographical features**			
A	**Geographical Data**			
	i) Latitude	12° 13´ and 13° 33´ North latitudes		
	ii) Longitude	75° 33´ and 76°38´ East longitude		
	iii) Geographical Area	2010-2011	Hectare	662602
B	**Administrative Units**	2010-2011		
	i) Sub divisions			2
	ii) Tehsils			8
	iii) Sub-Tehsil			16
	iv) Patwar Circle(Hobblies)			38
	v) Panchayat Simitis			23
	vi) Nagar nigam			2
	vii) Nagar Palika			9
	viii) Gram Panchayats			258
	ix) Revenue villages			2559
	x) Assembly Area			7
2	**Population**	2011	Nos.	1776221
A	Sex-wise			
	i) Male	2011	Nos.	8,85,807
	ii) Female	2011	Nos.	8,90,414
B	Rural Population			14,16,996
3	**Agriculture**	2010-11		
	Land utilization			
	i) Total Area		Hectares	662602
	ii) Forest cover		Hectares	58775
	iii) Non Agriculture Land		Hectares	78810
	iv) Cultivable Barren land		Hectares	30365
4	**Forest**			
	i) Forest	2010-11	Hectares	58775
5	**Livestock & Poultry**	2007		
A	**Cattle**	2007		
	i) Cows	2007	Nos	633535
	ii) Buffaloes	2007	Nos.	191484

S. No	Particular	Year	Unit	Statistics
B	**Other livestock**			
	i) Goats		Nos	201205
	ii) Pigs		Nos.	2489
	iii) Dogs		Nos.	71508
6	**Public Health**			
	(a)Allopathic Hospital (b)Beds in Allopathic hospitals (c) Govt.Ayurvedic Hospital (d)Beds in Ayurvedic hospitals (e)Unani hospitals (f) Community health centers (g)Primary health centers (h)Dispensaries (i) Sub Health Centers (j) Private hospitals	2010-2011	No No. No. No. No. No. No. No. No. No.	22 2370 5 57 1 14 137 44 456 34
7	**Education**	2010-11		
	i) Primary school		Nos.	1663
	ii) Middle School		Nos.	1308
	iii) Secondary & senior secondary schools		Nos.	516
	iv) Colleges		Nos.	182
	v) Technical University		Nos.	2

2.2.7 MAJOR EXPORTABLE ITEM

Coffee and Cordamum are indirectly exported through important Metropolitan Cities like Bangalore, Mangalore and Chennai. Garments are also exported from SEZ units.

2.2.8 GROWTH TREND

The District has major strength for Development and promotion of Industries which are summarized as under. The district is ideally located in the State of Karnataka, in terms of its excellent climatic condition and labour harmony. The district has strong agricultural base. The district good technical man power is available. Infrastructure facilities are established in the district. There is growth due to establishment of industrial areas and many small scale industries can start production in Gherkins, and food related industries.

2.2.9 TOURISM

- Shravana Belagola – The statue of Gommateshvara Bahubali at Śravana Belgola is one of the mostimportant pilgrimage destinations in Jainism.
- Hassanamba Temple – It is an 800 year old temple dedicated to goddess Shakti or Amba The main diety of the temple is that of Hassan.
- Channakeshava Temple - World famous for the finest examples of Hoysala workman ship; situated onthe banks of river Yagachi, 38 km from Hassan.

- Halebeed temple - Grand example of temple architecture with sequences from the greatest Hindu epics (Ramayana, Mahabharatha and Bhagavatha) depicted on the outer walls of the temples.
- Ramanathapura - Situated on the left bank of the cauvery and a noted centre of pil grimage and hasbeen called 'Dakshina Kashi'.
- Bisle Ghat - Situated about 65 Kms from Sakaleshpur on Sakaleshpur-Subramanya road. The place has mountainous region and full of panoramic sceneries, making it a desired place for trekkers.
- Gorur - Situated about 25 Kms from Hassan in Hassan-Arakalgud road. Famous for temples likeTrikuteshwara, Vasudeva and Kailaseshwara. The dam constructed across Hemavathi river is a major excursion spot.

2.3 Demographic Feature of Hassan District

In 2011, Hassan had population of 1,776,421 of which male and female were 883,667 and 892,754 respectively. In 2001 census, Hassan had a population of 1,721,669 of which males were 859,086 and remaining 862,583 were females.

There was change of 3.18 percent in the population compared to population as per 2001. In the previous census of India 2001, Hassan District recorded increase of 9.68 percent to its population compared to 1991.

2.3.1 Population

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There was change of 3.18 percent in the population compared to population as per 2001. In the previous census of India 2001, Hassan District recorded increase of 9.68 percent to its population compared to 1991.

Description	**2011**	**2001**
Actual Population	1,776,421	1,721,669
Male	883,667	859,086
Female	892,754	862,583
Population Growth	3.18%	9.68%
Area Sq. Km	6,814	6,814
Density/km2	261	253
Proportion to Karnataka Population	2.91%	3.26%
Sex Ratio (Per 1000)	1010	1004
Child Sex Ratio (0-6 Age)	973	958
Average Literacy	76.07	68.63

Description	2011	2001
Male Literacy	83.64	78.37
Female Literacy	68.60	59.00
Total Child Population (0-6 Age)	165,637 (9.32%)	199,665 (11.60%)
Male Population (0-6 Age)	83,971 (9.50%)	101,971 (11.87%)
Female Population (0-6 Age)	81,666 (9.15%)	97,694 (11.33%)
Literates	1,225,256	1,044,584
Male Literates	668,836	593,329
Female Literates	556,420	451,255

Source: Census 2011

2.3.2 Density

The initial provisional data released by census India 2011, shows that density of Hassan district for 2011 is 261 people per sq. km. In 2001, Hassan district density was at 253 people per sq. km. Hassan district administers 6,814 square kilometers of areas.

2.3.3 Literacy Rate

Average literacy rate of Hassan in 2011 were 76.07 compared to 68.63 of 2001. If things are looked out at gender wise, male and female literacy were 83.64 and 68.60 respectively. For 2001 census, same figures stood at 78.37 and 59.00 in Hassan District. Total literate in Hassan District were 1,225,256 of which male and female were 668,836 and 556,420 respectively. In 2001, Hassan District had 1,044,584 in its district.

2.3.4 Sex Ratio

With regards to Sex Ratio in Hassan, it stood at 1010 per 1000 male compared to 2001 census figure of 1004. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 973 girls per 1000 boys compared to figure of 958 girls per 1000 boys of 2001 census data.

2.3.5 Child Population

In census enumeration, data regarding child under 0-6 age were also collected for all districts including Hassan. There were total 165,637 children under age of 0-6 against 199,665 of 2001 census. Of total 165,637 male and female were 83,971 and 81,666 respectively. Child Sex Ratio as per census 2011 was 973 compared to 958 of census 2001. In 2011, Children under 0-6 formed 9.32 percent of Hassan District compared to 11.60 percent of 2001. There was net change of -2.28 percent in this compared to previous census of India.

2.4 Socio-Economic profile of Dakshina kannada

Two Sheltered by the soaring Western Ghats on the east and bordered by the blue waters of the Arabian Sea, Dakshina Kannada district is blessed with abundant rainfall, fertile soil and lush vegetation. Pristine beaches, picturesque mountain ranges, temple towns and a rich culture make it a sought after tourist destination. The district is well known for Yak-shagana- a fabulous costumed dance drama form, Kambala- the sport of buffalo racing by farmers, Kori-katta (Cock Fight) and Bootha Kola. District is a hub for major information technology and outsourcing companies. This district also has the distinction of formation of some of the leading banks in the country and well known educational institutions. Mangalore, the district head quarter is called as the gate way to Karnataka due to the pres-

ence of New Mangalore Port Trust which is an all weather port.

2.4.1 Location & Geographical Area

The district is a part of peninsular India located half way between Mumbai and Cape Cameron and is stretching 60 Kms. from North to South and 70 Kms. from East to West in the form of a low lying broken plateau from Western Ghats to Arabian Sea. Geographically the district is divided into three belts

- Coastal tract, the most thickly populated region
- Middle belt consisting of hills and fertile valleys with several gardens of areca nut, coconut and paddy fields.
- Western Ghats, the eastern boundary of the district, consisting dense evergreen forests

Dakshina Kannada District at a Glance

S. No	Particular	Year	Unit	Statistics
1	**Geographical features**			
A	**Geographical Data**			
	i) Latitude	12°27’ and 13°58’ North Latitude		
	ii) Longitude	74°35’ and 74°4’ East Longitude		
	iii) Geographical Area	2010-2011	Hectare	477149
B	**Administrative Units**	2010-2011		
	xi) Sub divisions			2
	xii) Tehsils			5
	xiii) Sub-Tehsil			-
	xiv) Patwar Cir-cle(Hobblies)			17
	xv) Panchayat Simitis			-
	xvi) Nagar nigam			-
	xvii) Nagar Palika			1
	xviii) Gram Panchayats			203
	xix) Revenue villages			416
	xx) Assembly Area			8
2	**Population**	2011		2083625
A	Sex-wise			
	iii) Male			10,32,577
	iv) Femaile			10,51,048
B	Rural Population			10,91888
C	Urban Population			991737
3	**Agriculture**	2010-11		
	Land utilization			
	v) Total Area		Hectares	477149
	vi) Forest cover		Hectares	128476
	vii) Non Agriculture Land		Hectares	65483
	viii) Cultivable Barren land		Hectares	58780
4	**Forest**			
	ii) Forest	2010-11	Hectares	128476
5	**Livestock & Poultry**	2007		
A	**Cattle**			
	i) Cows		Nos	396609
	ii) Buffaloes		Nos.	15119
B	**Other livestock**			
	iv) Goats		Nos	25749

S. No	Particular	Year	Unit	Statistics
	v) Pigs		Nos.	5332
	vi) Dogs		Nos.	221401
6	**Public Health**			
	(k) Allopathic Hospital (l) Beds in Allopathic hospitals (m) Govt.Ayurvedic Hospital (n) Beds in Ayurvedic hospitals (o) Unani hospitals (p) Community health centers (q) Primary health centers (r) Dispensaries (s) Sub Health Centers (t) Private hospitals	2010-2011	No No. No. No. No. No. No. No. No. No.	76 1895 2 31 2 7 64 7 430 1629
7	**Education**	2010-11		
	vi) Primary school		Nos.	362
	vii) Middle School		Nos.	1092
	viii) Secondary & senior secondary schools		Nos.	477
	ix) Colleges		Nos.	184
	x) Technical University		Nos.	-

2.4.2 Topography

The topography of the district varies from plain to undulated terrains at various locations. An interesting feature of the coastal strip and the middle belt is that, it is not a plane but a series of estuarine low lands separated by numerous hill ranges. The coastal tract is the most densely populated part of the district and is the most fertile belt. The middle belt again has an undulated topography with hills and dales. The district is characterized by sandy soil along the coastal belt and lateritic soil in other parts with high iron and aluminum contents. Laterite stones are available more in the high plain of interior district which are useful for construction purpose. There is rich deposit of alluvial soil in the valleys and ravine bases. The water retention capacity of the soil is very poor. To the east of the coastal region the soil is suitable for growing Arecanut, Banana, Cocoa and Rubber.

2.4.3 Climate

Dakshina Kannada features a Tropical Monsoon climate (Am) according to the Koppen climate classification. The average annual rainfall in Dakshina Kannada is 4,030 millime-

ters (159 in). The rainfall varies from 3,796.9 millimeters (149 in) at the Mangalore coast, 4,530 millimeters (178 in) at Moodabidri and 4,329 millimeters (170 in) at Puttur near the Western Ghats. The average humidity is 75% and peaks in July at 89%.

2.4.4 Agriculture

Agriculture which was once a major occupation of the people of Dakshina Kannada, has now taken a back seat because of the influx of money from natives settled in other cities, states and countries. Significant number of people from this district works in the Gulf (Middle East) countries and other states of India. Farms and fields are being converted into residential plots and commercial (shopping) complexes. Horticulture though has made some strides, and measures have been taken to improve the fruit plantation sector.

The main crops of Dakshina Kannada are Paddy, Coconut, Arecanut, Black Pepper, Cashew and Cocoa. Rubber, Banana and Vanilla crops are also cultivated in the Sullia taluk. Rice is generally cultivated three seasons in a year, Karthika or Yenel (May–October), Suggi (October to January) and Kolake (January to April). Urad or Black gram is grown in some areas during the season of Suggi. The Karnataka Milk Federation has a milk processing plant at Kulshekar in Mangalore. This plant processes milk procured from the cattle owned by farmers of the district.

2.4.5 Cultures, Tradition and Rituals

Even today, most people of the district follow the traditions, customs and rituals. The district has many temples of Hindu gods and goddesses, which are ancient and have deep spiritualism attached to them. The people of Dakshina Kannada worship the serpent god (Subramanya) .According to legend; the district was reclaimed by Parashurama from the sea. Nagaradhane or Snake worship is practiced according to the popular belief of the Naga Devatha to go underground and guard the species on the top. Rituals such as Bhuta Kola are performed to satisfy the spirits. Kambla, a form of buffalo race on muddy track in the paddy field, is organised in the 16 sites across the district. Cock fight (Kori Katta in Tulu) is another past time of the rural agrarian people

2.4.6 Availability of Minerals

Major types of minerals available in the district are Building Granite and Laterite Stone. Other minerals namely Quartz, Dolerite, Lime Shell and Lime Kankar are available in a minor quantity.

Production of Mineral 2010-11 (in Metric Tonnes)

NAME OF MINERAL	PRODUCTION 2010-2011					
	Mangalore	Bantwal	Puttur	Sullia	Belthangady	**Total**
Quartz	-	-	-	-	50	50
Building Granite	285703	165000	15900	8040	60485	535128
Laterite Stone	21315	4474	9350	12825	4250	52214
Dolerite	303.302*	-	-	-	-	303.302
Lime Shell	624	-	-	-	-	624
Lime Kankar	-	-	-	350	-	350
Total	**307642 MTs 303.302* M3**	**169474**	**25250**	**21215**	**64785**	**588366 MTS**

SOURCE- DEPT. OF MINES & GEOLOGY, MANGALORE

2.4.7 Forest

Dakshina Kannada district has large tracks of tropical evergreen forest called Western ghat forest which is one of the biodiversity hot spots in the world. This district has forest area of 128476 Hectares. Forest area is more in Belthangady taluk (49837 Ha) followed by Sullia taluk (43282 Ha) and Puttur taluk (27386 Ha). There is vast scope for development of ecotourism in forest area.

2.4.8 Administrative Set Up

The head of the district administration is the Deputy Commissioner and Magistrate who is drawn from Indian Administrative Service. Though most of the developmental activities in the district are carried out by the various functional departments, the Deputy Commissioner as head of the district has a central role as the coordinator of programs implemented in the district.

Dakshina Kannada District has 2 revenue sub divisions viz., Mangalore and Puttur and 5 Taluks viz., Mangalore, Bantwal, Puttur, Belthangady and Sullia.

The general administration of the district including industrial development at the apex is being looked after by the elected body called Zilla panchayat. The district has a Chief Executive Officer and other officers appointed by the State Government. Down below, there are various district level officers of the State Government to perform/execute the various regulatory/development functions assigned to them. The District Industries Centre is one such district level office headed by an official of the State Government designated as Joint Director under whom a number of functional Managers and Asst.Directors work for the promotion and development of industrial and commercial enterprises in the two sub divisions of Dakshina Kannada district. Taluk level extension officers headed by Dy.Director, Khadi and Village industries are appointed in each taluk of the district for the promotion of industries in rural areas.

2.4.9 Industrial Scenario Of Dakshina Kannada District

In Dakshina Kannada district, industries such as tile, beedi, cashew kernel, coconut oil, food and beverages and manufacturing activities like rubber/plastic goods, wooden products etc had a prominent presence. The tile industry has been in decline due to non availability of quality clay and fire wood in addition to labour shortage and public preference for concrete structures in the modern era. The Beedi rolling industry is one of the major home industries of district. After establishment of sea port at Mangalore in the seventies there is rapid momentum in industrialization in the district. Due to the presence of large and mega industrial units in the district, a large number of micro and small enterprises are coming up.

Taluks in Dakshina Kannada district have been divided into zones for industrial incentives namely Zone 3: Bantwal, Mangalore (excluding Corporation limits), Puttur, Sullya & Belthangadi

Zone 4: Mangalore (Corporation limits)

2.4.10 Major Exportable Item

Historically, Dakshina Kannada district has been a major exporter of commodities like Tiles, Leaf springs, Spices, Cashew nuts, Handicrafts etc. Recently the district has emerged as a major player in the export of Engineering goods, Readymade Garments,

Chemicals, Minerals and Ores, Food items, Fish Meal, Fish Oil, Flowers, Gherkins, Polished Granite etc. Export of perishables such as jasmine and vegetables to West Asia is getting boosted through international flights operating from the Mangalore airport. Dakshina Kannada district also has its share in the export of software from the state due to the presence of STPI, Mangalore and other major IT companies including Infosys. Following table depicts the details of items exported through New Mangalore port during 2010-11 and 2011-12.

2.4.11 Growth Trend

Increase in trade and commerce, development of service industries, IT-ITES clusters and Special Economic Zones are visible in the district in the recent years. A few chemical, engineering, automobiles and food processing units have been initiated in the district. The city of Mangalore in the district is undergoing a rapid economic change.

Several Special Economic Zones are emerging in the district. Mangalore Special Economic Zone (MSEZ) is designed as a multi product SEZ catering to petrochemical, manufacturing, service, trading and warehousing industry. The district is one among the few PCPIRs (proposed) (petroleum, chemicals and petrochemicals investment regions) in the county. Oil and Natural Gas Corporation (ONGC) Mangalore Refinery and Petrochemicals Limited. (MRPL) are planning mega investments in the region.

In IT/ITES activities too, the district is fast catching up with other major cities. IT major Infosys has established a large presence in the district. With increasing real estate costs in Bangalore, Mangalore has emerged as a prominent destination for development of IT industry. Keeping this in view, the Government of Karnataka (GoK) is facilitating development of IT Corridor and a Software Park in Mangalore. Infosys is setting up its IT SEZ near Konaje heralding the entry of other IT firms.

The district is fast emerging as an attractive real estate destination in Karnataka. There is boom in construction industry in the district. The district also has a potential to emerge as one of the largest domestic hospitality markets in South India, driven by the growth of the tourism sector and its strategic location as gateway to tourism in northern Karnataka.

2.4.12 Tourism

- **Mangaladevi Temple** is situated about 3 km from Mangalore. Goddess Mangaladevi is the presiding deity of this temple. The city owes the origin of its name to this deity. This temple was built in the 10th century century.
- **Alekan Falls** is an attractive waterfalls, noted for its picturesque locale. It is near Bale Kallu Gudda, one of the highest hills in the district. A winding scenic journey from Charmadi, 18 km away, takes to Alekan Waterfalls.
- **Dharmasthala** is a beautiful sacred island formed by the magnificent river Netravathi, famous for the ancient Manjunatha temple and the Sri Gomateshwara statue. This grand statue was carved out of a single stone to a height of 14 meter in the year 1973.
- **Ullal** is an enchanting beach marked by abundant fir trees. The Sayed Mohammed Shenphul Madani Mosque sanctifies this place. It is pilgrim spot as well as a good pic nic spot. It is situated 12 km from Mangalore.
- **Nethrani Island** is a small uninhabited island, 18 km southwest off a small fishing vil lage Murdeshwar Murdeshwar and is shaped like a upturned upturned boat with some vegetation vegetation along the rocky outcrop. The Island is famous for its Shiva tem ple and for having some of the best dive sites in world.

2.5 Demographic Feature of Dakshina Kannada (As per Census 2011)

2.5.1 Population

In 2011, Dakshina Kannada had population of 2,089,649 of which male and female were 1,034,714 and 1,054,935 respectively. In 2001 census, Dakshina Kannada had a population of 1,897,730 of which males were 938,434 and remaining 959,296 were females. There was change of 10.11 percent in the population compared to population as per 2001. In the previous census of India 2001, Dakshina Kannada District recorded increase of 14.59 percent to its population compared to 1991.

2.5.2 Density

The initial provisional data released by census India 2011, shows that density of Dakshina Kannada district for 2011 is 430 people per sq. km. In 2001, Dakshina Kannada district density was at 416 people per sq. km. Dakshina Kannada district administers 4,559 square kilometers of areas.

2.5.3 Literacy Rate

Average literacy rate of Dakshina Kannada in 2011 were 88.57 compared to 83.35 of 2001. If things are looked out at gender wise, male and female literacy were 93.13 and 84.13 respectively. For 2001 census, same figures stood at 89.70 and 77.21 in Dakshina Kannada District. Total literate in Dakshina Kannada District were 1,666,323 of which male and female were 864,019 and 802,304 respectively. In 2001, Dakshina Kannada District had 1,391,738 in its district.

2.5.4 Sex Ratio

With regards to Sex Ratio in Dakshina Kannada, it stood at 1020 per 1000 male compared to 2001 census figure of 1022. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 947 girls per 1000 boys compared to figure of 952 girls per 1000 boys of 2001 census data.

2.5.5 Child Population

In census enumeration, data regarding child under 0-6 age were also collected for all districts including Dakshina Kannada. There were total 208,297 children under age of 0-6 against 228,060 of 2001 census. Of total 208,297 male and female were 106,985 and 101,312 respectively. Child Sex Ratio as per census 2011 was 947 compared to 952 of census 2001. In 2011, Children under 0-6 formed 9.97 percent of Dakshina Kannada District compared to 12.02 percent of 2001. There was net change of -2.05 percent in this compared to previous census of India.

3 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

This bypass project is designed in such a way that it would have a minimum impact on environment. Most of the negative environmental impacts are related to construction works which are inevitable. The impacts during construction phase are mainly temporary or short term, whereas the impacts during operation stage will have long term effects. Most of these negative environmental effects can be 'design out' at an early stage through proper engineering designs, which will emphasize the contractors to follow environmentally friendly construction methodology and by applying proper environmental safeguard measures at site.

3.1 Impacts during Preconstruction Phase:

The environmental impacts associated with the pre construction stages mainly include impacts due to design and location of the project as well as site preparation for construction. The main issues involve in the preconstruction stage are acquisition of forest as well as private land and properties, tree felling, relocation of public utilities etc. Most of the impacts of preconstruction stage are permanent in nature. The anticipated impacts associated with the preconstruction stage and their mitigation measures have been presented in the Table below

Table: Anticipated Environmental Impacts due to the Proposed Bypass Project and their Mitigation Measures during Pre-construction Stage:

Environmental Components/ Issues	Impacts	Mitigation Measures
Acquisition of Land	Approximately 24 Ha of land will be required for acquisition to accommodate proposed bypasses.	The acquisition of land and private properties will be carried out in accordance with the RAP and entitlement framework for the project. Early identification of entitlement for Compensation and Advance planning of Resettlement And Rehabilitation Action Plan to Compensate the Losses. The Compensation will be paid in accordance with the MORTH Act and Policy and NPRR, Govt of India and will be decided by the Competent Authority of the State Government appointed by the MORTH. All the affected people will be compensated as per NPRR before commencement of Construction works
Acquisition of Properties	A few private structures (Approximately 10-15) will be required to be acquired either partially or fully. The structures include mainly residential. The exact numbers of structure shall be determined during social impact study.	
Resettlement and Rehabilitation of People	The total number of persons who will be affected due to acquisition of properties due to construction of bypass road shall be determined during social impact study.	

Environmental Components/ Issues	Impacts	Mitigation Measures
Trees	The total number of trees which will require to be felled due to construction of proposed bypass shall be determined during EIA study.	All efforts will be made to preserve trees by restricting tree cutting within the formation width. Special attention will be given for protecting giant trees, and locally important trees (having cultural importance). Trees will be planted in the ratio of 1:3 within the proposed ROW along the proposed bypass road as compensatory plantation by following MORTH Plantation Strategy.
Forest Area	Diversion of 22 Ha of Reserve forest area is envisaged	The forest area acquisition has been optimized by keeping minimum cut and fill section. The Forest Clearance will be obtained as per Forest Conservation Act and the compensation will be paid in accordance with the assessment of losses and cost of compensatory afforestation by the Forest Department as per Forest Conservation Rules.
Religious/Cultural Features	No Religious structure or cultural features shall be affected due to construction of proposed bypass.	If any relocation of structure is at all required, the relocation site will be decided with the consultation with local population and the related community users. Preference of the local community using the structure will be addressed during relocation/ renovation of such affected features.
Severance	Severance Problem	Required number of vehicular and sufficient nos. Pedestrian/cattle underpasses shall be provided for crossing the road for pedestrians, local/ village traffic and cattle to avoid severance problem.
Traffic Safety	Accident Hazards	During operation there will be provision of highway patrolling, ambulance and recovery vans to deal with emergency situations.
Temporary Access Roads	Temporary loss of forest land	Non bituminous access roads shall be planned in such a way to have a minimum length. It shall be connected to nearby rail stations (Kadagravelli, Yedakumai & Arbetta) where all machinery, material and manpower shall be transported through existing railway. Access roads shall be dismantled after construction and afforestation shall be carried out.
Dumping Yards	Temporary loss of forest land	Attempt shall be made to use excavated muck as a construction material as much as possible. Minimum required land shall be acquired temporarily and dumping shall be made after construction of proper retaining walls to avoid disturbance to forest land, Afforestation shall be carried out after construction and shall be converted to forest land.

3.2 Impact During Construction and Operation Phase:

During construction period the major environmental issues will be related

During construction period the major environmental issues will be related to dust generation, emission of gaseous emissions, borrow area and quarry operations, pollution due to operation of plants and equipments, contamination of land and soil, contamination of water bodies and public as well as workers health and safety. These anticipated impacts will mainly temporary and localised in nature and are likely to persist for short duration till the construction activities are over in a particular area. However there are some long term adverse impacts due to construction. These impacts however can be mitigated effectively through proper planning, scheduling and by application of environmental friendly construction practices. The likely impacts due to construction activities and operation of the project are explained along with the mitigation measures and institutional responsibility of implementation of environmental safeguards measures have been presented in the table below:

Table: Matrix of Potential Environmental Impacts and Mitigation Measures during Construction and Operation Stage

Environmental Issue/Attributes	Mitigation Measures	Location	Institutional Responsibility	
			Implementation	Supervision
Loss of Top Soil	Excavation will be done only to the pegged area for constructing the road.	Throughout the stretch	Contractor/ Concessionaire	IC and PIU, MORTH
	Agricultural areas will be avoided for borrowing of materials, unless requested by the land owner.	Borrow Sites	Contractor/ Concessionaire	IC and PIU, MORTH
	The topsoil from all areas of cutting and all areas to be permanently covered will be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding 2m.	Borrow sites, Quarry ,Plant site and construction zone	Contractor/ Concessionaire	IC and PIU, MORTH
	The stored topsoil will be spread back to maintain the soil physico-chemical and biological Characteristics.	Borrow areas, Quarry, Plant site and construction zone	Contractor/ Concessionaire	IC and PIU, MORTH
Compaction of Soil	Construction vehicles, machinery and equipment will move, or be stationed in the designated area, to avoid compaction of	Construction site and all ancillary	Contractor/ Concessionaire	IC and PIU, MORTH

Environ-mental Is-sue/Attrib utes	Mitigation Measures	Location	Institutional Responsibility	
			Implementa-tion	Supervi-sion
	soil.	sites		
	If operating from temporarily hired land, it will be ensured that the topsoil for agricul-ture remains preserved & not destroyed by storage, material handling or any other con-struction related activities.	Construc-tion site and all ancillary sites	Contractor/ Concessionaire	IC and PIU, MORTH
Borrowing of Earth	No earth will be borrowed from within the RoW	Borrow Areas	Contractor/ Concessionaire	IC and PIU, MORTH
	Non-productive, barren lands, raised lands, river beds, waste lands are recommended for borrowing earth.			
	If new borrow areas are selected, it will be ensured that there is no loss of productive soil, and environmental considerations will be met with.			
	If vehicles carrying materials from borrow areas are pass through villages, the exca-vation and carrying of earth will be done during day time only.			
	The unpaved surfaces used for the haulage of borrow materials will be maintained properly			
	Precautionary measures as the covering of vehicles will be taken to avoid spillage dur-ing transport of borrow materials.			
	To avoid any embankment slippages, the borrow areas will not be dug continuously, and the size and shape of borrow pits will be decided by the Engineer			
	Borrow pits will be redeveloped by filling and providing 150 mm thick layer of pre-served top-soil; or by creating a pond for fisheries, etc; or by levelling an elevated, raised earth mound and covering it with 150 mm thick preserved top-soil			

Environmental Issue/Attributes	Mitigation Measures	Location	Institutional Responsibility	
			Implementation	Supervision
	Replantation of trees in borrow areas will be carried out			
Stone Quarry	The quarry material will be obtained from licensed sites only, which operate with proper environmental clearances, including clearances under the Air Act or if Concessionaire wants to open a new Quarry he shall take all the requisite license from Dept. of Mines and Geology. For coarse aggregate excavated rock shall be used as much as possible if found suitable.	Quarry sites	Contractor/ Concessionaire	IC and PIU, MORTH
Soil Contamination from Fuel and lubricants	Impervious platform and oil and grease trap for collection of spillage from construction equipment vehicle maintenance platform will be appropriately provided at construction camp, servicing area and liquid fuel and lubes at storage areas.	Construction Camp, Vehicle and Equipment Servicing Centre and Construction site	Contractor/ Concessionaire	IC and PIU, MORTH
Soil Contamination from Construction waste and spoils	All spoils will be disposed off as desired and the site will be fully cleaned before handing over.	Construction site throughout the project stretch	Contractor/ Concessionaire	IC and PIU, MORTH
	The non-usable bitumen spoils will be disposed off in a deep trench providing clay lining at the bottom and filled with soil at the top (for at least 0.5m)			
Community water Source	Any community water source lost incidentally will be replaced immediately	Throughout the project stretch	Contractor/ Concessionaire	IC and PIU, MORTH
Drainage and run off	Earth, stones, wastes and spoils would be properly disposed off, to avoid blockage of any drainage channel.	Throughout the project stretch	Contractor/ Concessionaire	IC and PIU, MORTH
	All necessary precautions will be taken to construct temporary or permanent devices to prevent inundation or ponding.			
Contamina-	All necessary precautions will be taken to	Throughout	Contractor/	IC and

Environmental Issue/Attributes	Mitigation Measures	Location	Institutional Responsibility	
			Implementation	Supervision
tion of water from construction and allied activities	construct temporary or permanent devices to prevent water pollution due to increased siltation and turbidity.	the project stretch and allied sites including Construction camp and labour camp	Concessionaire	PIU, MORTH
	All wastes arising from the project will be disposed off, as per SPCB norms, so as not to block the flow of water.			
	Wastes must be collected, stored and taken to approved disposal site.			
Sanitation and waste disposal in construction camps	Garbage tanks and sanitation facilities will be provided at camps	Construction Camp	Contractor/ Concessionaire	IC and PIU, MORTH
	The construction camps will be located away from water sources.			
	Efforts will be made to provide good sanitary and sewage disposal facilities at camp to avoid epidemics			
	The workplace will have proper medical approval by local medical, health or municipal authorities.			
Use of water for construction	The Concessionaire will make arrangements for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected.		Contractor/ Concessionaire	IC and PIU, MORTH
	If a new tube-well is to be bored, prior sanction and approval by the Ground Water Department/ concerned authority will be obtained			
	Wastage of water during construction will be minimized.			
Emissions from Vehicles and Equipments	All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB norms.	Plant sites	Contractor/ Concessionaire	IC and PIU, MORTH
	The asphalt plants, crushers and the batching plants will be sited at least 0.50 km in the downwind direction from the nearest			

Environmental Issue/Attributes	Mitigation Measures	Location	Institutional Responsibility	
			Implementation	Supervision
	human settlement.			
Dust Generation	The hot-mix plants, crushers and batching plants will be sited at least 0.5 km down-wind from the nearest habitation. The hot mix plant will be fitted with dust suppression system.	Plant sites and Construction site	Contractor/ Concessionaire	IC and PIU, MORTH
	Water will be sprayed in the lime/cement and earth mixing sites, asphalt mixing site and temporary service and access roads.			
	After compacting, water will be sprayed on the earthwork regularly to prevent dust.			
	Vehicles delivering material will be covered.			
	Vehicles and machinery will be regularly checked to conform to the CPCB and NAAQ Standards			
	Mixing equipment will be well sealed and equipped with dust control removal devices			
	Workers at mixing sites will wear masks to reduce the chances of exposure to dust			
	Regular monitoring of PM10, PM2.5/SOx, NOx, CO,etc will be carrier out as mentioned in the Environmental Monitoring Plan			
Noise Generation from Construction vehicles and Machinery	The plants and equipment used for construction will strictly conform to CPCB noise standards.	Plant sites and Construction site	Contractor/ Concessionaire	IC, PIU, MORTH, State Pollution Control Board, Karnataka
	Vehicles and equipments used will be fitted with silencer and maintained accordingly.			
	Noise standards of industrial enterprises will be strictly enforced to protect construction workers from severe noise impacts.			
	Noise to be monitored (for 24 hrs.) as per monitoring plan			
Noise from Blasting	Blasting as per Indian Explosives Act will be adopted.	Quarry site	Contractor/ Concessionaire	IC, PIU, MORTH,

Environmental Issue/Attributes	Mitigation Measures	Location	Institutional Responsibility	
			Implementation	Supervision
Operation	People living near such blasting sites will have prior information of operational hours.			State Pollution Control Board, Karnataka
	Workers at blasting sites will be provided with earplugs			
Loss or Damage to Vegetation	Apart from trees earmarked for felling, no additional tree clearing within the RoW will be carried out.	Throughout the stretch	Contractor/ Concessionaire	IC, PIU, MORTH and Forest Dept.
	Area of tree plantation cleared will be replaced according to compensatory Afforestation Policy under Forest Conservation Act-1980.			
	Replantation of tree species along new ROW.			
	Plantation of shrubs and under trees in the median.			
	Effort will be made to save giant trees with girth size more than 2.5 m.			
Compaction of Vegetation	Construction vehicles, machinery and equipment will move or be stationed in the designated area only to prevent compaction of vegetation outside the RoW	Throughout the stretch	Contractor/ Concessionaire	IC, PIU, MORTH
	While operating on temporarily acquired land for storage, material handling or any other construction related or incidental activities, it will be ensured that the trampling of soil and damage to naturally occurring herbs and grasses is avoided.	Throughout the stretch		
Occupational Health & Safety	Adequate drainage, sanitation and waste disposal will be provided at workplaces.	Throughout the stretch	Contractor/ Concessionaire	IC, PIU, MORTH
	Proper drainage will be maintained around sites to avoid water logging leading to various diseases.			
	Adequate sanitation and waste disposal facilities will be provided at construction camps by means of septic tanks, soakage			

Environ-mental Is-sue/Attrib utes	Mitigation Measures	Location	Institutional Responsibility	
			Implementa-tion	Supervi-sion
	pits etc.			
	A health care system will be maintained at construction camp for routine check up of workers and avoidance of spread of any communicable disease			
Traffic Safety	To ensure safe construction in the tempo-rary accesses during construction, lighting devices and safety signal devices will be installed.	At Concret-ing snd plant sites	Contractor/ Concessionaire	IC, PIU, MORTH
	Traffic rules and regulations will be strictly adhered to.			
	Safety of workers undertaking various oper-ations during construction will be ensured by providing helmets, masks, safety gog-gles, etc			
	The electrical equipment will be checked regularly			
	At every work place, a readily available first aid unit including an adequate supply of dressing materials, a mode of transport (ambulance), nursing staff and an attending doctor will be provided.			
	Road safety education will be imparted to drivers running construction vehicles.			
	Adequate signage, barriers and persons with flags during construction to control the traffic will be provided.			
	If any valuable or invaluable articles such as fabrics, coins, artefacts, structures, or other archaeological relics are discovered, the excavation will be stopped and Archaeology Department will be intimated.			
	Construction camps blasting sites and all allied construction activities will be located at least 500 m away from the cultural prop-erty.			

Environmental Issue/Attributes	Mitigation Measures	Location	Institutional Responsibility	
			Implementation	Supervision
Harm to Wild life	Since work shall be carried out mainly within reserve forest area no harm to wildlife shall be tolerated. Proper barricade shall be made to restrict interference with the wild-life, if any.			
Operation Phase				
Contamination of Surface Water due to Traffic Movement & Accidents	Contingency Plans and proper drainage will be developed for clean up of oil spills, fuel and toxic chemicals	Throughout the project stretch	PIU, MORTH	PIU, MORTH
Air Quality Deterioration	Provision of Vegetative Screens		PIU, MORTH, State Forest Department	PIU, MORTH, State Forest Department
	Control of Vehicular emissions through law enforcement		Department of Transport	Department of Transport
	Truck parking, lay-byes to be provided in suitable areas		PIU, MORTH	PIU, MORTH
	Regular Monitoring			
Noise Pollution	Noise attenuating Tree Species to be planted along the road	Specially inhabitant location	PIU, MORTH	PIU, MORTH
	Posting of signs prohibiting the use of horns at settlement areas.			
	Noise barrier shall be designed and implemented in cut & fill sections for the protection to environment and wild life			
Accident Hazard and Safety	Provision of elaborate system of sign boards and road markings along the whole stretch	Throughout the Project Stretch	PIU, MORTH and State Police and Traffic	PIU, MORTH and State

Environmental Issue/Attributes	Mitigation Measures	Location	Institutional Responsibility	
			Implementation	Supervision
	Provision of suitable lighting arrangement at required locations		Department	Police and Traffic Department
	Development of Emergency Response and Contingency Plan for accidents			

3.3 Purpose of the Report

The purpose of the Environmental Impact Assessment (EIA) is to incorporate environmental concerns at the project level. EIA has been carried out at the project planning and design stage as part of Preliminary report to ensure that the project is environmentally feasible. The general objectives of EIA study are as follows:

(i) to provide information about the general environmental settings of the project area as baseline data;
(ii) to provide information on potential impacts of the project and the characteristic of the impacts, magnitude, distribution, the affected group and their duration;
(iii) to provide information on potential mitigation measures to minimize the impact including mitigation costs;
(iv) to assess the best alternative project at most benefits and least costs in terms of financial, social and environment; and
(v) to provide basic information for formulating management and monitoring plan.

The EIA will be prepared as the projects are likely to have moderate to minor impacts. The EIA will be structured in accordance with the requirements of the JICA/ADB.

4 OBJECTIVE AND SCOPE OF THE EIA REPORT

The scope of the EIA includes the following:

- To carry out assessment considering World Bank safeguard policies, 1999.
- Considering the MoEFCC guidelines on Highway project in EIA notification, 2006 and amendments.
- To carry out the preliminary environmental screening to assess the direct and induced impacts due to the project works;
- To assess and document baseline conditions relevant to the project with the objective to establish the benchmarks;
- To assess the potential positive and negative significant impacts due to the project and identify the cost effective mitigation measures to address these impacts adequately in the Envi ronmental Monitoring and Management Plan (EMMP);
- To do the analysis of alternatives incorporating environmental concerns and the associated costs in the economic analysis.
- To give special attention to the environmental enhancement measures in the projects for the following:
  - Provision of protection work in land slide prone zones;
  - Tree plantation along the project road;
  - Cultural property enhancement along the project roads;
  - Bus bays including a review of their location;
  - Traffic safety provisions like Guard post, Road Delineators, Metal Beam Crash Barrier along the Project roads, depending upon the site requirements, and
  - Re-development of the borrow, quarry areas located on public land.
  - Propose an effective muck management plan
- To prepare EIA report adequate public consultation and the recommendations arising there on.
- To identify all mitigation measures in he EIA and EMMP.
- To prepare the bill-of-quantities (BOQ) and technical specifications for all items of work on account of environmental enhancement measures in such a way that these may be readily integrated to the construction contracts.
- To provide additional inputs in the areas of performance indicators and monitoring mechnisms for environmental components during construction and operational phase of the pro ject.

To provide the cost of mitigation measures and to ensure that environmental related staffing, training and institutional requirements are budgeted in project cost.

4.1 Legal Requirements

NOC and Consents under Air, Water, EP Acts & Noise rules of SPCB for establishing and operating plants from SPCB. The NOC shall be made available after the SPCB completes the process of conducting Public Hearing of the project (which shall be carried out as per the Prior Environmental Clearance process)

- NOC under Hazardous Waste (Management and Handling) Rules, 1989 from SPCB
- PUC certificate for use of vehicles for construction from Department of Transport
- Quarry lease deeds and license and Explosive license from Dept. of Geology and Mines & Chief controller of explosives
- NOC for ground water extraction for construction and allied works from Ground Water\ Authority

Apart from the above clearances, the concessionaire also has to comply with the following:

- Clearance of Engineer for location and layout of Worker's Camp, Equipment yard and Storage yard.
- Clearance of Engineer for Traffic Management Plan for each section of the route after it has been handed over for construction.
- An Emergency Action Plan should be prepared by the contractor and approved by the Engineer for accidents responding to involving fuel & lubricants before the construction starts.
- Submit a Quarry Management Plan to the Engineer along with the Quarry lease deeds
- Submit a muck management plan to the Engineer along with the quantity and disposal

Various environmental regulations and policies of Government of India, state Government as well as World Bank's safeguard policies have been reviewed with respect to the proposed project activities. Based on the study, the requirements of various clearances and permits for different activities have been identified for the project as listed below.

Table: Acts and its objective

National Act	Year	Objective	Authority
Environment (Protection) Act and amendments	1986	To protect and improve the overall environment	MoEFCC, CPCB
Notification on Environment Impact Assessment of Development projects (and amendments) (referred to as the Notification on Environmental Clearance)	2006	To provide environmental clearance to new development activities following environmental impact assessment.	MoEFCC, CPCB, KSPCB, and State Environmental Impact Appraisal committee
Forest (Conservation) Act	1980	To protect and manage forests	MoEFCC, and State Forest Dept
Water (Prevention and Control of Pollution) Act (and subsequent amendments)	1974	To provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water.	CPCB, and KSPCB
Air (Prevention and Control of Pollution) Act (and subsequent amendments)	1981	To provide for the prevention, control and abatement of air pollution, and for the establishment of Boards to carry out these purposes.	CPCB, KSPCB, and Transport Department
The Hazardous Wastes (Management, Handling and Transboundary Movement)	2009	The rule provides prevention for mishandling of Hazardous Wastes and gives a process to control and transport the same.	MoEFCC, CPCB, and KSPCB

National Act	Year	Objective	Authority
Rules,			
The Municipal Solid Wastes (Management and Handling) Rules,	2000	The rule facilitates and provides methods to manage the Municipal Solid Wastes in an efficient and reusable manner.	MoEFCC, CPCB, and KSPCB
The Bio-Medical Waste (Management and Handling) Rules, and amendments	1998	Due to its contamination and hazardous nature the Bio-Medical Wastes to be handled and treated in compliance to the rules.	MoEFCC, CPCB, and KSPCB
E-waste (Management and Handling) Rules,	2011	Due to widespread use of electronic gadgets and equipments for industries and office complexes	MoEFCC, CPCB, and KSPCB
The Noise Pollution (Regulation and Control) Rules, and amendments	2000	Work place noise is covered under Indian factories Act, 1948 but this rule provides safety against noise in ambient condition with generation of noise by certain point and area source.	MoEFCC, CPCB, and KSPCB
Fly Ash notification	2007	Fly ash in construction activities, Responsibilities of Thermal Power Plants and Specifications for use of ash-based products/ responsibility of other agencies,	MoEFCC, CPCB, and KSPCB
Public Liability Insurance Act	1991	The main objective of the Public Liability Insurance Act 1991 is to provide for damages to victims of an accident which occurs as a result of handling any hazardous substance. The Act applies to all owners associated with the production or handling of any hazardous chemicals.	MoEFCC, CPCB, and KSPCB
The Chemical Accidents	1996	This rule ensures the prepared-	MoEFCC, CPCB, and

National Act	Year	Objective	Authority
(Emergency Planning, Preparedness and Response) Rules,		ness for the emergencies caused by chemical hazards.	KSPCB
Building and Other Construction Workers (Regulation of Employment and conditions of Service) Act.,	1996	To regulate the employment and conditions of service of building and other construction workers and to provide for their safety, health and welfare measure and for other matter connected therewith or incidental	Ministry of Labour and Employment
The Land Acquisition Act	2013	Set out procedures for acquisition of land by government	Land and Land Revenue Department
Central Motor Vehicle Act Central Motor Vehicle Rules	1988 1989	To control vehicular air and noise pollution. To regulate development of the transport sector, check and control vehicular air and noise pollution.	Motor Vehicle Department
Ancient Monuments and Archaeological sites and Remains Act	1958	Conservation of Cultural and historical remains found in India.	Archaeological Dept. GOI, Indian Heritage Society and Indian National Trust for Art and Culture Heritage (INTACH).

4.2 Triggered Safeguard Policies of the world bank

Safeguard Policies Triggered by The Project	YES	NO
OP 4.01 / BP 4.01 – Environment Assessment	[X]	[]
Natural Habitats (OP/BP 4.04)	[X]	[]
Pest Management (OP 4.09)	[]	[X]
Indigenous Peoples (OP/BP 4.10)	[X]	[]
Cultural Property (OPN 11.03, being revised as OP 4.11)	[X]	[]
Involuntary Resettlement (OP/BP 4.12)	[X]	[]
Forests (OP/BP 4.36)	[X]	[]
OP/BP 7.5 – Projects on International Waterways	[]	[X]
Projects in Disputed Areas (OP/BP 7.60)	[]	[X]

4.3 Methodology

The methodology used for this study is based on the procedures described in World Bank Environmental Assessment Guidelines of 1999, and MoEFCC's Environmental Impact Assessment Notification dated 14th September 2006 and amendments therein.

The Environmental Impact Assessment has been carried out using current ADB and Government of India guidelines, specifically:

- Project Terms of Reference (TOR) by MoRTH ;
- Environmental Impact Assessment Notification dated 14thSeptember 2006, Ministry of Environment and Forest (MoEFCC) and amendment, Government of India;
- The Environmental (Protection) Act, 1986 of Government of India;
- Environmental guidelines for Road/Rail/Highway Projects, 1989, Government of India;
- Handbook of environmental procedures & guidelines,1994, Government of India; and
- Guidelines for Environmental Impact Assessment of Highway Project (IRC:104-1988).

The methodology adopted includes the following work plan:

Activity 1: Submission of Inception Report with methodology

Technical Consultant including Environmental Specialist had a field visit, in July 2015, in order to get the team members appraised of the project background, present status, approach and methodology to be followed and sources of secondary data / reports.

Activity 2: Collection and Review of Relevant Documents

The environmental team will collect and review project parameters, including technical information, and design specification provided by engineering team.

Activity 3: Field Investigation

The environmental team will undertake a field environmental survey. Various environmental features of the project corridors will be observed and studied.

Activity 4: Ecological Investigation

The environmental team will undertake a field ecological survey. Various ecological features of the project corridors will be observed and studied.

Activity 5: Stake holders and Public Consultation

During field environmental survey, public consultations will be conducted to obtain the views of local people, project affected persons and local administrative representatives. Focused Group Discussion will be adopted as tool for the public consultation along with social team. The formats for the same is provided as Annexure 1.

Based on collected data and information, potential adverse environmental impacts will be identified and examined using standard "Checklist Method". Thereafter possible mitigation measures will be identified and on the basis of findings of impact appraisal comprising the key elements embodied in this EIA, an Environmental Management Plan (EMP) has been developed. Continued discussions undertaken with the executive agency and technical team of the consultant for integrating environmental management measures into the project.

5 BYPASS ALIGNMENT "OPTION – A"

Option - A is proposed on the Southern side of existing NH-48. The alignment starts at Heggade Km. 236.400 of NH-48 passes through Greenfields, bypasses Adda Hole, Maranhally Kadagaravalli, Yedakumari, Gundya, Arebetta villages and ends at Adda Hole Km 263.400 of NH-48,. The total length of alignment under this option is 23.579 Km, and the route consists of 6 tunnels (length: 1700~ 2900m), 6 bridges (length: 50~ 1300m), One viaduct (length 3280 m) and approach roads to the structures. The route has low gradient (roads & bridges: 0.0~ 3.5%, tunnels: 3.0~ 3.5%) and gentle curves (R=500~ 2000m). Locally a very few curves have radius of 300 m. The height of bridge piers in the deep valleys is limited to less than 100m that makes the early implementation of the project possible. Also, tunnel structures are limited up to 3.0km that allows traffic of all the types of vehicles and makes the scale of ventilation/emergency facilities ordinary size. Additionally, 4.1km out of total route length of 23.579km was planned as roads to be constructed by "cut and fill" that requires deforestation of the construction area.

Terrain

In general, the terrain can be classified as Rolling and Hilly terrain. The general ground elevation varies along the proposed alignment from 860 to 150 m above sea level.

Carriageway & Shoulder

The typical cross section for the proposed bypass comprises of Four (2x Two) Lane carriageway with each lane of 3.5m widths separated by varied median/ gap 2.5m to 30m. Apart from this, paved shoulder of 1.5m and Gravel shoulder of 1.0m wide is proposed. The proposed roadway is 12m for each road.

High Level Bridges

The typical cross section for the proposed high level bridges comprises of two separated 2 lane bridges with 3.5m lane width separated by varied gap between two crash barriers from 2.5m to 30m. Apart from this, paved shoulder of 1.5m and foot path of 1.5m wide is proposed on each sides. The total width of each bridges from crash barrier to crash barrier is 12m.

Tunnels

The typical cross section for the proposed tunnels comprises of twin cell box tunnels separated 3 lane tunnel including 1 lane emergency lane of lane width 3.5m each separated by varied gap of 20m to 30m. Apart from this, foot path and drain of 1.5m wide is proposed on each sides. The total width of each tunnel cell box is 14m. There are 7 tunnels proposed

Land use

Option - A passes predominately through reserve forest areas on both sides. There are little areas of coffee plantation & agricultural land at start and end of the project. A few locations alignment crosses existing Bangalore- Mangalore railway line from below through tunnel and in one location above railway line through ROB.

Built up Areas

Option - A alignment generally avoids built-up areas.

Horizontal Alignment

Option - A takes off at Km. 236.400 near Heggade village on the southern side of existing NH-48. The alignment proceeds in the west-south direction, avoiding built-up areas, and crosses the SH-114 at Gundya. The alignment then passes west north of Shiradi Ghat and joins the existing NH-48 at 263.400 near Adda Hole village, thus the length of the proposed alignment is 23.579 km. Overall the Horizontal alignment can be designed for fairly good Geometry at design speed of 100 to 80 km/hr predominately.

Vertical Profile

In general, the terrain can be classified as Rolling at starts & end, and Hilly & Mountainous all along the proposed bypass alignment, vertical Geometry can be designed fairly as per the standards of Indian Road Congress (IRC). The alignment is designed in such a way that the maximum longitudinal gradient is kept 3.5% for tunnels, 3.5% for High Level Bridges and 3.5% for road approaches. However, the vertical profile will be further refined and re-designed for maximum 3% gradient at tunnels; 1 % at bridges and 5% at road approaches during detailed design stage.

Forest Area

There is reserve forest area for almost full length along the proposed alignment.

River Crossing

Yerevatti River is crossing the proposed alignment near railway line crossing. Hence, RoB and River bridges will be proposed at these crossing. Kempu hole river is running parallel to existing road NH-48 and Railway line. One Bridge is proposed on this river after proposed flyover on SH-114 crossing, near to Gundya, end of the bypass.

Submergence Area

There are no submergence areas along the proposed bypass alignment. Bridges are proposed over the existing rivers, valley and nalla.

Major and Minor junctions

The proposed alignment crosses one State Highway SH-114 about 800m distance from T-Junction with NH-48.

Viaduct/Flyover

In order to provide safe and efficient access from the project highway to other cross roads and vice versa, a Viaduct/Flyover is proposed with slip roads on SH-114 crossing.

Rail Over Bridges

One ROB' is required in this option at km 54.650 of the existing railway line, hence proposed.

Bus Bays

As it is a proposed bypass, no existing bus bays are envisaged due to no human settlement exist along the proposed alignment. However Bus Bays are proposed near to existing railway stations for better rail and road connectivity.

Right of Way (ROW)

It is proposed to have 60m ROW, 30m on either side of the proposed centre line of the alignment. At Tunnel and bridges locations the right of way will be needed only during construction period of 5 years. 20m to 40m space between two carriageways will not be disturbed to the maximum extent.

Effect on Existing Railway Line

This alignment is running near the existing railway track. Some where it is laterally as well as vertically 40-50m from the existing track. The alignment is designed in such a way that at least 2-D distance of tunnel tube is maintained at such locations. Instrumentation & Monitoring of railway tracks shall be proposed during tunnel construction below existing railway line.

Utilities along the Project Highway

Utilities such as overhead/ underground electrical, telephone cables and OFC may be required for tunnels and other locations along the project highway. These will be aligned suitably either side of the ROW.

Religious Structure & Private Property Buildings

There is no religious structure along the proposed alignment. The alignment is designed in such a way to minimum effect of private property buildings at start and end of the project.

Road Safety

Project Bypass being a high speed facility, Road safety is of paramount importance. Hence, road safety will be incorporated in the design stage itself. Necessary signage, pavement markings, crash barriers, blinkers etc will be incorporated at appropriate locations.

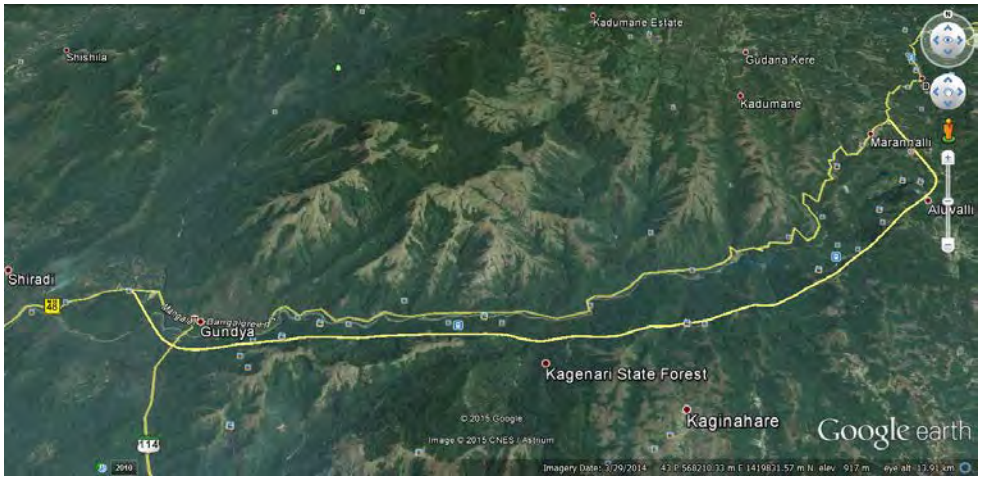

Fig. Proposed Alternative Alignment Option A

A summary of alignment features of Option “A” has tabulated below:

Table: Alignment Features of Alignment "Option A"

Sl	Length (m)	Type of Structure	Geometry	Gradient %
1	2320	Cut & Fill	St/Curve	3.5
2	300	ROB & CD	St/Curve	3.0
3	2958	Tunnel -1	St/Curve	3.5
4	88	Cut & Fill	St/Curve	3.5
5	50	Bridge-1	St/Curve	3.5
6	83	Cut & Fill	St/Curve	3.5
7	2129	Tunnel -2	Straight	3.5
8	82	Cut & Fill	St/Curve	3.5
9	1090	Bridge-2	St/Curve	0.0
10	89	Cut & Fill	St/Curve	3.5
11	2140	Tunnel -3	St/Curve	3.5
12	73	Cut & Fill	St/Curve	3.5
13	50	Bridge-3	St/Curve	3.0
14	144	Cut & Fill	Straight	3.5
15	1872	Tunnel -4	Straight	3.25
16	185	Cut & Fill	St/Curve	3.5
17	1020	Bridge-4	St/Curve	0.0
18	97	Cut & Fill	St/Curve	3.5
19	1660	Tunnel -5	St/Curve	3.5
20	500	Cut & Fill	St/Curve	3.5
21	100	Bridge-5	Straight	3.5
22	521	Cut & Fill	Straight	3.5
23	150	Bridge-6	St/Curve	3.5
24	54	Cut & Fill	St/Curve	3.5
25	1901	Tunnel -6	St/Curve	3.5
26	706	Cut & Fill	St/Curve	3.5
27	3217	Viaduct	St/Curve	3.5
24	7050.000	Access Road	St/Curve	3.5

6 ENVIRONMENTAL BUDGET

Environmental Management Plan will be prepared as part of detailed EIA study and is intended to become a part of the contract documents so that implementation of all the environmental measures can be ensured. The implementation actions, responsibilities and timeframes will be specified for each component and adverse impact anticipated. The cost of implementing above mitigation measures during the construction stage works out to Rs. 1.02 Crores. The operational cost of the same is estimated at Rs. 4.85 lakhs during the first two years. The cost estimates are presented in **Table**.

Table: Estimation of Environmental Management Plan Cost

Description	Unit	Quantity	Rate(Rs.)	Amount(Rs.)
A. Annual Cost During Construction Phase during Five Years				
1.Compensatory avenue plantation of twice the number of trees to be cut and their fencing and maintenance for five years	No.	15,000	400	60,00,000
2.Shrub plantation@500 saplings (single row) per Km for the cut and fill section and their fencing and maintenance for five years	No.	100	15000	15,00,000
Environmental Monitoring				
3.1. Air Quality Monitoring at 15 sensitive locations for three seasons for 5 consecutive years	No.	70	12,000	8,40,000
3.2. Water Quality Monitoring at 5 locations for two seasons for 5 consecutive years	No.	50	3,000	1,50,000
3.3. Noise Monitoring at 15 sensitive locations for three seasons for 5 consecutive years	No.	75	1000	75,000
3.4. Soil Quality Monitoring at 9 sensitive locations for two seasons for 5 consecutive years	No.	45	3,000	1,35,000
3.5. Mobilisation Charges for 3 seasons for 5 years	No.	15	75,000	11,25,000
4. Dust Suppression at Site(6 trips/day for 365 days for 5 years)	No.	150	1000	1,50,000
5. Severances & Others (including training, workshops, awareness campaigning etc.)		Lump sum		50,000
6. Two Rainwater Harvesting Structures per 5 Kilometer for 24km	No.	5	40,000	2,00,000

Description	Unit	Quantity	Rate(Rs.)	Amount(Rs.)
Total cost during construction phase				1,02,25,000
B. Annual Cost During Operational Phase during First Two Years				
1. Environmental Monitoring				
1.1. Air Pollution Monitoring at 15 sensitive locations for 3 seasons for first two years	No.	37.25	12,000	4,47,000
1.2. Noise Monitoring at 15 sensitive locations for 3 seasons for first two years	No.	37.5	1000	37,500
Total cost during Operation phase				4,84,500
Total Cost (A+B)				**1,07,09,500**
Contingency (10%)				**10,70,950**
Total				**1,17,80,450**

7 STRUCTURE OF THE EA REPORT INCLUDING EMP

In this section we are presented the Structure of EA Report including EMP which we will be submitted in KD7: Draft Detailed Project Report.

7.1 Contents

1. Introduction

- Purpose of the report
- Identification of project & project proponent
- Brief description of nature, size, location of the project and its importance to the country, region
- Scope of the study – details of regulatory scoping carried out (As per ToR)

2. Analysis of Alternatives (Technology & Site)

- Description of each alternative
- Summary of adverse impacts of each alternative
- Mitigation measures proposed for each alternative and selection of alternative

3. Project Description

- Type of project
- Need for the project
- Location (maps showing general location, specific location, project boundary & project site layout)
- Size or magnitude of operation (incl. Associated activities required by / for the project)
- Project Development Plan and land use suitability analysis.
- Project phasing and development strategy
- Project description including drawings showing project layout, components of project etc. Schematic representations of the feasibility drawings which give information important for EIA
- Description of mitigation measures incorporated into the project to meet environmental standards, environmental operating conditions, or other EIA requirements

4. Description of Environment

- Study area, period, components & methodology
- Establishment of baseline for VECs, as identified in the scope
- Base maps of all environmental components

Impact assessment and Mitigation measures

- Details of investigated environmental impacts due to project location, possible accidents, project design, project
- construction, regular operations, final decommissioning or rehabilitation of a completed project
- Measures for minimizing and / or offsetting adverse impacts identified

- Irreversible and irretrievable commitments of environmental components
- Assessment of significance of impacts (Criteria for determining significance, assigning significance)
- Mitigation measures

5. Environmental Monitoring Program

- Technical aspects of monitoring the effectiveness of mitigation measures (incl. measurement methodologies, frequency, location, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules)

6. Additional Studies

- Social Impact Assessment; R&R issues
- Public consultation
- Corporate Social Responsibility
- Disaster management Plan including Emergency evacuation plan.

7. Project Benefits

- Improvements of environmental condition
- physical infrastructure
- Improvements in social infrastructure
- Employment potential –skilled; semi-skilled and unskilled
- Other tangible benefits

8. Environmental Management Plan

- Description of administrative aspects that ensures proper implementation of mitigative measures and their effectiveness monitored, after approval of the EIA
- Environmental Cost and Budget

9. Summary & Conclusion (Constitute the summary of the EIA Report)

- Overall justification for implementation of the project
- Explanation of how, adverse effects have been mitigated

7.2 Data Collection

For the data collection we will be three types of form which is mentioned below:

- Secondary Data Checklist For EIA
  (Annexure J1 of QAP Attached)
- Environmental Survey Checklist For EIA
  (Annexure J1 of QAP Attached)

--------End of Main Document----------

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Sr. No.	Topic	Pages
1	Secondary Data Checklist for EIA	2
2	Environmental Survey Checklist for EIA	1

ANNEXURE - 1

Secondary Data Checklist for EIA

A. SECONDARY DATA CHECKLIST FOR EIA

S. No.	Data Base
1.	**General** • Base Map at City Level showing administrative boundaries • Route map with surrounding features • Environmental Protection Administrative Mechanism in Karnataka.
2.	**Climate** • wind roses for last 5 years • rainy days, annual average rainfall, monthly maximum, min and avg. rainfalls for last 5 years • mean, maximum and minimum monthly temperatures for last 5 years • relative humidity ranges, inversion
3.	**Socio-economic profile** • Demography/Census handbook • Short term and long term migrations due to project • Economic activities Location(latitude, longitudes of city & route & Route Map) • Area of land to be acquired • Details of properties to be affected
4.	**Geology** • Soil type, Soil depth, • Geological formation type, Depth of rock bed • Faults and fissures • Earthquakes frequency
5.	**Drainage** • Drainage map
6.	**Surface Water** • Location of wetlands, lakes, streams, rivers and their uses • Drinking water sources of City • Water Quality of Lakes, Rivers, Streams, Nalas near proposed maintenance workshops • Water Demand and Sources • Surface water flow in stream/river crossings
7.	**Ground Water** • Ground Water Depth • Quality
8.	**Traffic Volume count** Mode wise on all intersections and road stretches along the route
9.	New or Diversion of transmission & pipelines
10.	**Natural Resource & Energy Consumption** • Quantity of Energy – Electricity(MW) and fuels(MT) to be consumed • Soil filling needed • Water to be consumed • Timber/wood requirement • Consumption of Stone aggregate, Sand, Cement, glass, bricks, steel and other construction materials • Mineral resource consumption
11.	**Waste Generation** • Estimated wastewater generation • Estimated solid waste generation

	• Hazardous substances to be used for construction • Estimated Hazardous wastes to be generated from project activities • Estimated overburden waste • Estimated demolition and construction waste
12.	**Air Pollution** • Existing ambient air quality monitoring data of SPCB (if available)
13.	**Potential Health hazards and Accident Risks** • Existing health issues • Potential group of people to be affected by project viz. hospital patients, children, elderly etc.
14.	**Impact on Flora Fauna** • Area of forest land to be cleared • No. and species of trees to be cut • Type of vegetation to be cleared • Distance of Wetlands, Rivers/water courses, sites of migratory birds and animals • Protected, Rare, Important birds & animals reserve and list of species near project site
15	**Impact on Cultural, heritage, monuments and Sensitive landuses** • Distance & name of Protected and Notified monuments of National, State and Local Level importance from road • Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals) • Distance of Wildlife reserve, Flora fauna breeding ground, River/streams, Ecopark, mountains, biodiversity reserve, agriculture research station, garden, zoo, park etc. from road • Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas • Defence installations • Densely populated or built-up areas along route • City Areas already Polluted viz. Ground Water, drains, river, lakes and critically air polluted areas as per standards • Areas susceptible to natural hazards viz. earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions • Frequency and scale of earthquakes, subsidence, erosion, flooding etc.
16.	**Landuse** • Location major existing commercial areas
17.	**Aesthetic Environment and urban design** • Existing built form • Congestion
18.	**Existing Institutional structure for environmental management in city**

ANNEXURE - 2

Environmental Survey Checklist for EIA

B. ENVIRONMENTAL SURVEY CHECKLIST FOR EIA

S. No.	Data Base
1.	**Sensitive landuses** • Name & Distance of hospitals, schools, places of worship, community facilities from road
2.	**Physiography** • Route Levels & Contours upto 500m from road • Building lines and built areas to be demolished • Land acquisition requirement • Surrounding landuses within 500m of carriageway
3.	**Vegetation** • Distance of Forest land (if any on route) and it's type • Forest land area & location to be acquired(if any) on map • Agricultural land to be acquired, single cropped or double cropped (if any) location on map • Name, number of trees with girth size on route
4.	**Surface Water** • Distance of Water bodies from route • Flood prone areas along route • Flood plain of river
5.	**Drainage** • Drain/Stream crossings locations • Width & depth of drains across route • Depth of flow in drains and streams
6.	**Air Quality on Route** • Levels of SPM, RSPM, SO_2, NO_2 , CO along route (sampling to be done according to major traffic variations along route) • Noise levels along route(sampling to be done according to major traffic variations along route)

Prepared for:

सड़क परिवहन और राजमार्ग मंत्रालय
MINISTRY OF ROAD TRANSPORT & HIGHWAYS

Karnataka
Public Works, Ports & Inland Water Transport Department

Project:

Consultancy Services for "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.000 to 261.450 on NH-48 in the State of Karnataka"

Subject:

KD-6 - Draft Detailed Project Report for Final Approved Alignment for Bypass

Volume - IV(b): Resettlement Action Plan

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Revision History

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INTRODUCTION

This report is prepared under Contract Agreement clause 2.8; "Key Date No: KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)" after incorporation of Client's observations on earlier submitted "KD5: Kucha Draft Detailed Project Report (KDDPR)" vide letter no. NH/PIU-Tunnel/NH-48/KD-3/2015-16/383-386 dated 14.12.2015.

The present submission (10 Hard Bound Sets and 5 Soft Copies of each) is as detailed below:

(i) Volume-I, Main Report:

- *Executive summary*
- *Project Description*
- *Socio Economic Profile*
- *Materials Surveys and Investigation*
- *Traffic Surveys and Analysis*
- *Design Standards and Specifications*
- *Alignment Proposals*
- *Summary of EIA/IEE and Action Plan*
- *Summary of Resettlement Plan*
- *Preliminary Cost Estimates*
- *Preliminary Economic Analysis*
- *Preliminary Financial Analysis*
- *Suggested Methods of procurement and packaging*
- *Conclusions and Recommendations*
- *Acknowledgement*
- *Compliance of the Observations*

The basic data obtained from the field studies and investigations and input data used for the detailed engineering design (if any) shall be submitted in a separate volume as an Appendix to Main Report.

(ii) Volume – II : Design Report

Part- I Traffic Study, Analysis and Forecast :

- *Description of Existing Road in Ghat Section*
- *Road and Bridge Inventory*
- *Traffic Surveys, analysis and forecast*
- *Proposed Pavement Design*

Part-II Design of Tunnels :

- *Proposed Tunnel Design, Standards*
- *Structural Analysis- Primary Lining*

Part-III Design of Bridges and Cross-Drainage Structures :

- *Proposed Bridges and Structures Design Basis and*
- *Bridges Dimensioning*

Part-IV Geological Design and Geotechnical Report :

- *Geological Survey and Analysis*
- *Geotechnical Investigations Report*

(iii) Volume-III Materials Report :

(iv) Volume - IV(a) Environmental Assessment Report including Environmental Management Plan (EMP) &

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i. *Viaducts – General Arrangement Plan and L-Section*
j. *Cut & Fill and Viaducts – General Arrangement Plan and L-Section*
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n. *Indicative Land Acquisition Plans*
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(xi) Volume - X Civil Work Contract Agreement :
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Volume – IV (b): Resettlement Action Plan (RAP)

A. General

This Volume - IV(b): Resettlement Action Plan (RAP) Report, a part of "KD 6: Draft De tailed Project Report for Final Approved Alignment for Bypass (DDPR)" is submitted in accordance with the Contract Agreement and as per requirement specified in Terms of Reference (ToR) for preparation of Resettlement Action Plan (RAP) of "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH-48 in the State of Karnataka".

1 GENERAL

The section of National Highway – 48 Bangalore – Mangalore road between Maranahally (km 238.00) and Gundya (km 261.450) runs in deep mountain and valleys are called Shiradi Ghat. The average rain fall is of 6000 mm to 7000 mm per year. The topography changes up to approximately 700 mtrs over a length of 26.00 km. The Shiradi Ghat of NH-48 is very steep and comprised of many hairpin bends. The road is being closed every year during monsoon for certain period due to earth slips. Due to rugged terrain and difficult Geomorphology the widening of the road is not easy. The tremendous in VPD has been causing strenuous for smooth plying of vehicles and maintenance of the road. Further, Shiradi Ghat is a highly eco-conscious forest reservation are. This stretch of road may be got reduced by constructing 4-lane new Bypass [two tubes of 2+1(emergency lane) tunnels, 4-lane bridges, number of lane and lane width have been designed considering the current traffic intensity and projected traffic volume for 20 years] comprising of four lane road. High rise pier Bridges with long arch span to negotiate deep valleys and Tunnel road to cross mountain ranges. The total length of road between Maranahally and Gundya could be reduced to 23.6km as against 26.0km. It is proposed to link this stretch of 4-lane Bypass to entire Bangalore – Mangalore expressway which is proposed to be widen as 4-lane road throughout.

2 EXISTING CHARACTERISTICS OF THE PROJECT ROAD

The terrain on this Ghat section of 23km can be termed as hilly and mountainous. The abutting land use pattern varies from residential to agricultural and forest area. Sparingly industrial land also is observed along with barren lands. Almost throughout the ghat section of the Project Highway, very few human settlements were observed along the road. They were as semi built-up and completely built-up areas. The settlements are mainly residential, commercial, religious places viz temple, masjid/mosque, church and petrol stations. The river Kempu hole runs almost parallel to the road on left side along the entire Ghat section. Important crops grown are coffee, Black Pepper, Potato, Paddy and Sugarcane. Three mini hydel power station is located at the Ghat section to the left of the highway.

Important places and villages are Heggade, Maranhally, Kempuhole, Gundiya, and Adda hole along the Project stretch. The existing road is having two lane undivided carriageway width of 7.0 m of flexible & newly laid rigid pavement and predominantly gravel/earthen shoulder of 1.0m to 2.0m width.

The existing road is having two lane undivided carriageway width of 7.0 m of flexible pavement with predominantly earthen shoulder and paved shoulder at few locations of width varying from 1.0m to 1.5m. The horizontal geometry of the Project road doesn't meet IRC standards with respect of design speed, pavement surface condition, riding quality etc. It has many sharp and substandard curves; the stretches passing through ghat sections have sharp curves with design speed of less than 30kmph. All major utility providers have cables running throughout the project road on both sides.

The State PWD had successfully completed the improvement and reconstruction work of the badly damaged bituminous pavement by providing cement concrete pavement from km 238 to km 250 in 2015; and taking up balance section from km 228 to km 238 and km 250 to km 263 shortly.

2.1 The Project Area

The project road passes to Dakshin Kannada and Hassan District. In this project road, Heggade, Maranhally, Aluvalli, Yadekumari, Kagenari State forest and Gundya village are coming along the proposed road and Tunnel.

3 SOCIAL IMPACT ASSESSMENT

'Social Impact Assessment (SIA) includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment.

Social Impact Assessment of the project is an important component of project preparation. The Right to Fair Compensation and Transparency in Land Acquisition and Rehabilitation and Resettlement Act, 2013; project specific R&R Policy as approved by GoUP and World Bank policy require social impact assessment during the design stage to avoid, reduce and mitigate potential negative impacts of project action and enhance positive impacts, sustainability and development benefits.

Assessment results are considered with technical and economic feasibility findings in the final selection of roads to be rehabilitated. The assessments also contribute to engineering design and result in the preparation of social action plans governing project implementation and the resettlement and rehabilitation of those who may be displaced by road improvements.

The main goals of social analysis is to put forward a sustainable and socially relevant design for highway improvement, whereby the displacement is minimized and wherever done, affected persons are suitably rehabilitated. In order to fulfill this goal, the main objectives of the social screening are:

3.1 Encroachment

To undertake a preliminary evaluation of the highway with the objective of identifying and assessing the area specific issues related to anticipated residential, commercial, cultural and industrial encroachments within ROW and also to explore alternative project designs so that the displacement because of the project is minimized.

3.2 Loss Estimation

To estimate various kinds of losses (Land and other movable and immovable assets), deprivation of social facilities, cultural conflicts and identify vulnerable groups who may be displaced resulting from highway widening and strengthening; identify the most critical/problematic locations of the project that may cause displacement and resettlement of the people.

4 FRAMEWORK DEVELOPMENT FOR THE PREPARATION OF LAND ACQUISITION PLAN AND RESETTLEMENT PLAN

The proposed road intervention is being carried by MoRTH. Land free from all encumbrances to contractors will be given for the construction and maintenance of road. For this purpose following activities are required to be carried out:

(a) Land acquisition as National Highway Act 1956

(b) R&R Framework as per The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013

(c) Institutional arrangement for R&R implementation.

4.1 Identification of Impact

In this project most of the alignment passes through forest land but only few location land acquisition will be require for approach road. These impacts are analyzed in detail in social assessment report.

5 RESETTLEMENT POLICIES AND LEGAL FRAMEWORK

5.1 Key Social Laws and Regulations

This section presents the legal framework for the land acquisition process and the Resettlement and Rehabilitation Policy which also includes the entitlements for affected eligible families. Project has developed Resettlement and Rehabilitation Policy based on the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013; World Bank's OP 4.12 and various government orders issued by state government for issues related to R&R. The policy recognizes the need to support restoration of livelihoods of adversely affected people and lays down norms for rehabilitating the affected people and broadly outlines an approach and institutional framework to achieve its objectives. The key Social regulations and legislations that will govern then preparation and implementation of the project is presented below.

Table 1: Relevant Social Legislations

Acts/Rule/Policy	Year	Objective	Responsible Agency
Ancient Monuments and Archaeological Sites and Remains Act	1958	Conservation of cultural and historical remains found in India.	Archaeological Dept. GOI, Indian Heritage Society and Indian National Trust for Art and Culture Heritage (INTACH).
Right to fair compensation and transparency in land acquisition, rehabilitation and Resettlement Act	2013	Fair compensation for acquisition of immovable assets; Resettlement of displaced population due to LA and economic rehabilitation of all those who are affected due to land acquisition.	Revenue Department. Govt. of Karnataka
The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act	2006	Grants legal recognition to the rights of traditional forest dwelling communities, partially correcting the injustice caused by the forest laws. Makes a beginning towards giving communities and the public a voice in forest and wildlife conservation	Ministry of Tribal Affaires, GOI and Department of Tribal Welfare,

5.2 World Bank Safeguard Policies

Projects financed with IDA resources need to comply with World Bank Operational Policies. The World Bank has Environmental and Social Safeguard Policies to reduce or

eliminate the adverse effects of development projects. The safeguard policies of World Bank are provided in the table below.

Table 2: Safeguard Policies of World Bank

World Bank Safe Guard Policies	Objective
OP/BP 4.12	Involuntary Resettlement-The objective of this policy is to avoid or minimize involuntary resettlement where feasible, exploring all viable alternative project designs. Furthermore, it intends to assist displaced person in improving their former living standards; community participation in planning and implementing resettlement; and to provide assistance to affected people, regardless of the legality of title of land
OP 4.10	Indigenous People -This policy aims to protect the dignity, right and cultural uniqueness of indigenous people; to ensure that they do not suffer due to development; that they receive social and economic benefits
OP/BP 4.11	Cultural Property –This policy aims at assisting in the preservation of cultural property, historical, religious and unique natural value-this includes remains left by previous human inhabitants and unique environment features, as well as in the protection and enhancement of cultural properties encountered in Bank financed project.

5.3 National Highways Act 1956

Land for construction of a new highway or upgradation /widening is acquired using the NH Act 1956. Key provisions relating to acquisition are as follows:

A. *Power to Acquire Land, etc.*

(1) Where the Central Government is satisfied that for a public purpose any land is required for the building, maintenance, management or operation of a national highway or part thereof, it may, by notification in the Official Gazette, declare its intention to acquire such land.

(2) Every notification under sub-section (1) shall give a brief description of the land.

(3) The competent authority shall cause the substance of the notification to be pub lished in two local newspapers, one of which will be in a vernacular language.

B. ***Declaration of Acquisition.***

(1) Where no objection under sub-section (1) of section 3C has been made to the competent authority within the period specified therein or where the competent authority has disallowed the objection under sub-section (2) of that section, the competent authority shall, as soon as may be, submit a report accordingly to the Central Government and on receipt of such report, the Central Government shall declare, by notification in the Official Gazette, that the land should be acquired for the purpose or purposes mentioned in sub-section (1) of section 3A.

(2) On the publication of the declaration under sub-section (1), the land shall vest absolutely in the Central Government free from all encumbrances.

(3) Where in respect of any land, a notification has been published under subsection (1) of section 3A for its acquisition but no declaration under sub-section (1) has been published within a period of one year from the date of publication of that notification, the said notification shall cease to have any effect: Provided that in computing the said period of one year, the period or periods during which any action or proceedings to be taken in pursuance of the notification issued under sub-section (1) of section 3A is stayed by an order of a court shall be excluded.

(4) A declaration made by the Central Government under sub-section (1) shall not be called in question in any court or by any other authority.

C. ***Power to take Possession.***

(1) Where any land has vested in the Central Government under sub-section (2) of section 3D, and the amount determined by the competent authority under section 3G with respect to such land has been deposited under sub-section (1) of section 3H, with the competent authority by the Central Government, the competent authority may by notice in writing direct the owner as well as any other person who may be in possession of such land to surrender or deliver possession thereof to the competent authority or any person duly authorised by it in this behalf within sixty days of the service of the notice.

(2) If any person refuses or fails to comply with any direction made under subsection (1), the competent authority shall apply-

(a) in the case of any land situated in any area falling within the metropolitan area, to the Commissioner of Police;

(b) in case of any land situated in any area other than the area referred to in clause (a), to the Collector of a District, and such Commissioner or Collector, as the case may be, shall enforce the surrender of the land, to the competent authority or to the person duly authorised by it.

D. ***Determination of amount payable as compensation***

(1) Where any land is acquired under this Act, there shall be paid an amount which shall be determined by an order of the competent authority.

(2) Where the right of user or any right in the nature of an easement on, any land is acquired under this Act, there shall be paid an amount to the owner and any other person whose right of enjoyment in that land has been affected in any manner whatsoever by reason of such acquisition an amount calculated at ten per cent. of the amount determined under sub-section (1), for that land.

(3) Before proceeding to determine the amount under sub-section (1) or sub-section (2), tbe competent authority shall give a public notice published in two local newspaper, one of which will be in a vernacular language inviting claims from all persons interested in the land to be acquired.

(4) Such notice shall state the particulars of the land and shall require all persons interested in such land to appear in person or by an agent or by a legal practitioner referred to in sub-section (2) of section 3C, before the competent authority, at a time and place and to state the nature of their respective interest in such land.

(5) If the amount determined by the competent authority under sub-section (1) or sub-section (2) is not acceptable to either of the parties, the amount shall, on an application by either of the parties, be determined by the arbitrator to be appointed by the Central Government.

(6) Subject to the provisions of this Act, the provisions of the Arbitration and Concilia tion Act, 1996 (26 of 1996) shall apply to every arbitration under this Act.

(7) The competent authority or the arbitrator while determining the amount under sub-section (1) or sub-section (5), as the case may be, shall take into considera tion

(a) the market va]ue of the land on the date of publication of the notification under section 3A;

(b) the damage, if any, sustained by the person interested at the time of taking pos session of the land, by reason of the severing of such land from other land;

(c) the damage, if any, sustained by the person interested at the time of taking pos session of the land, by reason of the acquisition injuriously affecting his other immovable property in any manner, or his earnings;

(d) if, in consequences of the acquisition of the land, the person interested is com pelled to change his residence or place of business, the reasonable expenses, if any, incidental to such change.

5.4 Involuntary Resettlement and RFCTLARR Act, 2013

Details of the RFCTLARR Act, 2013 are mentioned below:

S. No	Topics/Issues/Areas	RFCTLARR
1	Application of LA	Section 2 Applicable to projects where government acquires land for its own use, hold and control, including PSU and for public purpose; for PPP where ownership of land continues to vest with govt; private companies where 80% of land owners1 have given consent or 70% in case of PPP.
	Principle of avoidance	Alternatives to be considered as Act in chapter II, point # 4 (d) says "extent of land proposed for acquisition is the absolute bare minimum needed for the project; and (e) says land acquisition at an alternate place has been considered and found not feasible.
	Linkages with other projects	No such provision
2	Application of R&R	In addition to the above, Section 2(3) land purchased by private company as prescribed by Govt. or when part acquired by Government
3	Affected area	Section3(b): Area notified for 'acquisition'
4	Family	Section 3(m) includes person, his and her spouse, minor children, minor brothers and sisters dependent. Widows, divorcees, abandoned women will be considered as separate family.
5	Affected family for eligibility	Section 3 (a): whose land and other immovable property acquired. (b)&(e): Family residing in affected area such as labourers, tenants, dependent on forest and water bodies, etc whose primary source of livelihood is affected due to acquisition (c)Scheduled tribes and other forest dwellers whose rights recognized under the Forest Dwellers Act 2006. (f) Family assigned land by state or central government under any schemes (g) Family residing on any land in urban area that will be acquired or primary source of livelihood affected by acquisition.
6	Cut-Off date	Section 3 c (ii), (iv) (vi): Families residing for preceding 3 yrs or more prior to "acquisition of land".

S. No	Topics/Issues/Areas	RFCTLARR
7	Non-application of Chapter II	Section 6(2): Irrigation projects where EIA is required under other laws, provisions of SIA not applicable
8	Consultation – Phase I during preparation	Section 4(1) date issued for first consultation with PRIs, Urban local bodies, Municipalities, etc to carry out SIA. Section 5: Public hearing of SIA in affected area. Provide adequate publicity of date and time.
9	Time duration to prepare SIA and SIMP	Section 4 (2): within six months from the date of its commencement
10	Disclosure – Stage I	Section 6(1): Translated in local language available in PRI institutions and local urban government bodies; district administrative offices and websites of concerned. Government agency.
11	Formation of Expert Group to appraise SIA and SIMP	Section 7(1): Constitute a multidisciplinary Expert Group include members of decentralized Government Institutes (PRIs, ULBs).
12	Time stipulated for Group to submit its report	Section 7(4): Submit its report within two months from the date of its constitution
13	Scope of work of the Expert group	Section 7 (4) (a&b): assess whether it serves any public purpose or not; if social costs outweigh potential benefits then should be abandoned; Section 7 (5) (a&b): if serves public purpose, then it has considered minimum land acquisition, and alternate options to minimize displacement; potential benefits outweigh social costs
14	Consultation – Phase II during appraisal	Section 2 (2): Prior consent of 80% and 70% of land owners in PPP and where private company has approached the Govt. to acquire balance land has been obtained,
15	Disclosure – Stage II	Section 7 (6): recommendations of expert group under 7(4&5)to be made public in local language in district and block administrative office and PRIs
16	Minimize impact on multi crop land	Section 10: In case multi-crop land is to be acquired under exceptional circumstances, the area to be acquired cannot exceed aggregate of land of all projects in district or state. The area to be acquired cannot exceed the total net sown area of the district or state. Wasteland equivalent to twice the area

S. No	Topics/Issues/Areas	RFCTLARR
		acquired will be developed
17	Information dissemination of preliminary notice	Section 11 (1), (2) & (3): Notice published in local language and meetings called of Gram Sabahs, municipalities to provide full information about the purpose of the project, summary of SIA and particulars of administrator appointed for R&R' summary of R&R scheme
18	Updating land records	Section 11 (5): Once established that the land is required for public purpose, accordingly notice to be issued under section 19 following which land records to be updated within two months
19	Census and preparation of R&R schemes	Section 16 (1) (2): carry out census of affected people and their assets to be affected, livelihood loss and common property to be affected; R&R scheme including time line for implementation.
20	Information dissemination and Public hearing - Stage III	Section 16(4)&(5): mandatory to disseminate information on R&R scheme including resettlement area and organize public hearing on the Draft R&R scheme in each Gram Sabha, Municipality and consultations in Scheduled area as required under PESA.
21	Approval of R&R Scheme	Section 17 & 18: Draft R&R Scheme to be finalized after addressing objections raised during public hearing and approved.
22	Final declaration of R&R Scheme	Section 19 (2): Only after the requiring body has deposited the money will the Govt. issue the notice along with 19(1).
23	Time period stipulated	Section 19 (2): the entire process to update land records, disseminate information, preliminary survey, census, hearing of objections, preparation of R&R schemes and approval, deposit of money must complete within 12 months from the date on which section 11, the preliminary notice issued. Section 19 (7): If the final declaration not made within 12 months of section 11 (1), the process will lapse, except under special circumstances.
24	Preparation of land acquisition plans	Section 20: Land marked, measured for preparation of acquisition plans.
25	Hearing of claims	Section 21(1) (2): Notices issued indicating Govt's intension to take possession of land, and claims on compensation and R&R can be made

S. No	Topics/Issues/Areas	RFCTLARR
		not less than one month and not more than six month from the date of issue of section 21(1).
26	Time period stipulated for declaring the award	Section 25: It is required to announce the award within 12months of issue of Section 19 (final declaration to acquire land, approved R&R scheme) after completing land acquisition plans, hearing of objection, settling individual claims for declaration of the award. If award not made within the stipulated time, the entire proceedings will lapse.
27	LA Act 1984 deem to lapse and RFCTLAR&R is applicable	Section 24: where award is not declared under section 11, or where made five years ago but land not taken in possession or where award declared but money not deposited in the account of majority of beneficiary.
28	Methodology for determining replacement value for land	Section 26 and First Schedule: Recognizes 3 methods and whichever is higher will be considered which will be multiplied by a factor given in Schedule First; compensation given earlier will not be considered; if rates not available floor price can be set; steps to be taken to update the replacement value.
29	Valuation of structures	Section 29 (1) without deducting the depreciated value.
	Solatium and interest	Section 30(1) 100% of the compensation amount Section 30(3): 12% per annum on the replacement rate from the date of notification of SIA to the date of ward or land taken over
30	R&R Award	Section 31, Second Schedule: A family as a unit will receive R&R grant over and above the compensation and those who are not entitled to compensation. Second Schedule: Homeless entitled to constructed house, land for land in irrigation projects in lieu of compensation, in case of acquisition for urbanization 20% of developed land reserved for owners at a prices equal to compensation' jobs or onetime payment or annuity for 20 years' subsistence grant, transportation, land and house registered on joint name husband and wife, etc
31	Transparency	Section 37(1): Information of each individual family including loss, compensation awarded, etc will be available on the website.
32	Possession of land	Section 38(1): Land will be taken over by the government within three months of compensation and 6 months of

S. No	Topics/Issues/Areas	RFCTLARR
		R&R benefits disbursed; infrastructure facilities at resettlement sites will be completed within 18 months from the date of award made under section 30 for compensation; in case of irrigation and Hydle projects R&R completed six months prior to submergence.
33	Multiple displacement	Section 39: Additional compensation equivalent to compensation determined will be paid to displaced
34	Acquisition for emergency Purpose	Section 40 (5): 75% additional compensation will be paid over and above the compensation amount
35	Prior consent before acquisition and alienation	Section 41(3) Mandatory to get consent from Gram sabah, Panchayat, Autonomous Councils in Scheduled areas
36	Development plans for SC and ST	Section 41: Separate development plans to be prepared, settle land rights before acquisition; provision of for alternate fuel fodder, non-timber produce on forest land to be developed within 5 years; 1/3rd compensation amount to be paid as first installment and rest at the time of taking possession; ST to be resettled within Scheduled area; land free of cost for community purpose; land alienation will be null and void and ST and SC considered for R&R benefits; fishing rights restored in irrigation and hydle projects; if wish to settle outside the district additional benefits to be provided in monetary terms; all rights enjoyed under other laws will continue. Second Schedule: additional provisions for SC&ST for land for land in irrigation projects, additional sum over and above the subsistence grant,
37	Institutional arrangement	Section 43-45: Appointment of administrator, R&R Commissioner, when more than 100 acres of land is to be acquired, R&R Committee will be formed at project level, social audit to be carried out by Gram Sabha and Municipalities
38	Change of land use	Section 46(4): Land will not be transferred to the requisitioning authority till R&R is not complied with in full
39	Monitoring and Evaluation	Section 48-50:Set up National and State level Monitoring Committee to review and monitor progress
40	Authority to settle	Section 51-74: the Authority will be set up settle any legal disputes that arise from acquisition and R&R, the ag-

S. No	Topics/Issues/Areas	RFCTLARR
	claims	grieved party can move to the high court thereafter.
41	Exempt from tax and fee	Section 96: Compensation and agreements will not be liable to tax
42	No change in status of land acquired	Section 99: Once the land is acquired for a particular purpose, its purpose cannot be changed
43	Return of unutilized land	Section 101: If the acquired land remains unutilized for 5 years, then it will be returned to original owner, heir or included in land bank
44	Distribution of increased value of land transferred	Section102: 40% of appreciated value of acquired land will be distributed to owners provided no development has taken place

5.5 Entitlement Matrix

The detailed entitlement matrix as per new land act 2013 for the project is presented in the table….

S. No	Application	Definition of Entitled Unit	Entitlement	Details
A. Loss of Private Agricultural, Home-Stead & Commercial Land				
1	Land within the Corridor of Impact (COI)	Titleholder Family and families with traditional land Right	Compensation at Replacement value, Resettlement and Rehabilitation	a) Land for land, if available. Or, Cash compensation for the land at replacement value, which will be determined as provided under section 26 of RFCTLARR Act 2013. b) The land if allotted will be in the name of both husband and wife. c) If post acquisition, residual land is economically unviable, the land owner will have the choice of either retaining or sell off rest of the land. d) Refund of stamp duty and registration charges incurred for

S. No	Application	Definition of Entitled Unit	Entitlement	Details
				replacement land to be paid by the project; replacement land must be bought within a year from the date of payment of compensation to project affected persons. e) Subsistence allowance of Rs. 36000 as one time grant f) One time grant of Rs. 500,000 or annuity g) Compensation at replacement value for loss of crops if any
B. Loss of Private Structures (Residential/Commercial)				
	Structure within the Corridor of Impact (CoI)	Title Holder/ Owner	Compensation at Replacement value, Resettlement & Rehabilitation Assistance	a) Cash compensation for the structure at replacement value which would be determined as per as per section 29 of the RFCTLARR Act 2013. House under Indira Awas Yojna in rural area or Rs 50000 in lieu off and house under RAY in urban area or Rs 100,000 in lieu off the house if allotted will be in the name of both husband and wife. b) Right to salvage material from the demolished structures. c) Three months' notice to vacate structures. d) Refund of stamp duty and registration charges for purchase of new alternative houses/shops at prevailing rates on the replacement value as determined in (a) above. Alternative houses/shops must be bought within a year from the date of payment of compensation. e) In case of partially affected

S. No	Application	Definition of Entitled Unit	Entitlement	Details
				structures and the remaining structure remains viable, additional 10% to restore the structure. In case of partially affected structures and the remaining structure becomes unviable additional 25% of compensation amount as severance allowance. f) Subsistence allowance equivalent to Rs. 36000 as one time grant. G) Each affected family getting displaced shall get a one-time financial assistance of Rs 50,000 as shifting allowance. h) Each affected family that is displaced and has cattle, shall get financial assistance of Rs 25,000/- for construction of cattle shed. i) One time grant of Rs. 50,000 as resettlement assistance j) Each affected person who is a rural artisan, small trader or self-employed person and who has been displaced (in this project owner of any residential-cum commercial structure) shall get a one-time financial assistance of Rs 25,000/-for construction of working shed or shop. j) One time grant of Rs. 500,000
	Structure within the Corridor of Impact (CoI)	Tenants/ Lease Holders	Resettlement & Rehabilitation Assistance	a) Registered lessees will be entitled to an apportionment of the compensation payable to structure owner as per applicable local laws. b) In case of tenants, three months written notice will be provided along with Rs 50,000

S. No	Application	Definition of Entitled Unit	Entitlement	Details
				towards shifting allowance.
C. Loss of Trees and Crops				
4	Standing Trees, Crops . within the Corridor of Impact (Col)	Owners and beneficiaries (Registered/ Un-registered tenants, contract cultivators, leaseholders & sharecroppers	Compensation at replacement value	a) Three months advance notice to project affected persons to harvest fruits, standing crops and removal of trees. b) Compensation to be paid at the rate estimated by: i) The Forest Department for timber trees ii) The State Agriculture Extension Department for crops iii) The Horticulture Department for fruit/flower bearing trees. c) Registered tenants, contract cultivators & leaseholders & sharecroppers will be eligible for compensation for trees and crops as per the agreement document between the owner and the beneficiaries. d) Un-registered tenants, contract cultivators, leaseholders & sharecroppers will be eligible for compensation for trees and crops as per mutual understanding between the owner and the beneficiaries.
D. Loss of Residential/ Commercial Structures to Non-Titled Holders				
	Structures within the Corridor of Impact (Col) or	Owners of Structures or Occupants of structures identified as per	Resettlement & Rehabilitation Assistance	a) Non vulnerable encroachers shall be given three months' notice to vacate occupied land b) Vulnerable encroachers will be provided cash assistance at replacement cost for loss of structures as described in section 29 of the RFCTLARR Act

S. No	Application	Definition of Entitled Unit	Entitlement	Details
	Government land	Project Census Survey		2013. . c) Any encroacher identified as non-vulnerable but losing more than 25% of structure used will be paid cash assistance at replacement cost for loss of structures. The amount will be determined as per section 29 of the RFCTLARR Act 2013. d) All squatters to be paid cash assistance for their structures at replacement costs which will be determined as mentioned in section 29 of the RFCTLARR Act 2013. e) All squatters (other than kiosks) will be eligible for one time grant of Rs 36000 as subsistence allowance. f) All squatters other than Kiosks will be given shifting allowance of Rs 50,000 per family as one time grant for a permanent structure and Rs.30,000 for a semi-permanent structure and Rs. 10,000 for a temporary structure. g) Each affected person who is a rural artisan, small trader or self-employed person assistance' of Rs 25,000/- for construction of working shed or shop. h) In case of Kiosks, only Rs. 5000 will be paid as one time grant.

S. No	Application	Definition of Entitled Unit	Entitlement	Details
E. Loss of Livelihood				
6	Families living within the Corridor of Impact (CoI)	Title Holders/ Non-Title holders/ sharecroppers, agricultural labourers and employees	Resettlement & Rehabilitation Assistance	a) Subsistence allowance of Rs. 36,000 as one time grant. (PAPs covered under 1(f), 2 (f) and 5 (e) above would not be eligible for this assistance). b) Training Assistance of Rs 10,000/- for income generation per family. c) Temporary employment in the project construction work to project affected persons with particular attention to vulnerable groups by the project contractor during construction, to the extent possible.
F. Additional Support to Vulnerable Families				
7	Families within the Corridor of Impact (CoI)	SC, ST, BPL, WHH families	Resettlement & Rehabilitation Assistance	One time additional financial assistance of Rs. 50,000. Squatters and encroachers already covered under clause 5 are not eligible for this assistance.
G. Loss of Community Infrastructure/Common Property Resources				
8	Structures & other resources (e.g. land, water, access to structures etc.) within the Corridor of Impact (CoI)	Affected communities and groups	Reconstruction of community structure and • common property resources	Reconstruction of community structure and Common property resources in consultation with the community

S. No	Application	Definition of Entitled Unit	Entitlement	Details
H. Temporary Impact During Construction				
9	Land & assets temporarily impacted during construction	Owners of land & Assets	Compensation for temporary impact during construction e.g. diversion of normal traffic, damage to adjacent parcel of land / assets due to movement of heavy machinery and plant site.	Compensation to be paid by the contractor for loss of assets, crops and any other damage as per prior agreement between the 'Contractor' and the 'Affected Party'.
J. Resettlement Site				
10	Loss of residential structures	Displaced titleholders and non-titleholders	Provision of resettlement site/ vendor replacement	Resettlement sites will be developed as part of the project, if a minimum of 25 project displaced families opt for assisted resettlement. Vulnerable PAPs will be given preference in allotment of plots/flats at the resettlement site. Plot size will be equivalent to size lost subject to a maximum of provision given in RFCTLARR Act 2013. Basic facilities shall be provided by the project at resettlement site as per the provisions given in the Third Schedule of RFCTLARR

S. No	Application	Definition of Entitled Unit	Entitlement	Details
				Act 2013. Similarly, if at least 25 displaced commercial establishments (small business enterprises) opt for shopping units, the Project Authority will develop the vendor replacement at suitable location in the nearby area in consultation with displaced persons. Basic facilities such as approach road, electricity connection, water and sanitation facility, will be provided in the vendor replacement by the project. Vulnerable PAPs will be given preference in allotment of shops in vendor replacement. One displaced family will be eligible for only one land plot at resettlement site or shop in the vendor replacement.

6 PUBLIC CONSULTATION

Public information and consultation is an important method of involving various stakeholders particularly, local community with reference to the proposed development initiatives. It provides a platform to participants to express their views, concerns and apprehensions that might affect them positively or negatively. Through participation and consultation stakeholders influence development initiatives, and decision making process. The effectiveness of participation and consultation is directly related to the degree of involvement by the likely project affected persons and the local community and integration of outcome of consultations wherever feasible in the proposed development initiatives. Detailed planning is required to ensure that likely project affected persons, local community, interested groups, non-governmental organizations, civil society organizations; local government, line departments, etc are consulted regularly, frequently and purposefully during different stages of the project including project preparation.

It is a two-way information flow, from project authorities to people and, from people to project authorities. While decision making authority would be retained by the project authority, interaction with people and eliciting feedback allows affected populations to influence the decision making process by raising issues that should be considered in designing, mitigation, monitoring and management plans

The purpose of consultation will be to inform people about the project, take note of their issues, concerns and preferences, and allow them to make meaningful choices. As mentioned earlier public information and consultation will be held during screening stage and census and socio economic survey stages. The outcomes of consultations will be shared with design team to integrate their concerns and suggestions wherever possible.

Although, there is no habitation along the proposed Shiradi Ghat Bypass Tunnel Project as almost 95% of alignment passes through reserve forest areas and invaded land. However, by construction of the proposed bypass, through traffic between Bangalore – Mangalore will travel through tunnel & high level bridge project road. It will cause major effect on living hood of the residents in adjoining villages (Heggede, Manarhally, Kempole, Gundya and Addahole) along the existing NH-48 road.

Those losing agricultural lands will lose income opportunity. However, this will be a permanent setback, unless provided with adequate compensation amount and / or training facilities for new trades with sufficient seed capital.

Commencement of road project will benefit the community through generation of direct and indirect employment within the project areas due to construction activity, minor repairs and maintenance works. The project will require a good number of unskilled workers and they can form a cooperative, which will supply labourers to contractors whenever required. Up gradation of roads and community development programs in the project plan will benefit the communities at large.

Considering above, detailed discussions and public consultation will be conducted with the affected persons for resolving their short-long tem issues, employment, tourism, coffee plantation, small scale industries etc during and after project construction.

6.1 Role and Responsibilities Identified during Consultation

Table 3 envisaged responsibilities of officials and expected benefits from the consultation. From the consultation, it was established that implementation of the project could be better done with the help of regular MORT&H engineers.

Table 3: Role and Responsibilities Identified after Consultation under the Project

Stakeholders	Roles and Responsibility	Expected Benefit for the Project
Potential Project Affected Persons, Project affected groups, Project Affected Communities, Host population	• Participate in formal and informal public meeting, • Raise critical issues relevant to the project, • Suggest alternative alignments, • Options of widening, • Methodologies for agreement on compensation and assistance • Suggest methodologies for continued participation in project cycle • Safety and Protection	• Easing implementation. • *Incorporation of good practices (From long term memories of the people) of the past in project design.* • Planning for road safety issues. • Community Capacity building and sense of ownership of the project. • Tourism • Employment • Better Living
Engineers supervision consultant and MORT&H Division	• Land Acquisition • Participate in Public meetings • Participate in Block and District Level Meeting • Public Awareness	• Ease implementation • People oriented planning • Ensured public cooperation • Determination of market value • Knowledge share
Forest Official	• Enumeration of trees • Identification of eco sensitive hot spots • Salvaging/Auctioning of trees	• Faster permission for tree felling
Land Acquisition Officials	• Authentication of existing land • Ensure availability of land for road improvement • Timely evacuation of Corridor • Rehabilitation Plan	• Speedy and timely land acquisition

7 STRUCTURE OF RAP REPORT AND FORMAT

In this section we are presented the Structure of RAP report which we will be submitted in KD7: Draft Detailed Project Report.

Chapter 1- Introduction

Chapter 2- Study Methodology

Chapter 3- Resettlement Policies and Legal Framework

Chapter 4- Minimizing Negative Social Impact

Chapter 5 -Profile of State and Project Affected Persons

Chapter 6- Community Participation

Chapter 7- Gender Analysis

Chapter 8- Income Restoration

Chapter 9 -Institutional Arrangements

Chapter 10 - Grievance Redress Mechanism

Chapter 11- Monitoring and Evaluation

Chapter 12- Implementation Schedule

Chapter 13- Costs and Budget

8 DATA COLLECTION

For the data collection we will be three types of form which is mentioned below:

- Census Survey Questionnaire of Project Affected Person **(Annexure J2 of QAP Attached**)
- Socio-Economic Questionnaire of Project Affected Person **(Annexure J2 of QAP Attached)**
- Public Consultation format **(Attached)**

9 MAINTENANCE, LAND ACQUISITION, REHABILITATION & RESETTLEMENT COST

Provision has been included for maintenance of the existing 2-lane road during construction at Rs. 5,00,000 /= per Km per month for 60 months. This covers repair of pot holes and renewal coat by 25mm Mastic Asphalt/ Wearing Coat. Cost of Rehabilitation & Resettlement has been provided for as per initial social impact assessment. Provision for cost of land acquisition and compensation for permanent/temporary buildings and other structures has been made there in. The cost of environmental mitigation has been provided for, as per initial assessment. For specific items that have been used for mitigation of impacts in construction or operation stages including environmental monitoring, training of personnel for implementation of the Environmental Management Plan, logistical support for the implementing agency. General components like RCC, PCC, steel ISMB sections or angle sections etc., required for various mitigation measures have been included in the overall rate for the item. The costs of Resettlement and Rehabilitation were worked out based on the prevailing market rates in Heggade, Maranhally, Shiradi and Gundya, Adda hole villages of Hassan and Mangalore Districts respectively. The land acquisition costs for the properties to be acquired for this project has been worked out based on a market value assessment survey conducted at various locations along the proposed bypass alignments. The property dealers, locals and the government agencies as the revenue department etc. were contacted for this purpose.

It has already been stated that the list of affected properties is yet to be firmed up. However, a tentative estimate of cost for Rehabilitation & Resettlement has been worked out to Rs. 15 Crores, which covers all components of compensation, assistance and entitlements. The detailed cost estimate for resettlement will be provided in the Preliminary Project Report. The broad break up of tentative R & R budget is given below:

Table: Tentative budget for R&R Activities

Sl. No	Particulars	Amount (Rs.)
1	Compensation for structure	1,00,00,000
2	Construction cost	5,00,00,000
3	Compensation for land (including 30% as solatium)	5,00,00,000
4	Assistance @ Rs.20000 per PAF as per National Policy on Resettlement & Rehabilitation	4,00,00,000
5	Support for implementation of RAP (lump sum)	50,00,000
6	M & E consultant (lump sum)	50,00,000
Total		15,00,00,000

--------End of Main Document----------

10 TABLE OF ANNEXURES

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2	Socio-Economic Questionnaire of Project Affected Person	3
3	Public Consultation format	3

ANNEXURE – 1

Census Survey Questionnaire of Project Affected Person

CENSUS SURVEY

DATE (/ /)

Structure Identification Number (/ /)

Start Chainage (.)

End Chainage (.)

1	Agriculture	**2**	Open Land/Plot	**3**	Residential
4	Commercial	**5**	Industrial	**6.**	Residential cum Commercial
7	Plantation	**8.**	Petrol Pump		
9	**School**	**10**	Hospital	**11**	Hand Pump
12	Well	**13**	Temple	14	Shrine
15	Religious Tree	**16**	Chabutara	17	Yatri Shed/Bus Stop
18	Graveyard	**19**	Masjid	20	Others (specify)

Type of the Use

No of Storeys	
G	←
G+1	↑
G+2	→

Distance of property from the Centreline)		**Distance of Building from the centre line (m)**		**Property Width (Breadth)**	**Perpendicular to the road (length)**
Left	Right	Left	Right		
.	.	.	.	.	.

Assessment of the Supervisor

A. IDENTIFICATIONS

Reason for additional Questionnaire

District	**Block**	**Village/ Hamlet/ Town**

Identification.

A.2 Type of Property

Private	Government	Trust	Community	Others
1	**2**	**3**	**4**	**5**

A.3 **Ownership**

A.3.1 Do you own the structure/ plot/agriculture land?

1.	**Owner**	**2.**	**Tenant**

A.3.2 Occupiers Name _____S/o_____

A.3.3 If Tenant

Name of the Owner:_____

Address of the Owner: _____

A.4 UTILITIES IN THE PROPERTY

Sl.No	**Utilities**	**Unit owned**
1.	Trees	
2.	Dug wells	
3.	Tube wells	
4.	Lift Irrigation Points	
5.	Water Tap	
6.	Water Tank	
7.	Hand Pump	
8.	Boundary Wall	
9.	Barbed Wire Fence	
10.	Cattle Shed	
11.	Shrine	
12.	Chabutara	
13.	Chullaha	

(For Private Properties only)

A.5 **TYPOLOGY OF THE MAIN STRUCTURE**

How is the structure constructed?

Roof		Wall		Floor		Boundary		Kiosk
RCC/RBC	←	Brick	←	Concrete	←	Brick	←	If Kiosk fill only up to A. 6.3
Thatched	↑	Bamboo Plastic	↑	Mud	↑	Barbed Wire	↑	
Mud	→	Mud	→	Stone	→	Bamboo	→	
GI/Asbestos	↓	Asbestos	↓	Others	↓	Others	↓	
Bamboo	⊗	Others	⊗					
Others	⊕							

(Only for Agricultural Property)

B. LAND UTILISATION

B.1 Kindly give the details of landholding.

Sl.No.	Particular
1.	Irrigated
2.	Unirrigated
3.	Fallow

Unit (In acres)

		.		
		.		
		.		

B.2 CROPPING PATTERN (ASK FOR ONLY MAJOR CROPS)

Season	Sl. No.	Crop Name	Area cultivated (in acres)	Production	Rate (in Rs./Qtls.)
Kharif (Nov.-Mar)	1				
	2				
	3				
Rabi (July-Nov.)	1				
	2				
	3				
Summer (Mar-July)	1				
	2				
	3				

C. RESETTLEMENT & REHABILITATION (*for Commercial Structures Only*)

C.1 How old is the structure?

C.2 How long are you residing or operating from the structure?

C.3 What type of business are you doing, in case of commercial use?

1.	Tea Stall	8.	Educational
2.	Dhaba	9.	Motel/Hotel
3.	Grocery	10.	Electrical
4.	Cloth/Garments/Tailoring	11.	Furniture
5.	Chemist	12.	Godown
6.	Repairing	13.	Office
7.	Pan/Cigarette	14.	Any other, please specify

C.4 Is your business self owned?

If No, how many partners?

C.5 How many people have you employed?

C.6 Where would you prefer to settle? (Distance in kms)

ℵ	Same Village/Town
ℑ	Outside Village/Town
ℜ	Other Village/Town

C.7 Do you have any alternative land /structure? If Yes, where?

D. Household Details

D.1.1 **What Caste does the Occupier belong to?**

General	SC	ST	OBC
←	↑	→	↓

D.1.2**Religious group**

Hindu	Muslim	Sikh	Christians	Jainism	Buddhism
←	↑	→	↓	°	±

D.1.3 **Do you have a BPL Ration Card?**

1.	Yes	2.	No

D.1.4 No of Persons in Household

Above 14 yrs	Below 14 yrs

Codes for Relationship

1	Self	2	Wife	3	Husband	4	Son
5	Daughter	6	Son-in-law	7	Daughter-in-law	8	Grandfather
9	Grandmother	10	Grandson	11	Grand daughter	12	Grandson-in-law
13	Grand daughter-in-law	14	Brother	15	Sister	16	Brother-in-law
17	Sister-in-law	18	Father	19	Mother	20	Father-in-law
21	Mother-in-law	22	Uncle	23	Aunt	24	Cousin
25	Nephew	26	Niece	27	Any other (specify)		

Not for Kiosks

Member Number	1	2	3	4	5	6	7	8	9	10	11	12	
D.2.1 Name													Write down the names of all person who live and eat together in this household starting with head exclude persons under the age of 14 years.
D.2.2 Relationship													
D.2.3 Sex	**Is the NAME male or female?**												
	M	M	M	M	M	M	M	M	M	M	M	M	
	F	F	F	F	F	F	F	F	F	F	F	F	
D.2.4 Age	**How old was NAME on the last birthday?**												
													Record the age on last birthday
D.2.5 Marital Status	①	①	①	①	①	①	①	①	①	①	①	①	Married
	②	②	②	②	②	②	②	②	②	②	②	②	Unmarried
	③	③	③	③	③	③	③	③	③	③	③	③	Divorced
	④	④	④	④	④	④	④	④	④	④	④	④	Separated
	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	Widow/Widower
D.2.6 Education	**The class till which the person has been educated.**												
	①	①	①	①	①	①	①	①	①	①	①	①	Illiterate
	②	②	②	②	②	②	②	②	②	②	②	②	Primary (class 3)
	③	③	③	③	③	③	③	③	③	③	③	③	Secondary (Class 10)
	④	④	④	④	④	④	④	④	④	④	④	④	Higher (graduate)
	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	Technical
	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	Vocational
E.1	**Is the NAME working?**												
	①	①	①	①	①	①	①	①	①	①	①	①	Yes
	②	②	②	②	②	②	②	②	②	②	②	②	No
E.2 Occupation	**The main activity at the place of job?**												This may have multiple entries
													Agriculture
													Agri Labour
													Non Agri Labour
													Business/Trade
													Govt. Service
													Private Service
													Maid Servant
													Others
E.3	**What was the main reason for the NAME not working?**												To be filled for persons who are not working.
	①	①	①	①	①	①	①	①	①	①	①	①	No work available
	②	②	②	②	②	②	②	②	②	②	②	②	Seasonal inactivity
	③	③	③	③	③	③	③	③	③	③	③	③	Household family duties
	④	④	④	④	④	④	④	④	④	④	④	④	Old/young
	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	Handicapped
	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	Others
E.4 Income	**How much does the NAME earn in a month?**												
	①	①	①	①	①	①	①	①	①	①	①	①	Rs. 0-Rs. 2000
	②	②	②	②	②	②	②	②	②	②	②	②	Rs. 2000-Rs. 5000
	③	③	③	③	③	③	③	③	③	③	③	③	Rs. 5000 and above
E.5 Skills	**What is the skill possessed by the person?**												

ANNEXURE –2

Socio-Economic Questionnaire of Project Affected Person

SOCIO ECONOMIC QUESTIONAIRE

DATE

		/			/		

Structure Identification Number

			/		/			

A.1 Does the Household or Household member own a dwelling?

←	Owns a Dwelling
↑	Rents a Dwelling
→	Temporary Shelter
↓	Uses without paying

A.2 How many rooms are there in the dwelling?

Kitchen	←
Separate Toilet	↑
Living Room	→
Courtyard	↓

A.3 How Many livestock does the Household currently own?

Cows	
Goat	
Sheep	
Poultry	
Others	

A.4 Does the household have any of the following

←	Electricity
↑	Bed/Cot
↓	Sewing machine
°	Watch
±	Bicycle
″	Motor cycle
≥	Tractor
×	Thresher
∝	Tube Well

A.5 Does the household have the following electrical appliance

←	Bulb
↑	Fan
→	Radio/TV
↓	Television
°	Refrigerator
±	Others

Has the household purchased any Asset?

Land	
Residence	
Shop	

A. HOUSEHOLD ASSETS

B. Women

Decision Making Power of Women

	Member I				Member II				Member III			
Financial Matters	←	Yes	↑	No	←	Yes	↑	No	←	Yes	↑	No
Child' Education	←	Yes	↑	No	←	Yes	↑	No	←	Yes	↑	No
Healthcare of Child	←	Yes	↑	No	←	Yes	↑	No	←	Yes	↑	No
Purchase of Assets	←	Yes	↑	No	←	Yes	↑	No	←	Yes	↑	No
Day-to-day Activities	←	Yes	↑	No	←	Yes	↑	No	←	Yes	↑	No
Social Functions	←	Yes	↑	No	←	Yes	↑	No	←	Yes	↑	No
Others	←	Yes	↑	No	←	Yes	↑	No	←	Yes	↑	No

C. HOUSEHOLD AMENITIES

B.1 What is the source of drinking water?

←	Piped into dwelling and compound
↑	Public tap
→	Protected well
↓	Open well
◦	River, lake, pond
±	Tube well
″	Bore well (both for house and agricultural)

B.2 What kind of toilet facility does your household use?

←	None
↑	Flush/Sewer
→	Septic tank

B.3 What is the main fuel used for cooking

←	Firewood
↑	Coal
→	Charcoal
↓	Kerosene
◦	Dung cake/Crop Residue
±	Others

B.4.What is the main fuel for lighting

←	Kerosene
↑	Gas
→	Electricity from supply
↓	Electricity from other sources
◦	Candle
±	Firewood

B.5. How many minutes does it take from here to reach the nearest ……?

		0-14	15-29	30-44	45-59	60+
A.	Supply of Drinking Water	←	↑	→	↓	◦
B.	Market (Village Market)	←	↑	→	↓	◦
C.	Public Transport	←	↑	→	↓	◦
D.	Primary School	←	↑	→	↓	◦
E.	Secondary School	←	↑	→	↓	◦
F.	Primary Health Center	←	↑	→	↓	◦
G.	Maternity Center	←	↑	→	↓	◦
H.	Hospital	←	↑	→	↓	◦
I.	Bank	←	↑	→	↓	◦
J.	Tehsil	←	↑	→	↓	◦
K.	Grazing Ground	←	↑	→	↓	◦

D. Expenditure Pattern

Sl. No.	Particulars/Sources	Expenditure (Rs.)
1	Food	
2	Cooking Fuel	
3	Clothing	
4	Health	
6	Communication	
7	Social Functions	
8	Agriculture (such as on seeds, hiring of farm implements, etc.)	
9	Others specify ____	
10	Total	

E. Child and Health

D.1 How many live Births were there in the last year?

←	One	↑	Two	→	Three	↓	More than Three

D.2 Did the Mother receive Pre-Natal Care during Pregnancy from the Health Center or the Doctor?

←	**YES**	↑	**NO**

D.3 Where was the Child Delivered?

←	**Hospital**
↑	**At Home**
→	**Others**

D.4 Who had delivered the child?

←	Doctor
↑	Nurse
→	Midwife

D.5 Are Any of the Child Physically or Mentally Retarded?

←	**YES**	↑	**NO**

D.6 Was anybody of the Family Sick during the last one Month?

←	**YES**	↑	**NO**

D.7 What was the sort of sickness, type of treatment used

Sl.No	**Type of Illness**	**Type of treatment *(Use Codes)***					
1.		←	↑	→	↓	°	±
2.		←	↑	→	↓	°	±
3.		←	↑	→	↓	°	±
4.		←	↑	→	↓	°	±

Type of treatment

←	Private Dispensary
↑	Public Dispensary /Hospital
→	Private Doctor
↓	Ayurvedic Medicines
°	Homeopathic Medicines
±	Chemist (Over the Counter Medications)
	Quacks

ANNEXURE - 3

Public Consultation format

Annexure

Public Consultation

- Employment opportunity will increase for local people with the development work both as construction worker as well as service providers.
- Improved/better road will reduce travel time and diesel/petrol expenditure and increase mobility and access to bigger market centres for sale and purchase of goods, district education and health services.
- Price of land will increase.
- Establishment of industries in the area with the improvement of road.
- Loss of land and properties and disruption of livelihood of those close to the existing alignment.
- Faster traffic will increase chances of accident.
- Consultations revealed that religious structures could be shifted to other locations in consultation with villagers if the authority agrees to construct to the same at other location. Shifting religious structures will not be a major problem the community revealed.
- Community property such as pond, hand pump, water tank, etc affected should be rehabilitated at suitable location.
- Source of drinking water must be restored before the project work starts.
- In order to reduce spread of HIV/AIDS, suggestion regarding prohibition of sex, test of drivers, campaigning about AIDS and establishment of dhabas away from settlements were made during the consultations.
- Majority people preferred land for land or land and cash both as compensation and self-relocation.
- Provision of bypass to avoid resettlement however, majority petty service providers wanted the widening along the existing road as provision of bypass would affect their livelihood adversely.
- Provision of suitable mechanism for crossing the road near settlement to reduce chances of accidents.

The effectiveness of the R&R program is directly related to the degree of continuing involvement of those affected by the project. During the preparatory stage, consultations were held at local level as documented above. Several additional rounds of consultations with PAPs have been planned in the action plan through partner NGO during RAP implementation. Consultations during RAP implementation will involve agreements on compensation, assistance options, and entitlement package and income restoration. The other round of consultations will occur when compensation and assistance are provided and actual resettlement begins.

Information disclosure is pursued for effective implementation and timely execution of RP. For the benefit of the community in general and PAPs in particular, RP and R&R policy will be translated in local language (Kannad) to be kept at:

- Panchayat level
- Block Development Office
- Taluka Office
- District Magistrate Office
- PIU Office

The PIU offices will provide information on R&R policies and features of the rehabilitation plan to the people in continuous manner. For continued consultations, following steps have been envisaged in the project:

- The NGOs to be involved in implementation of the RAP, organize public meetings and will appraise the communities about the progress in the implementation of R & R works.
- There will be Grievance Redressal Committees (GRCs) for each district. The PAPs will be associated with such committees (each of the committees will include representative of the PAPs).
- The resettlement sites, and other amenities and facilities to be made available to the PAPs will be decided in consultation with the communities.
- The NGOs will organize public meetings to inform the community about the compensation and assistance to be paid. Regular update of the progress of resettlement component of the project will be placed for public display at the PIU office.
- All monitoring and evaluation reports of the R & R components of the project will be disclosed in the same manner as that of the RAP report suggested above.
- Key features of the entitlements will be displayed in billboards on the project corridor.
- Together with the NGO, PIU will conduct information dissemination tasks at major intersections and solicit the help of the local community/business leaders to encourage the participation of the PAPs in RAP implementation.
- Attempt shall be made to ensure that vulnerable groups understand the process and their needs are specifically taken into consideration.

For effective implementation of RAP it is essential to involve communities and PAPs in the process. The mechanism of involving PAPs, NGOs, Host population, Project and local officials is suggested below:

Project Stage	PAPs	NGOs	Host	Project and local Officials
Planning	• Participate in public meetings • Identify alternatives to avoid or minimize displacement • Assist in developing and choosing alternative options for relocation and income generation • Help to choose resettlement sites • Participate in survey • Provide inputs to entitlement provision • Assist in preparation of action plan • Suggest mechanism for grievance redressal • Conflict resolution and participate in grievance redressal • Participate in coordination	• Assist in impact assessment • Assist in census and SE survey • Participate in coordination committee • Participate in group meetings • Design and implement information campaigns • Support group formation, problem identification and planning for PAPs and hosts, • Suggest mechanism for grievance redressal of conflict resolution • Assist in preparation of action Plan	• Provide information on various aspects of host communities • Assist in data collection and design • Provide inputs to site selection • Identify possible conflict areas with PAPs • Identify social and cultural facilities needed at resettlement sites • Assist in identification of income generating (IG) schemes • Provide inputs for design of IG schemes • Help develop a process of consultation between hosts and PAPs • Suggest mechanism for grievance redressal and conflict resolution	• Provide information on Karnataka skills etc. • Suggest ways to minimize impacts • Indicate local staff and budget capacity for relocation • Assist NGO in information dissemination • Participate in consultations • Examine the feasibility of IG discuss with PAPs • Help documentation and consultations.

Project Stage	PAPs	NGOs	Host	Project and local Officials
	committee			
Implementation	• Participate in implementation support activities • Participation in local decision making activities	• Provide ongoing information for PAPs and hosts • Support in group management	• Assist APO in relocation • Manage common property at site • Participate in local committees	• Process IG proposals • Participate in grievance redressal
	• Decide on management of common properties • Participate in grievance redressal mechanism • Monitor provision of entitlements • Labour and other inputs at site • Credit and other group scheme management • O&M of sites and project inputs • Members of implementation committee	• Monitor entitlement provision by implementation of IG schemes. • Training to eligible PAPs • Support to vulnerable groups • Evaluate community participation • Provide advice on grievance redressal	• Assist PAPs in integration with hosts. • Assist PAPs in use of new production system • Use established mechanisms for grievance redressal	• Provide assistance under local schemes • Participate as member of implementation committee
M&E	• Participate in grievance tribunals • Report to PD on IG schemes • Report on service quality of sites	• Provide information to project staff on vulnerable groups • Act as M&E agency for project • Act as external monitors for project (where not previously involved)	• Provide inputs to M&E of R&R	• Ongoing interaction with PAPs to identify problems in IG programme • Participant in correctional strategies.

Prepared for:

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MINISTRY OF ROAD TRANSPORT & HIGHWAYS
Government of India

Karnataka
Public Works, Ports &
Inland Water Transport Department

Project:

Consultancy Services for "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.000 to 261.450 on NH-48 in the State of Karnataka"

Subject:

KD-6 - Draft Detailed Project Report for Final Approved Alignment for Bypass

Volume V: Technical Specifications

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Revision History

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Introduction

This report is prepared under Contract Agreement clause 2.8; "Key Date No: KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)" after incorporation of Client's observations on earlier submitted "KD5: Kucha Draft Detailed Project Report (KDDPR)" vide letter no. NH/PIU-Tunnel/NH-48/KD-3/2015-16/383-386 dated 14.12.2015.

The present submission (10 Hard Bound Sets and 5 Soft Copies of each) is as detailed below:

(i) Volume-I Main Report:

- *Executive summary*
- *Project Description*
- *Socio Economic Profile*
- *Materials Surveys and Investigation*
- *Traffic Surveys and Analysis*
- *Design Standards and Specifications*
- *Alignment Proposals*
- *Summary of EIA/IEE and Action Plan*
- *Summary of Resettlement Plan*
- *Preliminary Cost Estimates*
- *Preliminary Economic Analysis*
- *Preliminary Financial Analysis*
- *Suggested Methods of procurement and packaging*
- *Conclusions and Recommendations*
- *Acknowledgement*
- *Compliance of the Observations*

The basic data obtained from the field studies and investigations and input data used for the detailed engineering design (if any) shall be submitted in a separate volume as an Appendix to Main Report.

(ii) Volume – II : Design Report

Part- I Traffic Study, Analysis and Forecast :

- *Description of Existing Road in Ghat Section*
- *Road and Bridge Inventory*
- *Traffic Surveys, analysis and forecast*
- *Proposed Pavement Design*

Part-II Design of Tunnels :

- *Proposed Tunnel Design, Standards*
- *Technical Note on Tunnel Section and System*
- *Structural Analysis- Primary Lining*
- *Structural analysis of Inner lining and Design*

Part-III Design of Bridges and Cross-Drainage Structures :

- *Proposed Bridges and Structures Design Basis and*
- *Bridges Dimensioning*

Part-IV Geological Design and Geotechnical Report :

- *Geological Survey and Analysis*
- *Geotechnical Investigations Report*

(iii) Volume-III Materials Report :

(iv) Volume - IV(a) Environmental Assessment Report including Environmental Management Plan (EMP) &

(v) Volume - IV(b) Resettlement Action Plan (RAP) :

(vi) Volume - V Technical Specifications :

(vii) Volume - VI Rate Analysis :

(viii) Volume - VII Cost Estimates :

(ix) Volume - VIII Bill of Quantities :

(x) Volume - IX Drawings (A3 Size) :

a. *Location map*
b. *Layout plans*
c. *General Drawings*
d. *Plan and Profile of Refined Alignment "A"*
e. *Typical Cross Sections showing Pavement details of Cut & Fill Section*
f. *Typical Cross Sections of Tunnel*
g. *Typical Cross Sections of Bridges*
h. *Tunnels- General Arrangement Plan and L-Sections (L&R)*
i. *Viaducts – General Arrangement Plan and L-Section*
j. *Cut & Fill and Viaducts – General Arrangement Plan and L-Section*
k. *GAD for proposed RoB at Railway km 54+650*
l. *Standard Drawings*
m. *Miscellaneous Drawings*
n. *Indicative Land Acquisition Plans*
o. *Detailed Cross Sections @ 100m interval*

(xi) Volume - X Civil Work Contract Agreement,

(xii) Volume-XI Project Clearances

Volume – V: Technical Specifications

A. General

This Volume - V: Technical Specifications, a part of "KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)" is submitted in accordance with the Contract Agreement and as per requirement specified in Terms of Reference (ToR) for preparation of Technical Specifications of "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH-48 in the State of Karnataka".

1 Technical Specifications

These Technical Specifications define the technical and quality standards specifically for NATM tunnel construction works in all ground condition.

The construction works shall be executed by the Contractor according to the quality requirements defined in the Specification and to the satisfaction of the Employer's Representative. Any item of work arising from the execution of the works, not covered by the Technical Specification, shall be according to a Standard as agreed with the Employer's Representative and the Contractor.

It is the intent of this Specification to define standards for the tendering process as well as for the planning and execution of the work by the Contractor. This includes the definition of quality standards which have to be followed and will be checked during construction by the Employer's Representative. Deviations from the Specification must be submitted in writing in the tender.

This Technical Specification is based on the "Specification for Tunnelling, Third Edition", British Tunnelling Society, Institution of Civil Engineers, 2010 and latest version of "MORTH Specification for Road and Bridge Works", Ministry of Road Transport and Highways. 2010.

1.1 Definition

Behaviour Type (BT) means general categories describing similar ground behaviours with respect to failure modes and displacement characteristics.

Contractor means the person(s) named as contractor in the Letter of Tender accepted by the Employer and the legal successors in title to this person(s).

Contractor's Representative means the person named by the Contractor in the Contract or appointed from time to time by the Contractor who acts on behalf of the Contractor.

Cost means all expenditure reasonably incurred (or to be incurred) by the Contractor, whether on or off the Site, including overhead and similar charges, but does not include profit.

Day means a calendar day.

Design drawing, final drawing, construction drawing, fit-for-constriction drawing means drawing of detailed design prepared by the Contractor and approved by Employer's Representative.

Employer means the person named as employer in Contract Data and the legal successor in title to this person.

Employer's Representative and **Engineer** means the person appointed by the Employer to act as Employer's Representative for the purposes of the Contract and named as such in the Contract Data, or other person appointed from time to time by the Employer and notified as such to the Contractor.

Framework plan means the summary of the Geotechnical Design, including relevant parameters used in the design, and application criteria for the assignment of excavation and support methods.

Ground behaviour means reaction of the ground to the excavation of the full profile without consideration of sequential excavation and support.

Ground Type (GT) means ground, soil or rock, with similar properties.

(Design) Line of excavation means the line of excavation within which no unexcavated ground material shall remain at any time. If due to additional displacements of the ground unexcavated material extend into the line of excavation the Employer's Representative may order to excavate this material at no additional costs.

Materials means things of all kinds (other than Plant) whether on the Site or otherwise allocated to the Contract and intended to form or forming part of the Works, including the supply-only Materials (if any) to be supplied by the Contractor under the Contract.

Overbreak means the excavation beyond the line of excavation.

Overbreak Line means the line to which over break is allowed without any remedial work required.

Plant means the apparatus, machinery and vehicles intended to form or forming part of the Permanent Works.

Site means the places where the Permanent Works are to be executed and to which Plant and Materials are to be delivered, and where the Operation Service is to be provided, and any other places as may be specified in the Contract as forming part of the Site.

System Behaviour (ST) means behaviour resulting from the interaction between ground, excavation profile and support, separated in: system behaviour in the respective excavation section, system behaviour in the supported section and system behaviour in the final state.

Working Day mean a day, on which working is performed.

Works means the Permanent Works and Temporary Works or either of them as appropriate and the facility to be operated by the Contractor during the Operation Service Period.

1.2 Work during Bad Weather Condition

All works have to be continued during any weather condition. Difficulties due to heat, drought or heavy rain falls will be planned with the quoted unit prices. No extension of construction time is derived.

It shall be noticed that project area does show heavy rain fall risks. The Contractor shall investigate the working areas required for the tunnel & high level bridges construction concerning rain fall risk before establishing site infrastructure. Parts of the project area may not be accessible due to heavy rainfall.

1.3 Submittals

The Contractor shall provide description of all works prior to commencement of any work to the Employer's Representative for approval. The Contractor shall submit the documents in a way that sufficient time is left for approval of the submittals but latest 2 working weeks before start of the relevant works if not specified herein differently or directed by the Employer's Representative.

The description shall include but not limited to procedure, sequence, materials, equipment, laboratory etc. The Employer's Representative may request additional data and supplementation of the submittals at any time.

1.4 Standards and Units

Materials, equipment and methods shall comply with the Standards and Codes of Practice indicated using the versions that are current at the date for submission of tenders. The Contractor may propose the adoption of alternative standards and shall provide explanations with any proposals. The use of such standards shall be subject to the agreement of the Employer's Representative.

Some Indian, European and British Standards and Guidelines are listed in Clause 4.0. The list is provided for information only and does not illustrate all relevant Standards for the Works. All Work shall be in compliance with these Standards and Guidelines. First and foremost the compliance of Indian Standards is required unless defined otherwise in this Specification. International (in the first step European) Standards and Guidelines shall be accessed to when no Indian Standards/Guidelines are available for the specific matter.

References to sources for Standards, Guidelines and Recommendations cited in the contractual documents are provided in Table 1 for information only.

Table 1: References to sources of Standards, Guidelines and Recommendation

Abbreviation	Name
ASTM	American Society for Testing and Materials, 100 Bar Harbor Drive West, Conshohocken PA 19429 – 2595, U.S.A.
BSI (BS)	British Standards Institute, 389 Chiswick High Road, London, W4 4AL
DIN	Deutsches Institut für Normung e.V. Beuth Verlag GmbH, Burggrafenstrasse 6 D-10787, Berlin, Germany.
EFNARC	European Federation of Producers and Applicators of Special Building Products, Association House, 235 Ash Road, Aldershot, Hampshire, GU12 4DD, United Kingdom.
EN, ENV	European Committee for Standardisation, Central Secretariat, Rue de Stassart 36 B-1050, Brussels.
IRC	The Indian Road Congress, Jamnagar House, Shahjahan Road, New Delhi- 110011.
IS	Bureau of Indian Standards, Manak Bhavan, 9 Bahdur Shah Zafar Marg, New Delhi – 110002.
ISO	International Organization for Standardisation 1, rue de Varembé CP 56, CH- 1211 Genéve 20, Switzerland.
ÖNORM:	Austrian Standard Institute, Heinestraße 38, 1020 Wien, Austria
RVS (Austrian Code for Road Construction)	Austrian Association on Road, Rail and Transport (FSV), Karlsgasse 5, 1040 Wien, Austria
ÖGG	Austrian Society for Geomechanics, Bayerhamerstrasse 14, 5020 Salzburg, Austria

The units applied are those of SI-System according to ISO 1000. A full stop (.) is used as decimal delimiter. Additionally in the schedule of prices the following abbreviations are applied:

d calendar day

each each

ls lump sum

wd working day

1.4.1 Listing of Standards

The list is provided for information only.

Indian Standards

ID of Standard	Description
IS 10262-2009	Guidelines for concrete mix design proportioning
IS 1077-1992	Common Burnt Clay Building Bricks
IS 11171-1985	Dry-Type Power Transformers
IS 1199-1959	Methods of sampling and analysis of concrete
IS 12269-1987	53 grade ordinary Portland cement
IS 12330-1988	Specificatioon for sulphate resisting Portland cement
IS 1248	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories
IS 1278-1972	Filler rods and wires for gas welding
IS 1343-1980	Code of Practice for Prestressed Concrete
IS 1542-1992	Sand for plaster
IS 1554-1988	(Part 1): PVC insulated (heavy duty) electric cables: Part 1 For working voltages upto and including 1 100 V
IS 1566-1982	hard-drawn steel wire fabric for concrete reinforcement
IS 1885-1993	Electrotechnical Vocabulary: Part 32 Electric cables
IS 1651-1991	Stationary cells and batteries, lead-acid type (with tubular positive plates)
IS 8130-1984	Conductors for insulated electric cables and flexible cords
IS 1786-2008	High strength deformed steel bars and wires for concrete reinforcement-
IS 1791-1985	General Requirements for Batch Type Concrete Mixers
IS 1905-1987	Code of practice for structural safety of buildings; masonry
IS 2062-2011	Hot Rolled Medium and High Tensile Structural Steel
IS 2116-1980	Sand for masonry mortars
IS/IEC 60947-1-2007	Low-voltage Switchgear and Controlgear :Part 1 General
IS 2180-1988	heavy duty burnt clay building bricks
IS 2309-1989	Code of practice for the protection of buildings and allied structures against lightning
IS 2386-1963	(Part 1 & 8): methods of tests for aggregates for concrete
IS 2502-1963	Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
IS 2505-1992	Concrete vibrators - Immersion type - General requirements
IS 2514-1963	Concrete vibrating tables
IS/IEC 60947-2-2003	Low-Voltage Switchgear and Control gear - Part 2 : Circuit Breakers
IS 13118-1991	High-Voltage Alternating-Current Circuit-Breakers
IS/IEC 60947-3-1999	Lowpvoltage switchgear and controlgear : Part 3 Switch-es, disconnectors, switch-disconnectors and fuse combi-
IS 269-1989	Ordinary and low heat Portland cement (33 GRADE)
IS 2705-1992	Current transformers

ID of Standard	Description
IS 2750-1964	Steel Scaffoldings
IS 2751-1979	Code of Practice for Welding of Mild Steel Plain and De-formed Bars for Reinforced Concrete Construction
IS 280-2006	Mild Steel Wire for General Engineering Purposes
IS 13925-1-2012	Shunt capacitors for ac power systems having a rated voltage above 1000 V Part 1:General
IS 2961-1973	Chrome retan finished upper leather
IS 8130-1984	Conductors for insulated electric cables and flexible cords
IS 3043-1987	Code of practices for earthing
IS 3085-1965	Method of Test for Permeability of Cement Mortar and Concrete
IS 3156-1992	Voltage transformers
IS 3231-1986	Electrical relays for power systems protection
IS 3427-1997	A.C. Metal Enclosed Switchgear and Controlgear for Rated Voltages Above 1 kV and Up to and Including 52
IS 3443-1980	Crane rail sections
IS 3558-1983	Code of practice for use of immersion vibrators for con-solidating concret
IS 3597-1998	Concrete pipes - Methods of test
IS 5578-1984	Guide for marking of insulated conductors
IS 11353-1985	Guide for Uniform System of Marking and Identification of Conductors and Apparatus Terminals
IS 3764-1992	Code of safety for excavation work
IS 383-1970	Coarse and Fine Aggregates From Natural Sources For Concrete
IS 3954-1991	Hot Rolled Steel Channel Sections for General Engineer-ing Purposes - Dimensions
IS 4031-1989	Methods of physical tests for hydraulic cement
IS 4032-1985	Method of chemical analysis of hydraulic cement
IS 4081-1986	Safety code for blasting and related drilling operations
IS 4138-1977	Safety code for working in compressed air
IS 432-1982	Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement
IS 456-1978	Plain and Reinforced Concrete - Code of Practice
IS 457-1957	Code of Practice for General Constrution of Plain and Reinforced Concrete for Dams and Other Massive Struc-
IS 458-2003	Precast Concrete Pipes (with and without Reinforce-ment)
IS 4756-1978	Safety code for tunnelling work

ID of Standard	Description
IS 4880 (Part 1-7)	Code of practice for design of tunnels conveying water
IS 4925-2004	Concrete Batching and Mixing Plant
IS 4988-1968	(Part 1-5): Glossary of terms and classification of earth moving machinery
IS 5082-1998	Wrought aluminium and aluminium alloy bars, rods, tubes and sections for electrical purposes
IS 516-1959	Method of Tests for Strength of Concrete
IS 5525-1969	Recommendation for detailing of reinforcement in RCC
IS 5640-1970	Method of test for determining aggregate impact value of soft coarse aggregates
IS 5819-1970	Recommended Short-circuit Ratings of High Voltage PVC Cables
IS 5831-1984	PVC insulation and sheath of electric cables
IS 5878-1971	(Part 1-7): Code of Practice for Construction of Tunnels
IS 5892-2004	Concrete transit mixers & agitators
IS 6430-1985	Mobile air compressor for construction purposes
IS 6461-1972	Glossary of terms relating to cement concrete: Part I Concrete aggregates
IS 6461-1972	Glossary of Terms Relating to Cement Concrete - Part III : Concrete Reinforcement
IS 650-1991	Standard Sand for Testing of Cement
IS 694-2010	POLYVINYL CHLORIDE INSULATED UNSHEATHED AND SHEATHED CABLES/CORDS WITH RIGID AND
IS 7098-1988	Crosslinked polyethylene insulated PVC sheathed cables: Part 1 For working voltage upto and including 1 100
IS 7245-1974	Concrete payers
IS 7251-1974	Concrete finishers
IS 7293-1974	Safety code for working with construction machinery
IS 7319-1974	perforated concrete pipes
IS 783-1985	Code of Practice for Laying of Concrete Pipes
IS 7861-1981	(Part 2): Code of pracdtice for extreme weather concreting: Part II Recommended practice for cold weather con-
IS 7861-1981	(Part 1): Code of practice for extreme weather concreting Part 1 Recommended practice for hot weather concreting
IS 800-2007	General Construction In Steel - Code of Practice
IS 8041-1990	Specification for rapid hardening Portland cement (2nd revision)
IS 8112-1989	High strength ordinary Portland cement (43 grade)
IS 814-2004	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel

ID of Standard	Description
IS 816-1969	Code of practice for use of metal arc welding for general construction in mild steel
IS 817-1992	(Part 1): Training of Welders - Code of Practice: Part 1 Manual metal arc welding
IS 818-1968	Code of Practice for Safety and Health Requirements in Electric and Gas Welding and Cutting Operations
IS 2062-2011	Hot Rolled Medium and High Tensile Structural Steel
IS 8623-1993	Low-Voltage Switchgear and Controlgear Assemblies
IS/IEC 60898 -2002	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations : Part 1
IS 9012-1978	Recommended practice for shotcreting
IS 9103-1999	Concrete Admixtures
IS 9284-1979	Method of test for abrasion resistance of concrete
IS 9417-1989	Recommendations for welding cold worked bars for reinforced concrete construction

European Standards

Eurocode 1	Basis of design and actions on structures
Eurocode 2	Design of concrete structures
Eurocode 3	Design of steel structures
Eurocode 5	Design of timber structures
Eurocode 7	Geotechnical design
Eurocode 8	Design of structures for earthquake resistance
BS EN ISO	Plastics. Determination of water absorption
BS EN 196:2005	Methods of testing cement
BS EN 197-1:2011	Cement. Composition, specifications and conformity criteria for common cements
BS EN 197-1:2004	Cement – Part 1: Composition, specifications and conformity criteria for common cements
BS EN 206-1:2001	Specification, performance, production and conformity
BS EN 295-7:1996	Requirements for vitrified clay pipes and joints for pipe jacking
BS EN 338:2010	Structural timber. Strength classes
BS EN 450-1:2005	Fly ash for concrete – Part 1: Definitions, specifications and conformity criteria A1:2007
BS EN 471:2004	High-visibility warning clothing for professional use - Test methods and requirements
BS EN 480:2006	Admixtures for concrete, mortar and grout. Test methods
BS EN ISO 527- 3:1996	Plastics. Determination of tensile properties. Test conditions for films and sheets
BS EN 681-2:2000	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Thermoplastic elastomers
BS EN 771-3:2011	Specification for masonry units. Aggregate concrete masonry units (dense and light-weight aggregates)
BS EN 772-2:1998	Methods of test for masonry units. Determination of percentage area of voids in masonry units (by paper indentation)
BS EN 791:1996	Drill rigs – safety
BS EN 815:1997	Safety of unshielded tunnelling boring machines and rodless shaft boring machines for rock

BS EN 932-6:1999	Tests for general properties of aggregates. Definitions of repeatability and reproducibility
BS EN 933-1:2012	Tests for geometrical properties of aggregates. Determination of particle size distribution. Sieving method
BS EN 934-2:2009	Admixtures for concrete, mortar and grout – Part 2: Concrete admixtures – Definitions and requirements, conformity, marking and
BS EN 1008:2002	Mixing water for concrete – Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete
BS EN 1011-1:2009	Welding - Recommendations for welding of metallic materials - General guidance for arc welding
BS EN 1011-2:2001	Welding. Recommendations for welding of metallic materials. Arc welding of ferritic steels
BS EN 1062-7:2004	Paints and varnishes. Coating materials and coating systems for exterior masonry and concrete. Determination of crack bridging
BS EN 1090-2:2008	Execution of steel structures and aluminium structures. Technical requirements for steel structures
BS EN 1097	Tests for mechanical and physical properties of aggregates
BS EN 1367	Tests for thermal and weathering properties of aggregates
BS EN ISO	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
BS EN 1537:2000	Execution of special geotechnical work – rock anchors
BS EN 1542:1999	Products and systems for the protection and repair of concrete structures. Test
BS EN 1562:2012	Founding. Malleable cast irons
BS EN 1563:2012	Founding. Spheroidal graphite cast iron
BS EN 1744	Tests for chemical properties of aggregates
BS EN 1849-2:2010	Flexible sheets for waterproofing. Determination of thickness and mass per unit area. Plastic and rubber sheets
BS EN 1928:2000	Flexible sheets for waterproofing. Bitumen, plastic and rubber sheets for roof waterproofing. Determination of watertightness
BS EN ISO 3506-2: 2009	Mechanical properties of corrosion-resistant stainless-steel fasteners - Nuts
BS EN ISO	Paints and varnishes. Pull-off test for adhesion
BS EN ISO	Quality management systems. Requirements
BS EN 10025:2004	Hot rolled products of structural steels
BS EN 10080:2005	Steel for the reinforcement of concrete. Weldable reinforcing steel.
BS EN 10164:2004	Steel products with improved deformation properties perpendicular to the surface of the product – technical delivery conditions
BS EN 10226-1:2004	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
BS EN ISO 11925- 2:2011	Reaction to fire tests. Ignitability of products subjected to direct impingement of flame. Single-flame source test
BS EN 12110:2002	Tunnelling machines – Air locks – Safety requirements
BS EN 12111:2002	Tunnelling machines – Road headers, continuous miners and impact rippers – Safety requirements
BS EN 12310-2:2000	Flexible sheets for waterproofing. Determination of resistance to tearing (nail shank). Plastic and rubber sheets for roof waterproofing
BS EN 12317-2:2010	Flexible sheets for waterproofing. Determination of shear resistance of joints. Plastic and rubber sheets for roof waterproofing
BS EN 12336:2005	Tunnelling machines - Shield machines, thrust boring machines, auger boring machines, lining erection equipment - Safety requirements
BS EN 12350	Testing fresh concrete

BS EN 12390	Testing hardened concrete
BS EN 12504-1	Testing concrete in structures – Part 1: Cored specimens – Taking, examining and testing in compression
BS EN 12588:2007	Lead and lead alloys. Rolled lead sheet for building purposes
BS EN 12620:2002	Aggregates for concrete
BS EN 12878:2005	Pigments for the colouring of building materials based on cement and/or lime. Specifications and methods of test
BS EN 12889:2000	Trenchless construction and testing of drains and sewers
BS EN 13055-	Lightweight aggregates. Lightweight aggregates for concrete, mortar
BS EN 13139:2002	Aggregates for mortar
BS EN 13263-	Silica fume for concrete – Part 1: Definitions, requirements and con-
BS EN 13492:2004	Geosynthetic barriers - Characteristics required for use in the construc-
DIN EN 13670-	Execution of concrete structures
BS EN 13791:2007	Assessment of in-situ compressive strength in structures and pre-cast
BS EN 14487-	Sprayed concrete – Part 1: Definitions, specifications and conformity
BS EN 14487-	Sprayed concrete – Part 2: Execution
BS EN 14488-	Testing sprayed concrete – Part 1: Sampling fresh and hardened con-
BS EN 14488-	Testing sprayed concrete – Part 2: Compressive strength of young
BS EN 14488-	Testing sprayed concrete – Part 3: Flexural strengths (first peak, ulti-
BS EN 14488-	Testing sprayed concrete – Part 4: Bond strength of cores by direct ten-
BS EN 14488-	Testing sprayed concrete – Part 5: Determination of energy absorption
BS EN 14488-	Testing sprayed concrete – Part 7: Fibre content of fibre reinforced con-
BS EN 14889-	Fibres for concrete – Part 1: Steel fibres. Definitions, specifications and
BS EN 14889-	Fibres for concrete – Part 2: Polymer fibres. Definitions, specifications
BS EN 15167-	Ground granulated blast furnace slag for use in concrete, mortar and
BS EN 60204	Safety of machinery. Electrical equipment of machines
BS EN 61672-	Electroacoustics. Sound level meters. Specifications
DD CEN/TS 14416:2005	Geosynthetic barriers. Test method for determining the resistance to roots
PD CLC/TR 50426:2006	Assessment of inadvertent initiation of bridge wire electro-explosive devices by radio-frequency radiation. Guide.

British Standards

BS 143 and 1256:2000	Threaded pipe fittings in malleable cast iron and cast copper alloy
BS 1134:2010	Assessment of surface texture. Guidance and general information
BS 4190:2001	ISO metric black hexagon bolts, screws and nuts. Specification
BS 4449:2005	Steel for the reinforcement of concrete – Weldable reinforcing steel – and decoiled product Bar, coil
BS 4482:2005	Steel wire for the reinforcement of concrete products. Specification
BS 4483:2005	Steel fabric for the reinforcement of concrete
BS 4921:1988	Specification for sherardized coatings on iron or steel
BS 5228-1:2009	Code of practice for noise and vibration control on construction and open sites. Noise
BS 5228-2:2009	Code of practice for noise and vibration control on construction and open sites. Vibration
BS 5607:1998	Code of practice for the safe use of explosives in the construction indus-
BS 5911-1	Concrete pipes and ancillary concrete products. Specification for unreinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints (complementary to BS EN 1916:2002)

BS 5975:2008	Code of practice for temporary works procedures and the permissible stress design of falsework
BS 6100	Building and civil engineering. Vocabulary. (various dates)
BS 6164:2011	Code of practice for health and safety in tunnelling in the construction
BS 6319	Testing of resin and polymer cement compositions for use in construction (various dates)
BS 6472:2008	Guide to evaluation of human exposure to vibration in buildings (1–80
BS ISO 4866:2010	Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their
BS 7385-2:1993	Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration (Part 2)
BS 7668:2004	Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification
BS 7671:2011	Requirements for electrical installations
BS 7973-1:2001	Spacers and chairs for steel reinforcement and their Specification. Product performance requirements
BS 7973-2:2001	Spacers and chairs for steel reinforcement and their Specification. Fixing and application of spacers and chairs and tying of reinforce-
BS 7979:2001	Specification for limestone fines for use with Portland cement
BS 8102:2009	Code of practice for protection of below ground structures against water from the ground
BS 8500-1:2006	Concrete – Complementary British Standard to BS EN 206-1. Method of specifying and guidance for the specifier
BS 8500-2:2006	Concrete. Complementary British Standard to BS EN 206-1. Specification for constituent materials and concrete
BS 8666:2005	Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification

International Standards

ASTM D 1777	Standard Test Method for Thickness
ASTM D 3776	Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
ASTM D 4491a	Standard Test Method for Water permittivity
ASTM D 4751	Standard Test Method for Apparent opening sizeof a Geotextile
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geo-
ASTM D 3786	Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geo-
ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D 3787	Standard Test Method for Bursting Strength of Textiles-Constant-Rate-of- Traverse (CRT) Ball Burst Test
ASTM D 4157	Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)
EFNARC-1996	European Specification for Sprayed Concrete
ASTM C-39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C-78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C-94/C	Standard Specification for Ready-Mixed Concrete
ASTM C-172/C	Standard Practice for Sampling Freshly Mixed Concrete

ASTM C-685/C	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
EFNARC Three Point Bending Test on Square Panel with Notch	Testing Sprayed Concrete - Flexural tensile strength of fibre concrete on sprayed test specimen.
Austrian concrete society publica-	Guide line on shotcrete and testing methods
Austrian concrete society publica-	Inner lining concrete
JSCE -2004	Recommendation for design and construction of steel fibre reinforced concrete, Publications of Japan society of civil Employer's
DIN 67524 (Part 1/02)	Lighting of street tunnels and underpasses
DIN 67524-2008	Tunnel illumination
DIN 5035	Artificial lighting
RABT (2006)	Guidelines for equipment and operation of road tunnels

1.5 Materials

All materials supplied to the Works shall conform to all of the following:

- This specification.
- The appropriate Indian Standard, if no Indian Regulation is available the corresponding European or British Standard shall be adopted.
- Where an industry certification scheme is available, material shall be supplied in accordance with that scheme.
- Materials shall be supplied from a quality assured source, operating a Quality Assurance system in compliance with the relevant part of BS EN ISO 9001.

Where required in the particular specification or where stated on the drawings, samples should be supplied and the subsequent material shall conform to the samples.

Materials used on site shall be used in accordance with the manufacturer's recommendations and instructions.

All materials should be handled and stored in a way to maintain their integrity and to avoid damage and degradation.

Details of the level of inspection and testing to be adopted in respect of supplied materials shall be agreed with the Employer's Representative prior to commencement of work. Individual submissions are then restricted to those required by the Quality System.

1.6 Quality Management and Records

The project shall be administered using an accredited Quality Management System conforming to BS EN ISO 9001. The individual requirements for agreement by the Employer's Representative of materials and workmanship throughout this Specification shall be incorporated into agreed self-certification procedures.

The agreed Quality Control arrangements, including hold points and submission of records for the Employer's Representative's acceptance, shall be set out in agreed Inspection and Test Plans.

References to the agreement of materials, workmanship, methods etc. throughout this specification shall be interpreted as requirement of agreement of the Employer's Representative.

The Contractor shall maintain all records necessary under this specification , including quality records as appropriate.

Electronic records shall be maintained and backed up on a daily basis to prevent loss of data in the event of failure of electronic data storage.

Copies of all site records shall be available to the Employer's Representative.

The Contractor shall supply the Employer's Representative with all information necessary for the Health and Safety file including as-built drawings and records, maintenance schedules, operation and maintenance manuals, within the time specified in the Contract. Information shall be provided in the agreed format. The Health and Safety File shall be prepared by the party identified in the Contract.

2 Site Installation

2.1 General

The Contractor shall be responsible for providing all necessary provisions for the execution of the construction works under this Contract. This includes plants, equipment, materials and laboratories.

The Contractor shall design, furnish, install, maintain and operate at the project area all temporary works and equipment such as Contractor's camp, offices, stores, workshops, warehouses, assembly areas, machinery, vehicles, material yards, health, safety and environment friendly measures, electric power, telecommunications, illumination, water supply system, concrete and aggregate processing plants, material testing laboratory, temporary construction roads etc.

56 days prior to commencement of any works the Contractor shall submit layout plans at adequate scale showing the temporary construction facilities of the Contractor to the Employer's Representative and they shall include:

- The Contractor's camp, offices, parking space, workshop, warehouses and storage areas including explosive magazines
- Water supply, electric power supply including illumination and communication system
- Sewerage, sewage treatment and disposal
- Construction of temporary roads
- Concrete and material processing plant, cement and aggregate storage
- Material testing laboratory
- Temporary tunnel ventilation system
- Survey plan
- Security and safety arrangement plan, medical care services.

2.2 Contractor's Camp

The Contractor shall design, furnish, install, maintain and operate the Contractor's camp at the location and within the designated lines defined by the local Authorities or the Employer's Representative. The Contractor's camp shall provide the housing, feeding and recreation of the Contractor's employees and those of his subcontractors. The Contractor's camp shall be designed for the maximum number of employees on the site.

All facilities shall be in compliance with the Indian Construction Workers Act 1996 on permanent and temporary housing of employees. Prior to any camp construction the Contractor's drawings and Specifications shall be approved by the Employer's Representative.

The Contractor shall provide additional adequate housings for the Employer's Representative staff.

2.3 Site Office, Stores

The Contractor shall design, furnish, install, maintain and operate all required offices, stores, warehouses and testing laboratories at the location and within the designated lines defined by the local Authorities or the Employer's Representative.

The Contractor shall provide and maintain a fully equipped site office for the Employer's Representative staff on each construction site.

2.4 Lighting & Ventilation during Construction

Lighting and ventilation during construction shall be in compliance with relevant Clause 7.7 and 7.8 in this Specification.

2.5 Electrical Power Supply

2.5.1 General

The Contractor shall be responsible for obtaining an adequate electrical supply for all his Site operations during the whole construction period.

Installations shall comply with IEC 60204 Safety of machinery, electrical equipment of machines and IEC 60364 Electrical installations of buildings.

If so required by the Employer's Representative, the Contractor shall make a copy of all certificates prepared upon completion of electrical installations and prepared for all required periodic checks available.

The Contractor shall appoint a competent person to be solely responsible for ensuring the safety of all temporary electrical equipment on site.

The Contractor is to comply at all times with the Electricity at Work Regulations.

The Contractor shall furnish, install and keep operational throughout the duration of the Works standby generating facilities of such capacity as to be able to maintain minimum services such as illumination, ventilation, water supply, dewatering etc. necessary for the Project Area safety and security during a failure of the primary power source.

Oil filled transformers are not permitted in subsurface usage. Transformers shall be air-cooled and dry type.

Electrical heaters or radiators having exposed coils or elements shall not be permitted underground.

The lighting circuits shall be separated from the other sub-circuits.

The Contractor shall furnish, operate and maintain 100% standby diesel-driven generators or alternative source of power supply at each working portal. The generators or alternative supply shall be capable of operating the lighting system and the pumps required to flooding of the underground works besides operating all other systems so to allow the work function smoothly in event of main power system failure. The generators shall be tested by the Contractor weekly to ensure the full working capability.

Drawings showing the design of the electrical power distribution system within each area shall be submitted to the Employer's Representative for approval at least 28 days prior to installation. This shall at least include a single line diagram for the distribution

systems within each area, protection schemes for the systems and description of the operation concept. The installation of the electrical distribution systems shall not be started unless the Employer's Representative has approved the submitted documents.

The client or representative of the client shall be allowed to access always all facilities of the construction site.

2.5.2 Earthing

All light fittings, electrical equipment and appliances shall be earthed electrically, and the Contractor's specialised personnel shall periodically check the effectiveness of such earthing. The earthing shall meet the requirements for plant and equipment given by Indian Standard 3043.

2.5.3 Cables

All exposed electrical cables installed within the tunnel shall comply with the following requirements:

- Flame retarding properties to IEEE 383,
- Toxicity level Acid evolution when burned 7%
- Flame propagation Oxygen index value 30% minimum
- Smoke density rating: 35% maximum

Supply cables at 3.3 kV or below shall be 3-core with the armouring used as the earth return in conditions where the cable is not subject to continues movement after installation or where the supply is to be a fixed point.

For supply to mobile or transportable equipment, where operation of the equipment subjects the cable to flexure, cables shall be sheathed in flame retardant LSFH.

2.6 Site Communication

The Contractor shall provide a suitable system for communication between the underground work site and workstations outside the tunnel, and maintain such system in working order at all times. An underground station (including telephone socket with bell and indicator) shall always be within 50 m of the point where major work is being carried out and at 200 m intervals along the driven tunnel.

2.7 Water Supply

The Contractor shall provide water that is adequate for year-round use in his camps as well as for general construction use.

The Contractor shall furnish, install, operate and maintain all necessary equipment including pumps, piping, fittings, valves, storage tanks and disinfectants for the water supply and distribution systems.

Special measures during low temperature periods shall be taken such as heating or thermal insulation of pipes to avoid freezing of water.

2.8 Concrete and Material Processing Plant

At each construction site the Contractor shall install and erect all required materials processing plants of sufficient capacity to meet his planned peak requirements during construction. The plants shall be subject to approval by the Employer's Representative. All control and measuring shall be regularly serviced and calibrated.

The following plants shall be installed but not limited to:

- concrete aggregates processing plant (crushing and screening);
- concrete plant (batching and mixing)
- grouting plant

2.9 Testing Laboratory

The Contractor shall install, equip and maintain an adequate field laboratory for the sampling and testing of materials such as concrete, earth or any other materials as specified herein.

The laboratory shall be adequately lit, supplied with sufficient electrical power, water and heating. Adequate space for testing devices and storage areas shall be provided.

The equipment to be supplied and the methods of testing shall be in accordance with the referenced Standards in these specifications. The proposed type and number of items of laboratory equipment shall be presented to the Employer's Representative and approved prior to purchase.

All facilities and services shall be available to the Employer's Representative as required. All sampling and testing to be undertaken shall be subject to the supervision of the Employer's Representative. The laboratory shall be run by Contractor's personnel experienced in sampling and testing of materials, and be subject to quality control.

Specialized testing which may be required and which cannot be performed in the Contractor's laboratory due to lack of time or equipment shall be assigned by the Contractor to an independent organization approved by the Employer's Representative. The Contractor shall accept all test results and all instructions or restrictions stipulated by the Employer's Representative based on such tests.

2.10 Removal

The Contractor's Camp shall be dismantled and removed subsequently on completion of the Works by the Contractor, unless otherwise specified or directed by the Employer's Representative.

All temporary installations must be completely removed after finalization of the relevant works. Rubbish, waste, debris and material must be removed.

Any disturbed area that will not be taken over for permanent use shall be restored at the completion of the Works to the original appearance as far as possible.

3 Working Environment

3.1 Health, Safety, Environment and Welfare

The Contractor shall adopt safe systems of work which minimise the risk to health, safety and Environment. All persons working on the site shall be competent to carry out their tasks and duties safely and in a manner that will endanger neither their own health nor the health of others. Persons, who are employed on the site for the first time, shall be subject to appropriate pre-employment occupational health checks, instructed on the hazards inherent in the site, precautions to be taken, the form of construction, and emergency procedures and fire safety. Such instructions shall be given whenever there is a material change in the working arrangements. The Contractor shall maintain a record of all persons instructed and each person shall be required to sign such record confirming that instruction has been received. No person shall be permitted on site without being inducted as set out above. The Contractor shall prepare a written statement of Safe Systems of Working which shall be issued to all persons at site.

All parties shall comply with the requirements and recommendations of BS 6164, BS EN 815, BS EN 12336, BS EN 12110, BS EN 12111 and BS 7671.

The Contractor shall also comply with the requirements of the Employer's codes of practice for safe working and those of any authority or body where their services or property are affected by the works.

A person responsible for Safety shall be appointed by the Contractor and this person shall be conversant with corporate policy, management operational instructions, regulations, legislation and current best practice and how these relate to health, safety, environment and welfare. Compliance with health, safety and environment requirements is the responsibility of managers and individuals at each and every level.

The Contractor shall establish on site:

- Welfare and first aid facilities with appropriately trained personnel, both on the surface and underground, as required by the scale of the Works. Welfare facilities shall include toilet and washing facilities. Where water washing facilities cannot be provided, appropriate alternative means of hand cleaning shall be provided. Barrier creams etc. for skin protection shall also be provided.
- Occupational health facilities on the surface, staffed by appropriate occupational health professionals as required by the nature and scale of the Works.
- Equipment for the rescue and evacuation of persons underground with persons instructed in its use.
- All necessary equipment, safety barriers, notices and the like for the protection of persons.
- Procedures to ensure that all plant and equipment underground is fitted with onboard fixed fire-extinguishing equipment covering fluid tanks, motors or engine compartments and tyres along with the use of reduced flammability (HFDU) hydraulic fluid.
- Comprehensive fire detection and fire-fighting facilities.
- Sufficient chemical or compressed oxygen self-rescuer sets for all persons underground in accordance with HSE guidance.

- A competent safety officer shall be appointed by the Contractor who shall be conversant with the hazards associated with the form of construction to be undertaken and who shall be responsible for ensuring compliance with all management directives, rules and regulations concerning occupational health and safety.
- Subject to any legal requirement or requirement of the Employer and the size and nature of the Works, the Contractor may appoint a visiting competent safety officer under item above. He shall visit the site at the start of operations and for changes in methods of working, but in any event his visits shall not be at greater intervals than one month.

3.2 Noise & Vibration

3.2.1 General

The Contractor shall minimise occupational exposure to noise and vibration, the amount of noise emitted to the environment and the environmental vibration levels generated by his work activity.

The Contractor shall select and utilize methods of working and items of plant and control in his works so as to minimise noise and vibration levels, including occupational noise and vibration exposure of the workforce, and not to exceed maximum permitted noise and vibration levels specified in the Contract or defined by local Authorities.

The adherence to any vibration levels specified in the Contract does not relieve the Contractor of his obligations with respect to structural or other property damage.

3.2.2 Temporary Fencing and Barriers

Where required the Contractor shall erect and maintain throughout the construction period temporary fencing of appropriate height taking account of the need for this fencing to act as a noise barrier around all working areas. The fencing shall be dismantled and reerected as the progress of the Works requires.

The line of the fencing shall be uniform and the exterior face of the fencing shall be treated with a durable finish. Where required, in order to prevent reflection of noise, the Contractor shall line the inside of fencing with sound-absorbent material with accepted acoustic absorption properties. The material shall be fire and water resistant.

Local fencing barriers or shelters shall be erected as necessary to shield particular activities, such as those involving the use of pneumatic or hydraulic techniques, and all stationary plant.

3.2.3 Plant & Equipment

The Contractor shall select and use plant, equipment and working practices which minimise occupational exposure to noise and vibration and minimise emissions of noise and vibration to the environment.

All plant shall be properly maintained and relevant service records completed. All plant shall be provided with effective silencers and vibration-dampening devices, and shall be operated according to the manufacturer's recommendations in such a manner as to avoid causing any excessive noise emission or vibration. The noise emitted by an item of plant shall not exceed the relevant values quoted in the Contract or defined by local Authorities.

3.2.4 Noise & Vibration Monitoring

Where monitoring is required the Contractor shall provide, calibrate, and operate according to the manufacturer's recommendations appropriate equipment for monitoring construction noise and vibration throughout the construction period.

The Contractor shall arrange for adequate standby equipment.

The Contractor shall notify the Employer's Representative immediately whenever the specified noise or vibration limit has been exceeded, and agree measures to avoid repetition.

Any items of plant causing excessive noise or vibration levels shall be removed from the site and substituted by alternative compliant equipment.

The Employer's Representative may instruct the Contractor to devise and use an alternative process if a construction method is causing unnecessary disturbance.

3.3 Access & Egress

The Contractor shall make all arrangements and assume full responsibility for transportation to the Site of all construction plant, materials and supplies needed for the proper execution of the Works.

Where designated access routes are indicated in the Contract, the Contractor shall use no other without the agreement of the Employer's Representative.

3.3.1 Maintenance of Routes

All public and private highways and roads which are being used by the Contractor's, Subcontractors' or Suppliers' vehicles for the construction of the Works shall be kept clean and free of dirt and mud arising from the Works. The Contractor, unless otherwise provided for in the Contract, shall provide, maintain and use as necessary suitable equipment including mechanical road sweepers, throughout the course of the Works where and as agreed with the highway authority.

The Contractor shall provide, maintain and use mechanical wheel washers and high-pressure hosing facilities at work sites and at such additional locations as required under the Contract.

The Contractor shall be responsible for all maintenance in all respects of all site roads.

Any area of public highway which is closed because of the Works shall not be reopened until appropriate safety and traffic management measures have been completed and until the Employer's Representative confirms that it is in a suitable condition for use by the public.

The Contractor shall protect the public from the Works by secure fencing and gates and shall control access through the gates as required under the Contract.

3.3.2 Access for Others

The Contractor shall at all times meet the full requirements for access for fire, ambulance and other emergency services and maintain liaison with them in that respect.

The Contractor shall at all times maintain access for the authorized representatives of utility providers and allow emergency operations to be carried out on any utility or service facilities within the Site.

The Contractor shall not use public or private rights of way for depositing or storing plant or materials. The Contractor shall maintain those parts of the public or private rights of way not temporarily occupied by the Works in a clean, passable and safe condition at all times.

The Contractor shall execute the works in such a manner that safe pedestrian access, including disabled person access, to all properties is maintained at all times.

Unless otherwise provided in the Contract, methods of construction and programming of the works shall be such that vehicular access to properties affected by the Works is not restricted.

3.3.3 Traffic Safety and Management

Where work is carried out on or adjacent to a trafficked highway the Contractor shall ensure that personnel shall, at all times, wear high-visibility fluorescent garments which shall comply with BS EN 471.

All proposals, details, execution, maintenance, removal and necessary reinstatement associated with traffic safety and management and temporary decking and other temporary structures on, or subways beneath, the highway shall be subject to the approval of the appropriate authorities. The Contractor shall supply all information required, for consultation with the appropriate authorities including the local authority, police and other authorities with jurisdiction or interest.

The Contractor shall agree a traffic management plan with the Employer's Representative based on consultation and agreement with highway authorities. This shall show the scheme of traffic safety and management measures including the provision of safety zones and traffic signing. The plan shall include the requirements of emergency services for access into and through the site.

Fenced storage areas, gantries, loading bays, skips and other temporary structures on the public highway shall be provided and maintained to the conditions of a license issued by the local authority.

All traffic safety and management measures necessitated by the Works shall be fully operational before the Contractor commences any work which affects the public highway.

The Contractor shall devise and put into effect traffic management procedures, including appropriate speed limits, within the site including on haul roads and temporary access roads, which are to an equivalent standard to those for a public highway unless directed otherwise by the Employer's Representative.

3.3.4 Signing, Signaling & Lighting

The Contractor shall provide suitable entry and exit signs, at the points of access to and from the site, for vehicles and plant engaged on the works. As far as possible, vehicles and plant shall enter and exit the site in a forwards direction.

Unless otherwise specified, the Contractor shall make all necessary arrangements including notices to relevant authorities for the provision, erection, maintenance, reposi-

tioning, covering and uncovering and final removal of all traffic signs as the progress of the works requires.

The Contractor shall devise and put into operation traffic management arrangements to separate pedestrian and vehicular traffic. Pedestrian access shall be clearly signed and provided with barriers of adequate strength.

The temporary traffic Contractor shall be responsible for the design, provision and maintenance of all signals and associated equipment unless otherwise given in the Contract.

Where required during the execution of the Works, the Contractor shall provide and maintain temporary lighting for the highways. Temporary lighting shall provide the same level of illumination as that of the existing street lighting, which it replaces. Temporary lighting shall be provided and approved prior to the removal of any existing street lighting.

3.3.5 Survey & Reinstatement

Prior to commencing the works the Contractor shall carry out a condition survey of all roads, rails and footways adjacent to the site. The survey record shall be available to the Contractor.

Unless stated otherwise, the Contractor shall reinstate all roads and footways affected by the works to the extent, lines and levels that existed prior to the commencement of the works and to standards that are at least equivalent to those that existed prior to the commencement of the Works.

Unless stated otherwise, the Contractor shall reinstate all surface water drainage systems (including but not restricted to gullies, channels, catch-pits, piperuns, manholes and covers as applicable and the like) affected by the Works. The Standard of reinstatement shall be at least equivalent to that existing prior to the Contract commencing.

3.3.6 Access within Works

The Contractor shall provide safe access in and about the site and underground workings.

All shafts, if any, shall have a ladder access in addition to any mechanical means.

The Contractor shall provide a safe designated pedestrian access in the tunnel and throughout the site area at all times. This shall have a firm level, slip-resistant and continuous surface and shall be suitable for use in emergencies when lighting may be unavailable.

The Contractor shall segregate pedestrian and vehicular access routes.

The Contractor shall maintain a clear means of egress from each tunnel face at all times. Such means of egress through or past equipment, trains and similar obstructions shall meet the minimum dimensions in BS EN 12336.

The Contractor shall establish, maintain and operate a system whereby the presence of personnel underground is recorded, together with their location where appropriate.

3.4 Disposal of Spoil & Water

The Contractor shall prepare a Site Waste Management Plan (SWMP), which sets out in detail how spoil and all waste is to be categorised, disposed of and monitored, the program for disposal and how legislation is to be complied with. This plan will address all waste matters at the site and have specific documented mechanisms for adopting a 'reduce, reuse, and recycle' approach to waste minimisation for dealing with all wastes. The SWMP will be reviewed by the Employer's Representative and accepted or approved as required by the Contract.

3.4.1 Solid Waste Disposal

The Contractor shall remove all excavated material, spoil, surplus materials and rubbish from whatever source on site and shall, except where otherwise specified in the Contract, make his own arrangements for their disposal and provide all the necessary facilities to achieve this. The Contractor shall also comply with any legal or local authority requirements applying to the handling and disposal of any contaminated spoil.

The Contractor shall set up a system to control and monitor the transport of spoil from site to the tip site, in accordance with the current legislation and requirements of the local Authorities. The system shall be agreed with the Employer's Representative and will provide evidence that each load has been deposited at a licensed tip site.

The Contractor shall retain auditable records of waste removed from site. Waste Transfer Notices should be collated and submitted to the Employer's Representative. Transfer and Consignment notes shall be kept in the site file.

The Contractor shall comply with all statutes and statutory instruments relating to spoil disposal.

3.4.2 Liquid Waste Disposal

Before discharging any surplus water, the Contractor shall obtain the prior approval of the owner of the sewer or water-course and of the Environment Agency.

The Contractor shall ensure that the condition of any discharged water complies with permitted limits. The parameters to be monitored include pH values, temperature and suspended solids.

4 Dewatering Arrangement

4.1 General

The Contractor shall design, furnish, maintain and remove temporary works for protecting the Works under construction against flood flows in rivers and nallahs, and design, furnish, operate, maintain and dismantle the temporary dewatering facilities required to remove water from construction activities and from natural surface flow or groundwater seepage from working areas on the surface as well as in the tunnel.

The Contractor's working methods and systems shall be designed to control ground and surface water to permit the construction of shafts, tunnels, breakouts and portal structures.

Where dewatering operations are used they shall be kept to the minimum necessary for the execution of the Works. If, at any time, during construction, the inflow of water increases more than the installed pumping capacity, the Contractor shall be required to install additional pumping facilities and perform additional sealing as required by the Employer's Representative. The dewatering system shall include a system for identifying ingress of soil material during the dewatering operation.

In planning temporary pumping systems, the Contractor shall take due consideration of water quality, pressure, quantity and variations in water levels.

Settlement ponds and other measures shall be provided so as to ensure that potentially contaminated or polluted matter from the execution of the Works is nowhere released into creeks, rivers or the ground.

The Contractor will be held responsible for all damage caused by his dewatering procedures or the lack of such, and he shall reinstate or repair disturbed ground or structures to their original condition or as otherwise approved.

Plant shall be delivered to site and maintained in good working order. Plant and pipe work shall be fitted with appropriate valves, controls and gauges. Each dewatering well shall be capable of individual adjustment and being shut down and isolated from the rest of the system. Appropriate standby equipment and spares shall be maintained on site at all times.

4.2 Construction Site

The Contractor shall perform all works necessary to drain the surface construction sites of rain, groundwater and service water. The work shall include, but not be limited to the following:

- design and construction of drainage, ditches, pits, pump sumps and settlement ponds with oil separators
- design, furnish, operate and maintain dewatering equipment and conduits
- relocation of dewatering facilities required for the performance of other works
- diversion of nallahs where required by construction of any permanent or
- temporary structure, including spoil and stockpile areas

- all auxiliary work required for the safe and continuous dewatering of the surface construction sites
- The Contractor shall perform all work necessary to collect and drain construction water and infiltrating groundwater, convey it to main conduits and convey it out from tunnel work to discharge points. The work shall include, but not be limited to, the following:
- design and construct pits, trenches and drainage measures along the tunnel invert
- design, furnish, operate and maintain dewatering equipment (including pumps and power supply) and conduits
- relocate dewatering facilities as required for the unhindered performance of the tunnel work
- design, construct and operate settlement ponds, with oil separators, at the portals or elsewhere, with discharge into creeks and rivers, as approved
- all auxiliary-work required for the safe and continuous dewatering of the underground working areas

The Contractor shall design and install complete facilities for the drainage of the temporary and permanent portal areas and the muck disposal areas.

Drainage ditches shall be excavated along the top of excavated slopes and on the berms. Such ditches shall be kept well back from the excavation edges. In loose materials the ditches shall be lined with concrete or with rock paving set in mortar immediately after completion of excavation. The ditches shall be regularly cleaned out of accumulated silt and other matter so that water may flow freely at all times.

Rivers, nallahs and intermittent streams in the vicinity of temporary or permanent works shall be diverted into culverts of lined ditches. Erosion must be prevented. Sediment laden water must be diverted through settling ponds or basins according to the environmental regulations.

5 Tunnel

The Contractor shall perform all necessary works to collect and drain construction and ground water in all tunnel at all headings. The longitudinal inclination of the Tunnel is continuous upward from west to east portal. Due to this, all tunnels heading towards western portal must be excavated with falling gradient. All required drainage measures including collection and pumping of any ground water in these downward inclined tunnel excavations must be included in the given prices. The water shall be drained out of the tunnel with minimum impact on ground stability and construction works. This includes, but not limited to:

- pits, trenches and drainage along the tunnel floor dewatering equipment including pumps
- pipes along tunnel side wall
- collecting local inflows directly from tunnel perimeter before and after installation of primary support
- collect inflowing water with dimpled sheets along the tunnel perimeter
- settlement ponds or basins with oil separators before discharge into rivers

Mountain water due to tunnel construction shall be collected and drained. Excavation areas shall be drained of all construction water and ground water. Water appearing at the face shall be drained to the longitudinal drainage system as soon as possible.

Dewatering arrangement has to be considered for falling and rising gradient of the excavation, a softening and damaging of the bench shall be avoided. The water drainage length shall be kept at a minimum. In case of falling gradient temporary pump sumps must be max 5m behind the excavation face (top heading, bench, temporary and permanent invert).

The Contractor shall provide adequate pumping capacity where required, including a sufficient number of standby pumping units and standby power, to handle all water entering any portion of the tunnel works. These units shall be connected to the power supply and dewatering systems in such a way that proper and uninterrupted drainage will be ensured throughout the construction period.

Heavy mountain water may occur and therefore additional drainage system to the longitudinal drainage system may be required. In such zones systematic drainage drillings ahead of the tunnel face may be required and ordered by the Employer's Representative.

If required, drainage drillings (placement, direction and length according to local conditions) shall be constructed with no delay. Instrumentation, for measuring the pore pressure, may be required by the Employer's Representative.

In tunnel sections with ground material sensitive to water (softening or swelling ground condition) particular care has to be taken concerning water drainage. The inflowing water shall be collected as soon as possible and conveyed in pipes not to allow contact to the tunnel floor. Construction water must be reduced to a minimum and collected and pumped immediately into pipes.

Water entering a working face from another part of the tunnel must be deviated not to affect construction works such as bench/invert excavation or concreting.

Unless otherwise specified all water emanating from the tunnel excavation shall be discharged into settlement ponds, designed so as to meet the requirements of the prevailing Indian regulations. The outflow from each settlement pond shall be arranged in a way to prevent any oil from leaving the pond irrespective of the volume of water entering the pond.

Dimpled sheet membrane shall be of HDPE with a sheet thickness of 1.0 mm. The drainage capacity shall be 10 l/s/m. The compressive strength shall be 150 kN/m².

Strip drains shall consist of dimpled sheet membrane as defined above, wrapped in a nonwoven het bonded geotextile. The geotextile shall comply with Clause 12.2.

5.1 Measurement and Monitoring

The Contractor shall install, operate, maintain and relocate the necessary devices for flow measurements. These measuring devices shall be checked and approved by the Employer's Representative before usage.

Gauging stations shall be installed and measurement of the total discharge shall be made as follows:

- *Heading Zone:* Measurement shall be performed during excavation and supporting work at a point not less than 50 m and not more than 100 m behind the heading face. Transfer of the measuring station in drill and blast advances shall be done in 100 m steps or as approved by the Employer's Representative.
- *Rear Zone:* Flow measurements at the portal or at the outlet of installed pump lines shall be performed, during the entire excavation and supporting work.

Measurement of water flow shall be performed once a day jointly by the Employer's Representative and the Contractor or as otherwise agreed upon.

All pumping rates must be recorded and the Contractor shall keep full and detailed records of all monitoring carried out. Copies of such records shall be available to the Employer's Representative.

The Contractor shall monitor all springs and wells which may be influenced by the lowering of the ground and mountain water table due to the tunnel construction. The zero readings must be done prior to any excavation.

5.2 Final Tunnel Dewatering Arrangement

5.2.1 Ground Water

A minimum gradient of 0.5% of the drainage pipes shall be provided in each tunnel cross section.

If not otherwise specified by the detailed design drawings or the Employer's Representative, the following ground water drainage pipes with the given diameters shall be installed at the lines will be given in the detailed design drawings.

- Side wall drainage: $\Phi \geq 250$ mm
- Sub-base drainage: $\Phi \geq 150$ mm
- Ground water collecting pipe: $\Phi \geq 400$ mm

Perforated pipes shall be made of slotted Polypropylene (PP) or polyvinyl chloride (PVC) or any other equivalent material in agreement with the Employer's Representative. The upper section of the pipe shall be longitudinal corrugated and slotted, with the bottom section closed. The width of slots shall not exceed 1.0 mm. The total area of the slots for water intake shall exceed 50 cm^2 per meter length of pipe.

The bedding shall consist of dry lean concrete in compliance with Clause 10.2. The pipe shall be embedded in no-fines concrete in compliance with Clause 10.3.

5.2.2 Carriageway Water

The carriageway water shall be collected and drained in a separate drainage system. The collection shall be continuous by a slot channel or punctual with a minimum interval of 65 m. Slot channels shall be made of water impermeable concrete with plastic fiber reinforcement.

The slot channel diameter shall be minimum 250 mm. A minimum longitudinal gradient of 0.5% shall be provided.

6 Open Excavation

6.1 General

In these Specifications the following works are covered:

- surface excavation in soil or rock (Cut) for the temporary and permanent tunnel portals, the tunnel portal structures, cut & fill sections, control building, muck dump areas, ditches, drains,
- surface fill (Fill) with soil and rock material for the platform of the tunnel portal structures and buildings, if any, muck dump areas or roads,
- erosion protection of embankment slopes with gabions, mattresses, rip-rap, etc.
- sub surface drainage
- backfill of structures
- water proofing of structures before refill

The existing ground surface area below which open excavation is required shall be cleared of trees, brushes, shrubs, embedded logs, fallen timber and surface litter and shall be grubbed of vegetation, roots and stumps. Cleared and grubbed material shall be disposed of in the designated spoil disposal areas.

No unexcavated material is permitted inside the design lines of the excavation.

14 days prior to commencement of any surface excavation the Contractor shall submit all detailed drawings and/or descriptions of his proposed excavation methods, sequences and equipment to the Employer's Representative for approval.

28 days prior to dumping of any spoil, the Contractor shall submit all detailed drawings and/or descriptions of his proposed method for laying, compacting and protection against erosion of the muck dump material including information of dumping sequences and equipment. The muck dump areas shall be within the areas so designated by the Local Authorities or the Employer's Representative and in compliance with Clause 4.4.1.

At least 28 days prior to placing of any fill material, the Contractor shall submit detailed drawing and/or descriptions of the construction procedure, mixing, treatment and compaction procedures, top-soiling, slope stabilization and surface erosion protection, and other completion works for approval, for construction of embankments. All data of working methods, equipment and provisions for the stability of the construction as well as temporary and permanent drainage of these areas shall be included. Details of volumes, material types, heights and grades shall be provided.

The Contractor shall forward information of the progress of surface excavation including information on excavated volumes, ground type, ground support installed, water inflows and difficulties encountered to the Employer's Representative at an interval in agreement with the Employer's Representative.

6.1.1 Standards

Open excavation works shall be in compliance with the following Standards and Guidelines unless otherwise defined in these Specifications.

- Specification for Road and Bridge Works (Fourth Revision) August 2001 reprinted in April 2005 issued by MoRT&H and published by IRC.
- IS 2720: Methods of test for soils — applicable parts
- IS 4532: Method of test for stabilized soils
- ASTM D3282: Classification of soils and soil-aggregates mixtures for highway construction purposes
- Eurocode 7: Geotechnical design

6.2 Cut

The excavation requirements and limits shown on the drawings have been established on the basis of the results of subsurface exploration by the Designer. The Employer's Representative will examine the conditions exposed at the actual excavated surfaces and, if the conditions are deemed unacceptable for the intended purpose, will relocate the excavation design lines locally outside of the excavation design lines shown on the Drawings.

If, in the opinion of the Employer's Representative, the necessity for excavation outside of the excavation design lines has been caused by negligence on the part of the Contractor or by ineffective executed excavating or blasting operations by the Contractor, the volume of additional excavation shall be backfilled with concrete or other material as required by the Employer's Representative. Such additional excavation and backfilling shall be done at no additional cost to the Employer.

Unclassified material and rock excavated outside of the excavation design lines for the Contractor's own purposes shall be replaced with concrete or other material as required by the Employer's Representative. Such additional excavation and backfilling shall be done at no additional cost to the Employer.

All initial support measures will be given in the detailed design drawings or directed by the Employer's Representative e.g. sprayed concrete, pre-stressed anchors, wire mesh etc. shall be in compliance with Clause 9 of this Specification.

The Contractor shall draw his own conclusions from site inspection, from the logs of rock cores, test pits, test trenches, test tunnels, test chambers and surface exposures and from other site investigation data made available to the Contractor, as to the excavation method that will be best suited for the satisfactory removal of materials to be excavated and as to the behaviour of unclassified material and rock in situ, during and after excavation.

Excavation shall include all items of work, equipment, facilities and material with respect to the proper excavation as specified, including mucking, dumping and transport of excavated materials in stockpile or disposal areas approved by the Local Authorities.

The Contractor shall apply, as approved by the Employer's Representative, excavating, drilling and blasting techniques, which will produce a smooth final profile, i.e. smooth blasting resulting in minimum over break as well as - minimum detrimental effect beyond the design lines for excavation in compliance with Clause 7.3.3. Explosives and detonating systems shall be used by the Contractor to produce a smooth final excavated surface.

The Contractor shall adopt excavation procedures such that the stability of surfaces in open excavations is not impaired. The Contractor shall be responsible for the stability and safety of all excavations until final acceptance of the Works and shall install such instrumentation in the excavations, in addition to the instrumentation required by the Employer's Representative, that the Contractor considers necessary to measure deformation and to establish that unstable conditions do not develop. The Contractor shall execute all remedial work required in excavations to ensure that the excavated surfaces are maintained in a sound and stable condition. The Contractor shall submit to the Employer's Representative all readings taken the instruments he installs not more than 1 working day after taking the readings.

During excavation, and at any time during the Work, all material which is unsafe or appears to endanger persons, the Works or the property of others, shall be immediately scaled and removed from the excavations. The fact that such scaling and removal may enlarge the excavation beyond the excavation pay lines shall not relieve the Contractor from the necessity of doing such scaling and removal of such materials. If it is not possible to remove loose rock by normal barring and wedging, then rock support, shotcrete or chain link mesh or any combinations of each, shall be applied to secure and prevent the loose rock from falling or becoming unstable.

Notwithstanding the provisions specified herein, the Employer's Representative may require the Contractor to take such action as the Employer's Representative deems necessary to assure the safety of the excavations and the Contractor shall immediately comply with such requirements. Nothing in these Specifications shall be construed to relieve the Contractor from the sole responsibility for safety.

If drilling and blasting operations is required, these shall be carried out in such way that they do not interfere with the work of others nor cause any damage to adjacent structures.

If slides occur in excavated slopes, all materials affected shall be excavated and removed to the designated spoil disposal areas. The slopes shall then be further excavated to a safe, stable and neat condition or to the lines, slopes, dimensions and elevations required by the Employer's Representative. If, in the opinion of the Employer's Representative, any slide was caused by negligence on the part of the Contractor, all remedial work shall be done at no additional cost to the Employer.

The Contractor's excavation operations and schedule shall allow for interruption while the geological conditions exposed at the excavated rock surfaces are mapped and assessed by the Employer's Representative. Local areas shall be cleaned off where required by the Employer's Representative to expose a fresh undisturbed surface. Such interruption and assistance shall be at no additional cost to the Employer.

Construction traffic shall only be routed over suitably protected parts of the excavated surfaces.

6.2.1 Excavation Classification

Surface excavation shall be classified according to the excavation method as:

- Loose excavation
- Rock excavation

Loose excavation means all excavation which may be performed without continuous and systematic drilling and blasting. Clearing and grabbing of trees, shrubs and plants, stockpiling of topsoil layer, digging, ripping and occasional blasting may be required.

Rock excavation means excavation which requires continuous and systematic drilling and blasting for loosening, including measures for smooth blasting methods. The Contractor shall solely adapt blasting hole diameters, distance, charging and detonating delay of holes to form a smooth, sound surface along the excavation design lines. The distance between blasting holes shall not exceed 10 times of the blasting hole diameter.

6.2.2 Excavation Material Disposal

The disposal of excavation material shall be in accordance to Clause 4.4.1 of this Specification.

Excavation material suitable to be utilised in the Works shall be stockpiled separately from materials to be disposed. The use of excavation material in the Works shall be in agreement with the Employer's Representative.

Suitable materials shall, wherever possible, be transported directly from the required excavation to the various designated final locations.

Excavated materials, not suitable for or in excess of the construction requirements, shall be disposed of in spoil areas designated by the Local Authorities, Forest Departments or the Employer's Representative. Unless otherwise provided for, spoil areas shall be built up in layers, with a maximum layer thickness of 0.6 m, and evenly compacted by the traffic of the construction equipment, aimed at minimizing future differential settlement. Final sloping and shaping of surfaces shall be as indicated on the Drawings. Other details of the work such as stabilization and drainage measures are shown on the Drawings.

All activity by the Contractor at spoils areas shall be confined to the limits designated by the Local Authorities, Forest Department or the Employer's Representative. The limits shall be clearly marked and, where directed barricaded to prevent traffic in areas outside the limits.

6.2.3 Fill and Embankment

The Contractor shall construct all compacted earthfill or rockfill embankment will be as shown on the Drawings or as otherwise directed by the Employer's Representative. This work shall include such work as selection of suitable material, transporting, spreading, adjusting moisture content, compacting to specified minimum dry density and completion in all respects, all in accordance with this Specification.

The embankment shall extend to the design lines as given in the drawings.

All permanent and long term temporary slopes shall generally be stabilized and erosion protected by planting of vegetation and greens similar to the typical local vegetation of the area. Additional measures such as bolts, anchors, shotcrete for cut slopes or gabions, rip-rap, geo-textile for embankment slopes must be applied as designed or ordered by the Employer's Representative.

The Contractor shall construct all sub-surface drainage measures in cuts or embankments as shown on the Drawings or as otherwise directed by the Employer's Representative. This work shall include such work as excavation, selection of suitable ma-

terial, transporting, placing, and completion in all respects, all in accordance with this Specification.

The material beneath the road sub-base shall have CBR values. The testing procedure shall be in accordance to AASHTO T193 and fulfil the requirements shown in the detailed design drawings and Indian Standards.

Trees, shrubs, grass; humus/topsoil shall be removed from the existing ground surface and stockpiled for later reinstatement if required by the Employer's Representative prior to any placing of embankment.

The prepared surface shall be benched in vertical and horizontal cuts to provide a shear key with the embankment material.

The material of the embankment shall be placed and compacted layers with a thickness not exceeding 300 mm loose before compaction.

The moisture content of the material to be compacted shall be as wet or just wetter than optimum moisture content determined by laboratory testing.

All embankment material shall be compacted to a dry density not less than 95 per cent of the maximum laboratory dry density in accordance with IS 2720, Part 8.

6.2.4 Back Fill

Backfill shall be placed to the specified type of the lines, grades and dimensions in the locations shown on the detailed design drawings by the Contractor or directed by the Employer's Representative.

All material proposed by the Contractor to be used as backfill shall be approved by the Employer's Representative prior to any placing of backfill material. The material to be used as backfill shall be as far as possible obtained from required excavation for Underground Excavation Works.

Backfill material shall be homogeneous without layers, pockets and lenses and may not consist of any organic component. Each load of material shall be distributed well and operation of equipment shall be restricted in the area near permanent structures to avoid any kind of damage. The Employer's Representative may reject full loads of backfill material that contain unacceptable percentage of organic component.

Backfilling may not be done before reaching full load capacity of adjacent structures and only after approval of Employer's Representative. The placing of the backfill shall be done simultaneously and with similar method, procedure and material at the different sides of a structure to avoid differential earth pressure.

Backfill material shall consist of well graded granular material containing 35% or less by weight passing a 0.075 mm sieve, as specified in ASTM D3282 and with a maximum particle size of 300mm.

Back fill material shall be placed and compacted layers with a thickness not exceeding 300 mm loose before compaction and shall be compacted to a dry density not less than 95 per cent of the maximum laboratory dry density in accordance with IS 2720, Part 8.

The moisture content of the material to be compacted shall be as wet or just wetter than optimum moisture content determined by laboratory testing.

Backfill material shall be tested every 300 m³ or 600 m² or 1 test per shift, whichever is less, or as directed by the Employer's Representative. Proctor test procedures shall be done in random backfill and impervious backfill; whereas the relative density testing of IS: 2720 shall be done for free-draining backfill.

6.2.5 Gabions

The foundation for each gabion and mattress shall be prepared by the Contractor to the satisfaction of the Engineer. Irregularities in the foundation shall be excavated or tightly filled with gravel to produce a surface which has no protrusions or cavities in excess of 100 mm and the surface shall be covered with a geotextile fabric.

Gabions and mattresses shall consist of double twisted woven mesh gabions with coated, polymer sheathed wires or equivalent in agreement with the Employer's Representative.

The construction working procedures of gabions and mattresses shall be in compliance with the manufacturer's recommendations and instructions.

6.2.6 Rip-Rap Layers

Rip-rap layers shall be furnished and placed by the Contractor on permanent embankments as erosion protection layer as shown on the detailed design drawings of as directed by the Employer's Representative.

Prior to any placing of rip-rap layers the source of the material shall be approved by the Employer's Representative. Rip-rap material shall consist of hard, dense and durable rock. Material from Underground Excavation Works may be used.

The minimum rock size shall not be less than 500 mm and shall not be greater than that which can be encompassed in the specified layer thickness.

Rip-rap layers shall not be placed on earth, gravel or weathered rock foundation when not agreed with the Employer's Representative. When the underground is not suitable for bedding of rip-rap layers, the rip-rap shall be placed on a 300 mm thick continuous layer of gravel, sand or rock fragments in agreement with the Employer's Representative.

6.2.7 Water Proofing Membrane

The water proofing membrane shall cover all backfilled structures from water and moister and is similar to the tunnel water proofing membrane as specified in 12.4.

6.3 Underground Excavation

6.3.1 General

The Contractor shall be responsible for the safety and security of excavations at all times during the execution of the Contract.

The geological/geotechnical information presented in the tender documents represents the state of knowledge of the geological/geotechnical conditions along the tunnel alignment based on available information at this stage.

Tunnel works to be executed are based on the New Austrian Tunneling Method, hereafter referred to as NATM, with observance of all principles related to the application of this method.

Mechanised techniques for excavation shall be used wherever practicable to eliminate or reduce health and safety risks.

The excavation material shall be classified in compliance with Clause 6.4 of this Specification. Different and adequate excavation methods shall be considered for rock excavation and loose excavation by the Contractor.

A detailed description, defined by the Contractor, of all excavation methods including equipment, location of headings, benches and pilot tunnels, drilling and blasting, controlled perimeter blasting, ripping, mucking, loading, hauling, temporary support systems, scaling, ventilation, lighting, pumping, safety measures, schedules, excavation cycles, simultaneous working of faces and sequence of operations he plans to follow in each excavation area to complete the work shall be included in the offer or submitted to the Employer's Representative prior to commencement for review. Additionally details concerning installation of pumping, ventilation and lighting systems shall be forwarded to the Employer's Representative for review. The Employer's Representative shall be provided with all submissions in sufficient time ahead of the construction works or at such dates as mutually agreed upon. No excavation shall be started in any excavation area until permission has been received in writing from the Employer's Representative.

The approval given by the Employer's Representative to the Contractor's methods and equipment does not relieve the Contractor of his full responsibility for proper and safe execution of tunnel excavations, or of liability for injuries to persons or fatal accidents, or any obligations under this Contract.

Manufacturer's certificates of compliance shall be submitted certifying that the materials and equipment proposed to be used meet Specification requirements.

During excavation, and at any time during the work, all ground material which is unsafe or appears to endanger persons, the Works or the property of others, shall be immediately scaled and removed from the excavations. The fact that such scaling and removal may enlarge the excavation beyond the line of excavation shall not relieve the Contractor from the necessity of doing such scaling and removal of such materials. If it is not possible to remove loose rock by normal barring and wedging, then rock support, shotcrete or steel mesh or any combinations of each, shall be applied to secure and prevent the loose rock from falling or becoming unstable.

Excavation shall be carried out in a uniform and controlled manner and over-cutting shall be kept to a minimum consistent with the need to maintain the necessary clearance for construction of the Works.

Drilling and blasting operations shall be carried out in such way that they do not interfere with the work of others nor cause any damage to adjacent structures.

The Contractor's excavation operations and schedule shall allow for interruption while the geological conditions exposed at the excavated rock surfaces are mapped and assessed by the Employer's Representative. Local areas shall be cleaned off where required by the Employer's Representative to expose a fresh undisturbed surface. Such interruption and assistance shall be at no additional cost to the Employer.

The excavation invert shall not be damaged due to construction works. Hence the invert of the tunnel shall be protected against damage and deterioration which may be caused by construction traffic. Any other surfaces which deteriorate or are damaged shall be made good to a standard agreed with the Employer's Representative.

Excavation shall be carried out in sections limited to such lengths, depths and widths as may be safely executed having regard to all the circumstances and as appropriate to the ground conditions and the equipment and method of construction being used.

In water-bearing strata the Contractor shall use such methods and take such steps as are necessary to control flows and maintain the stability of the excavation.

Additional excavation, not shown on the drawings, but the Contractor considers being required for his own purpose such as cross passages, mucking pits, niches or spaces for site installation may only be carried out in agreement with the Employer's Representative. Such excavations are done at no additional cost for the Employer and shall be backfilled to the excavation line.

6.3.2 Overbreak

The overbreak-line is defined with 30 cm for tunnel sections with drill and blast excavation and 20 cm for tunnel sections with excavation by mechanical means such as excavator or road header.

Overbreak shall be secured with determined measures in agreement with the Employer's Representative and according to the local conditions. Loose rock mass shall be removed. Any voids formed during the excavation process by overbreak and temporary works shall be backfilled completely with grout, concrete, sprayed concrete or other approved durable material.

- Accepted geological overbreak in tunnel excavation is defined as a local overbreak which occurs while the following four conditions are simultaneously fulfilled:
- Overbreak extends beyond the "overbreak"-line;
- The overbreak occurs above the tunnel invert;
- The Employer's Representative is immediately notified and given the opportunity for inspection, while both the cause and the extent of the overbreak are clearly visible; and
- Appropriate working methods were used and adequate rock reinforcement and support was installed in due time, and properly applied by the Contractor.

The Contractor shall survey and plot cross sections at sufficient intervals to allow for a reasonably accurate estimate of the volume of overbreak which he claims to be due to geological conditions.

Voids created by overbreak extending beyond the "overbreak"-line in tunnel excavations shall, as directed, be backfilled up to the "overbreak"-line as required by the Employer's Representative.

In the event of excessive geological overbreak, support shall be installed immediately as required to stabilize the ground. The Employer's Representative shall be informed immediately of such conditions. Remedial works shall be in agreement with the Employer's Representative. The design of the remedial works shall be done by the Contrac-

tor and approved by the Employer's Representative. Remedial works shall be executed before further advance of the face unless otherwise directed by the Employer's Representative.

The void formed by the geological overbreak shall be measured in-situ. Individual voids of less than 1 m^3 shall be discarded for measurement purposes. The materials required to complete the repair shall be quantified and approved by the Employer's Representative and certified for payment.

Where forepoling is required no separate remuneration for the additional overbreak will be made, i.e. the additional overbreak shall be included in the excavation costs.

6.4 Tunnel Excavation

6.4.1 General

Tunnel excavation in any kind of ground shall be performed in accordance with modern blasting and excavating practice, using methods and techniques that will reduce overbreak to a minimum outside of the line of excavation (pay line), and which will preserve, in the soundest possible condition, the structural integrity of the rock beyond the line of excavation.

Excavations shall not be advanced until the pattern ground support for the previous round has been installed and the profile of the previous round has been checked and all rock remaining inside the line of excavation has been removed. The Employer's Representative may stop the work for removal of undercuts at any time if undercutting is observed.

Tunnel excavation shall not be started until the exposed rock faces in its portal excavation have been stabilized with rock support and shotcrete and drainage measures have been installed as given in the drawings.

The Contractor shall maintain accurate records of all blasting and excavating operations and at the end of each shift he shall provide the Employer's Representative with two copies of the records, together with such additional data as the Employer's Representative may request. The forms shall bear the signatures of the Contractor's and the Employer's Representative certifying that records are accurate and complete and include but not limited to the following:

- Length of tunnel excavated and theoretical volume of solid material excavated
- Quantity of any rock support installation
- Occurred rock falls, zones of instability and logs of pilot holes
- Water inflow at the head and rate of discharge at the tunnel portal
- Unusual occurrences and all delays with reasons for these.

Holes drilled in swelling ground shall be conducted without water.

7 Geotechnical Design

The procedure of ground characterization during construction sequence is based on the Austrian "Guideline for the Geotechnical Design of Underground Structures with Conventional Excavation" by the Austrian Society for Geomechanics.

Rock mass classes are determined based on the rock at the excavation face of the tunnel before the commencement of the respective excavation sequence.

7.1 General

A continuous updating of the geotechnical model and an adjustment of excavation and support to the actual ground conditions during construction is required.

The rock mass characterization shall be determined according to the following steps, which are summarized and presented in Figure 1.

- Step 1: Determination of the encountered Ground Type (GT) and prediction of ground characteristics
- Step 2: Assessment of system behaviour in excavation area
- Step 3: Determination of excavation and support measures and prediction of System Behaviour in supported section
- Step 4: Verification of system behaviour

Step 1: The geological conditions during construction shall be monitored as defined in Section 7.3.4 to collect and record the relevant parameters specified in the design. Based on the geological conditions the Ground Type (GT)/ Rock Mass Types (RMT) shall be determined. Additional observations, like indications of overstressing, deformation and failure mechanisms as well as results from probing ahead and the evaluation of the geotechnical monitoring shall be used to update the ground model and predict the conditions ahead of the face.

Step 2: Based on the predicted ground conditions the system behaviour in the section ahead shall be assessed under consideration of the influencing factors, and compared to the framework plan. Particular attention has to be paid on potential failure modes.

Step 3: To determine the appropriate excavation class and support category the criteria laid out in the framework plan have to be followed. Consequently, it has to be checked if the actual ground conditions (Ground Type/ Rock Mass Type, system behaviour) comply with the prediction. The additional data obtained during construction form the basis for the determination of the applied excavation and support methods.

The system behaviour has to be predicted for the next excavation section, considering ground conditions and the chosen construction measures. This process is to be done during the daily review meeting as per Clause 8.4. Records of this meeting shall be kept and signed of all attended parties in compliance with Clause 8.4.

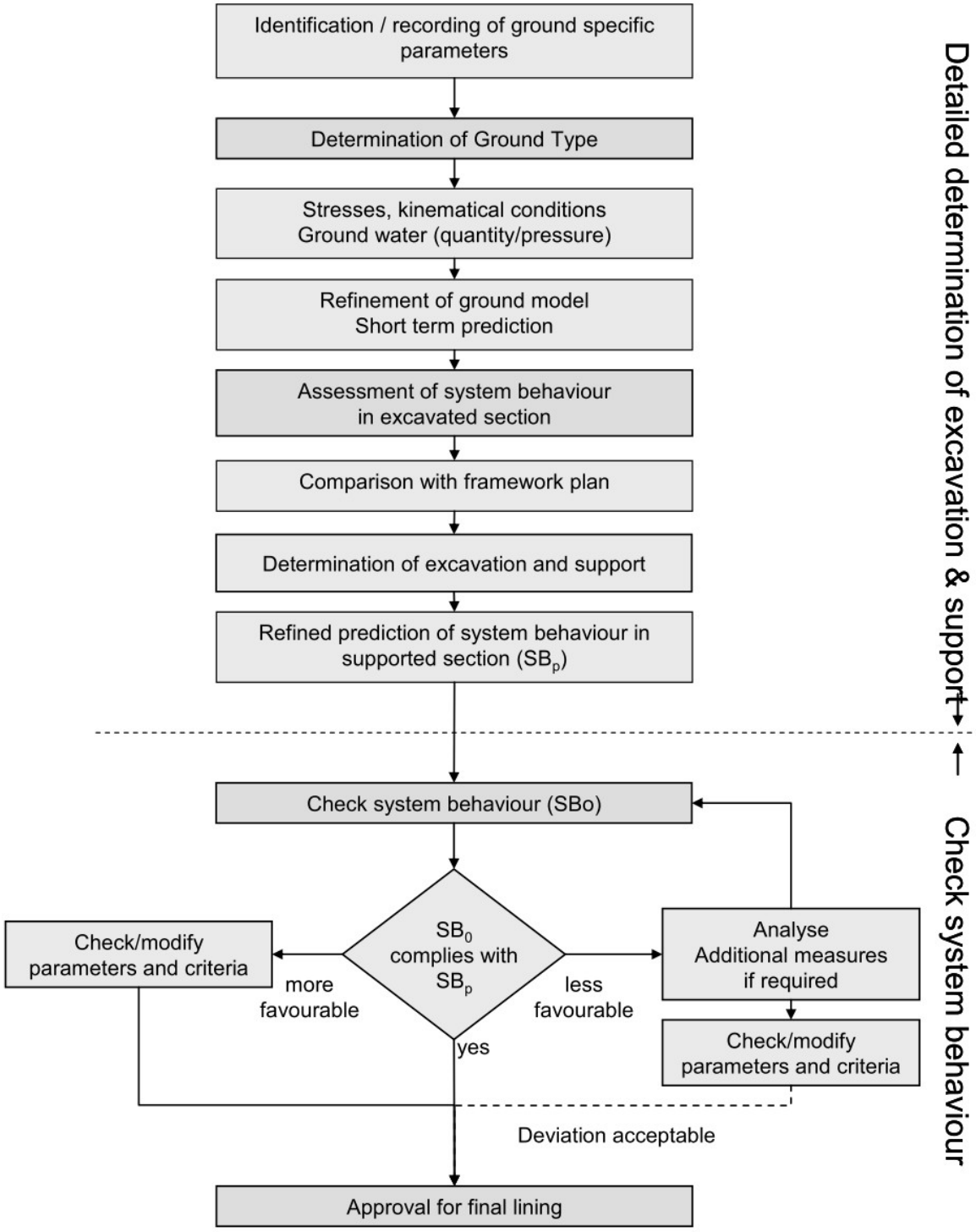


Figure 1: Basic procedure of determination of construction measures and check of system behaviour during construction (SB_P = predicted system behaviour, SB_0 = observed system behaviour) from Austrian "Guideline for the Geotechnical Design of Underground Structures with Conventional Excavation" by the Austrian Society for Geomechanics

Step 4: The system behaviour shall be monitored (visually and by measurements) in compliance with Clause 8 of this Specification and the criteria defined in the geotechnical safety management plan. When differences between the observed and predicted behaviour occur, the parameters and criteria used during excavation for the determination of the Ground Type and the excavation and support have to be reviewed. When the displacements or support utilization are higher than predicted, a detailed investigation into the reasons for the different system behaviour has to be conducted, and if required mitigation measures (like increase of support) ordered. In case the system behaviour is more favourable than expected, the reasons have to be analysed as well and the used parameters modified, if appropriate. This allows for a continuous improvement and refinement of the method for assignment of excavation and support methods.

7.2 Determination of Actual Ground Type

Key parameters shall be defined in agreement with the Employer's Representative for the identification of each Ground Type, considering that those can be recorded during construction. If directed by the Employer's Representative, additional parameters shall be monitored, which the Employer's Representative deems necessary for determination of the system behaviour.

Each of the key parameters shall be categorized. Whenever feasible, numerical values shall be used preferably than descriptive data, like spacing, joint opening, strength, etc. Due to practical reasons some of the required parameters can only be described qualitatively.

Using predefined criteria the parameters are weighted and combined, allowing the appropriate Ground Types to be identified. A correlation matrix shall be used.

Data collection on site shall be concentrated on collecting relevant geological and geotechnical data and on observing and recording the ground structure. The collected data are recorded in prepared forms. With the criteria defined during the design the Ground Type is determined. In heterogeneous ground conditions, the ground shall be divided into several sections, and the appropriate key parameters shall be collected for each section separately.

The geological and geotechnical data collected and evaluated on site are the basis for the extrapolation and prediction of the ground conditions. The geological work is not limited to recording the face conditions, but also shall involve prediction of the conditions in the volume of rock that controls the ground response.

7.3 Assessment of System Behaviour in the Excavation Area

In addition to the parameters required to determine the Ground/ Rock Mass Type(s), influencing factors, like ground water conditions, ground structure, estimated stress situation and kinematical conditions as well as observations of the system behaviour in the excavation area shall be recorded by the Contractor.

The reaction of the ground to the excavation and support are observed by the Contractor using an appropriate monitoring system in compliance with Clause 8 of this Specification.

The predicted ground structure in combination with the on-site observations and monitoring results shall be used for prediction of the ground behaviour for the sections to be excavated subsequently.

7.3.1 Determination of Excavation and Support and Prediction of System Behaviour

For the final determination of the excavation and support method, it must be checked if the ground conditions and system behaviour observed on site conform to the design assumptions. When the observed conditions conform to the predicted ones, stipulations in the framework plan have to be followed when determining the construction measures.

In case of a deviation exceeding the specified tolerance in the framework plan, the designer has to be informed to allow for an adaptation of the prediction, based on new findings. The designer shall agree with the required additional measures in due time and update the framework plan accordingly.

The final decisions on the applied construction measures are based on the design and additional information gained during construction and shall be done during the daily review meeting as per Clause 8.4 of this Specification. The goal is a safe and economical construction. The decisions have to be coherently explained and documented, for example in an appendix to the required excavation and support sheet (RESS) in compliance with Clause 8.6 of this Specification.

The prediction of the system behaviour shall contain the following but is not limited to:

- Expected magnitude and orientation of the tunnel displacements, and the surface (if applicable), including the displacements spatial and time dependent development
- Expected utilization factor of the support

7.3.2 Check of System Behaviour

The actual system behaviour in the supported area and in the final stage shall be compared to the predicted system behaviour, and checked, whether the behaviour is within the specified limits of the warning criteria. Additional measurements or evaluations may be required on direction by the Employer's Representative to determine for example the utilization of the lining.

Deviations between the expected and the observed behaviours have to be analysed and documented by the Contractor and discussed with the Employer's Representative in the daily review meeting as per Clause 8.4.

The reasons for the deviation in behaviour have to be analysed. In case the assumptions regarding the influencing factors are inappropriate, the parameters have to be modified. The modifications have to be supported by appropriate data and analyses and documented in an updated framework plan.

In case the ground quality is better than predicted, the geotechnical model has to be revised. In case of a significant deviation, the criteria for the determination of excavation and support have to be modified.

In case the ground quality is worse than predicted and warning levels exceeded, contingency measures according to the safety management plan have to be implemented, and ex-

cavation and support shall be adjusted accordingly. This can be done for example by additional bolting, installation of a temporary invert, etc. In some cases the installation of a stronger support in the following rounds may be sufficient to achieve the target. All additional support measures are defined in the daily review meeting and presented in the RESS in agreement with the Employer's Representative.

In case of significant deviations, the geotechnical model has to be revised and the criteria for the determination of excavation and support have to be modified. This generally requires that the framework plan is updated.

7.3.3 Updating of Design

Based on the information available during design, a number of assumptions and simplified models have to be used to arrive at a design, which is the basis for the framework plan and the tender documents.

A continuously update of the geotechnical design with the increasing level of information shall be done. This applies to the determination of the Ground/ Rock Mass Types, the assignment and calibration of key parameters and criteria as well as for the determination of the system behaviour. The refinement of parameter categories, the introduction of additional criteria, etc. help in improving the geotechnical model.

The tunnel engineer on site has to report to the designer in case of significant deviations of the actual geological/geotechnical situation or system behaviour from the predicted ones, as outlined in the framework plan. A detailed report, containing all relevant information and coordinated with the site geologist and the Employer's Representative and the Contractor, has to be prepared and submitted. After consideration of the facts the designer has to update the framework plan. This has to be documented in a supplement to the geotechnical report.

7.4 Blasting

7.4.1 General

Not less than 40 days prior to commencement of rock excavation in each area, the Contractor shall submit, for review by the Employer's Representative, details of the drilling and blasting methods which he intends to use in that area. If, at any time in a specific area, a plan which has been previously adopted does not produce conditions at the excavated rock face that conform to the requirements of these Specifications, the Contractor shall submit a revised plan to the Employer's Representative before continuing excavation in adjacent areas.

The Contractor shall develop controlled blasting techniques, which will satisfy the excavation requirements specified herein. In each different type of rock conditions the Contractor's initial blasts shall be performed as trials, and the burden, drill hole pattern and depth, explosive type and quantity, blasting sequence and drill delay pattern shall be modified to achieve the requirements specified herein.

Blasting means have to follow the licensing requirements and orders as well as the manufacturer's instructions.

Blasting operations shall be carried out only under the direction of an experienced operator. The Contractor shall appoint one competent person to be responsible for the security of explosives.

Blasting shall be carried out carefully so as to avoid loosening or shattering rock beyond the required line of excavation, and loose or shattered rock (where it does not contribute to stability of the excavation) shall be removed by scaling down or other means before personnel will be permitted to restart operations after blasting.

Notices of blasting operations shall be posted on site. Before each firing, the Contractor shall give audible warning, clear the area and shall take positive measures to prevent personnel from entering the danger area.

The Contractor shall monitor the results of blasting closely and, where it is proper to do so, shall propose changes to his blasting operation for the agreement of the Employer's Representative.

Under no circumstances shall any holes be charged until completion of all drilling operations at the face.

After each blasting operation the tunnel drive shall be sufficiently ventilated to remove any nitrous gases and the atmospheric conditions shall be constantly checked prior to personnel accessing the excavated face in compliance with Clause 7.7.

No person shall be allowed to approach the face and no face operation shall commence until the Contractor's authorized person in charge of the operation has given permission after blasting round.

As soon as practicable after blasting and without undue delay the Contractor shall erect such support as may be necessary to safeguard the excavation and personnel.

The shot-firer must keep a record of the number of shots fired, their time of firing, type and weights of explosives used and the type and number of detonators used, together with a record of the post-blast situation for each and every location. A copy of the record shall be available to the Employer's Representative at the end of every shift on which shots are fired.

7.4.2 Controlled perimeter blasting

Controlled perimeter blasting techniques shall be used to produce rock faces conforming to the required excavation lines, slopes, elevations and dimensions shown on the drawings with a minimum of disturbance to the rock at, or outside of, the excavation pay lines.

Drill holes for controlled perimeter blasting shall not be less than 42 millimeters in diameter and shall be a single row of closely spaced holes drilled to a maximum depth of one round length along the excavation pay lines and a spacing of 0.4 to 0.6 m depending on the ground condition. The spacing of the perimeter holes may be modified on the basis of results obtained and in agreement with the Employer's Representative.

All blast holes within a distance of 5 meters normal to the excavation pay lines shall be less than 75 millimeters in diameter and shall be loaded in a manner and detonated in a sequence to ensure that a minimum of damage will result to the face when the main charge is fired.

7.4.3 Explosives

The Contractor shall use explosives only in circumstances where it is safe to do so having due regard to the safety of persons, third-party property and the safety of the Works. Explosives shall not be used without the agreement of the Employer's Representative.

The Contractor shall obtain all necessary licenses and consents and shall provide secure storage facilities for all explosives and equipment in accordance with Indian or International Standards Code of practice for the safe use of explosives in the construction industry and the requirements of the local Authorities and the Employer's Representative.

Explosives shall be handled and used only by the Contractor's duly authorised personnel. The names and qualifications of such personnel shall be submitted to the Employer's Representative in writing in advance of any possible use of explosives.

At an early stage, in advance of the proposed use of explosives, the Contractor shall notify the Employer's Representative, third parties, statutory authorities and services which have an interest in or are likely to be affected by blasting operations, of the general nature of the operation. The Contractor shall subsequently give a minimum of 14 days notice to the Employer's Representative and others described above of the proposed use of explosives. With this notification the Contractor shall submit to the Employer's Representative a detailed method statement on all aspects of the proposed use of explosives, including the treatment of misfires.

The Contractor shall comply with the following documents in respect of the use of explosives:

- Indian Explosives Act 1884
- Indian Explosive Rules 1983
- The Manufacture and Storage of Explosives Regulations 2005
- BS 5607:1998 Code of practice for the safe use of explosives in the construction industry
- Control of Explosives Regulations 1991
- Carriage of Explosives by Road. Road Traffic (Carriage of Explosives) Regulations 1996
- PD CLC/TR 50426:2004 Assessment of inadvertent initiation of bridge wire electro-explosive devices by radio- frequency radiation. Guide Quarries (Explosives) Regulations 1988, as far as it is relevant to tunnel works.

7.4.4 Blasting Vibrations

For structures, Railway track in the proximity of blasting, the peak particle velocity shall be measured at the locations immediately adjacent to the structure nearest to the face being blasted or any other location where it is necessary to limit vibration.

Vibration monitoring proposals shall be submitted to the Employer's Representative for his agreement.

The measurement of peak particle velocity shall be obtained from instruments capable of measuring along three orthogonal axes, one of them shall be aligned parallel to the centre line of the excavation and another shall be vertical. The Contractor has to provide supports for the measuring instrument if so required by the manufacturer's instructions.

The measurements of the particle velocities shall be the responsibility of the Contractor. Copies of the readings in an agreed form shall be supplied to the Employer's Representative.

Prior to the commencement of blasting in any location, the Contractor shall demonstrate by the use of test firings, or by other means, that neither the peak particle velocities given in the particular Standards and Specifications will be exceeded.

The maximum allowable blasting vibrations shall be defined by the Contractor for every influenced structure with reference to the applicable Standards and Specifications for the relevant structure. The allowable blasting vibrations shall be approved by the Employer's Representative prior to any blasting operations.

8 Geological Mapping

Geological mapping shall be performed by the Contractor's qualified geologist to provide a documentation of rock and rock mass condition encountered during excavation. Additionally all exposed rock surfaces of the open and underground excavations shall be washed down by the Contractor for inspection and geological mapping by the Employer's Representative if he deems to do so. Exposed rock surfaces at the required excavation pay lines shall be mapped after preparation but before shotcrete application. Tunnel and other underground faces shall be mapped just before the start of drilling. The Contractor shall allow in his construction procedure and schedule for the geological mapping of each tunnel face not less than 30 minutes.

The geological mapping shall include but not limited to the following information:

Excavation face:-

- Tunnel meter
- geological unit
- intact rock:
  - rock type and lithology description
  - weathering and alteration degree
  - uniaxial and unconfined compressive strength (from point load tests)
- rock mass:
  - jointing degree
  - geometry, orientation (strike and sip) and properties of discontinuities
  - face condition (homogeneous or heterogeneous)
  - water inflow
  - overbreaks (separated in geological and non-geological)
  - ground response
  - suspected pervious zone
- the GSI value and the corresponding excavation class
- groundwater appearance

The Contractor shall provide lights, ladders, platforms and free access and shall assist the Employer's Representative to carry out inspection and geological mapping.

In case of sudden and unexpected changes of the geological conditions the Employer's Representative shall be informed immediately by the Contractor.

8.1 Exploratory Drillings

Long exploratory drillings with full core recovery shall be carried out when deemed necessary and required by the Employer's Representative. Based on the geological mapping and the exploratory drillings the Employer's Representative may require rock mechanic laboratory tests.

9 Temporary Ventilation System

9.1 General

Pits, tunnels shall at all times be kept ventilated to maintain an atmosphere fit for respiration and free from oxygen deficiency, potentially explosive or noxious gases and dust, whether present naturally or otherwise. Ventilation shall also be used to maintain a safe working temperature.

Underground works shall be ventilated in accordance with all applicable regulations. Details of the proposed ventilation system shall be submitted to the Employer's Representative, for review, not less than 40 days prior to the start of commencement.

Where more than one pollutant is present any adverse interaction between them shall be identified and mitigated.

All diesel engines used in the underground works shall be provided with means, which shall be maintained in efficient order, of cooling exhaust gases and reducing the concentration of toxic gases to acceptable levels, filtering particulates and preventing emission of flames or sparks. In underground workings and in confined spaces the air breathed by persons shall contain not less than 19% of oxygen by volume, and shall not contain concentration of gases, vapours or dust greater than is safe for the health or workmen, having regard to the effects of time, temperature, humidity and the combined effects contaminants. Smoking is forbidden in tunnels, pits and all confined spaces. In rock excavation all drill holes shall be wet drilled unless otherwise specified in this Specification in compliance with special ground condition.

9.2 Ventilation

The Contractor shall agree ventilation proposals with the Employer's Representative. Agreement shall not relieve the Contractor of his obligations under the Contract. Proposals shall include but not be limited to the types of fan employed, sitting arrangements where appropriate, the power supply and the fan performance data, together with duct characteristics.

In forcing systems, fans shall normally be placed on the surface. The inlet to any surface forcing fan shall have unobstructed access to fresh air. It shall not be in the vicinity of a storage site for oil, chemical or diesel drums. The fan shall also be sited so that it cannot draw in internal combustion engine fumes or gas from charging batteries. Blasting fumes shall be discharged from the underground works into a filter system or diverted adequately to ensure that concentrations of noxious or other harmful gases or dust are kept to the minimum limit as stated in the applicable laws/ Standards or the limits specified in the contract of lower.

If booster fans are to be employed by in-line staging, they shall be of an approved flame proof (FLP) construction and a monitoring system shall be installed so that the status and condition of such fans can be monitored at all times. Provision shall be made for the fan to be run continuously whether persons are within the underground works or not. After tunnel break-through the ventilating system shall be kept in operation in order to maintain the fresh air-volume requirements stated hereinafter.

If a ventilation system ceases to function for any reason and for a period exceeding 30 minutes, all work in areas being ventilated by that ventilation system shall immediately cease and all workers shall immediately leave the areas. Where a fan has been stopped and restarted, the condition of the air shall be tested before personnel enter the tunnel. If only forcing surface-mounted fans are employed, the ventilation system should be restarted and run continuously ensuring that any plugs of oxygen-deficient, flammable or noxious mixtures of gas are flushed out. Care should be taken that workmen do not encounter any plugs of these gases on re-entry to the tunnel. The Contractor should take into account that air residence time in long drives can be several hours and that layered gases of different densities are difficult to disperse, especially where the gradient of the tunnel changes. All equipment and ventilation duct shall be maintained in sound working order at all times. Any damage to ventilation duct shall be repaired within 12 hours of the damage.

The outlet of the duct shall be kept as close to the face as is practicable, designed to avoid turbulence and creation of dust and not more than 10 m away. Where dust is being produced by the tunnelling system, exhaust ventilation shall be used to extract such dust from the working area. Tunnelling shall not continue more than 10 m from the portal or pit unless positive ventilation has been established. The fresh air supply for underground works shall not be less than two cubic meters per minute at the face for each man underground and four cubic meters per minute per kW power for all diesel units operating underground. These fresh air volumes shall be cumulative and the Contractor shall allow, in his design calculations, for the maximum number of persons and diesel powered equipment deployed in the Works at any one time. Any estimated losses, e.g. due to the leaks in the ducts, shall be considered. The fresh air supply shall also be adequate to produce a linear velocity of 0.3 meters per second throughout the underground works. Testing devices shall be provided for measuring carbon monoxide, methane, oxides of nitrogen and aldehydes in underground works during the operation of internal combustion engines. Readings of carbon monoxide content shall be taken by the Contractor at least once during each shift. Readings of oxides of nitrogen content and of aldehydes content shall be taken frequently to ensure safety of the workers. A record of all taken readings shall be kept by the Contractor and submitted to the Employer's Representative daily. Ventilation ducts shall be firmly fixed to the vaults in such position that a minimum clearance of 20 cm remains between the duct and the extremities of vehicular traffic employed in the Underground Works.

9.3 Monitoring

Atmospheric monitoring equipment shall be positioned at each working face and also within 20 m of the tunnel entrance when the tunnel has advanced 250 m or more. Monitors shall also be provided every 500 m along the tunnel. Monitoring equipment shall be capable of continuously monitoring the levels of potentially explosive gases, toxic gases and radioactive gases as appropriate and the oxygen content. The equipment shall give both visual and audible warning of the presence of potentially explosive, radioactive or toxic gases and where the oxygen content falls below safe working levels defined in Table 2 below. An immediate and effective means of communicating warnings to the surface shall be installed. The atmospheric monitoring system shall be a fixed system supplemented by portable monitoring equipment as necessary, except in small tunnels where the use of portable equipment only shall be permitted at the discretion of the Employer's Representative.

Table 2: Admissible maximum concentrations of pollution gases in underground works

Pollution gas	Max. concentration
H_2S	10 ppm
SO_2	2 ppm
CO	50 ppm
NO_2	5 ppm
CO_2	5000 ppm
CH_4	1000 ppm
Silica dust	8 mg/m³

The full length of all tunnels shall be monitored continuously for the presence of explosive or noxious gases or lack of oxygen. Records shall be kept of monitoring results. If concentrations of noxious gases or other inflammable gases exceed the permissible limits stated in Table 2 above, BS 6164 or HSE guidance document EH40, or oxygen content below the level set out in BS 6164, all operation's shall be interrupted immediately and personnel shall be removed to a safe area. All sources of ignition shall be extinguished or removed. All equipment with the exception of ventilation equipment shall be shut down.

When any explosive gas concentration of 1.25% is present, all persons other than those essential for safety shall be withdrawn from all parts of the tunnel. The use of explosives and locomotives shall be prohibited and all electrical equipment not intrinsically safe shall be disconnected. All persons shall be withdrawn when the explosive gas concentration exceeds 2.0%.

The required measures will be mutually determined and agreed to by the Employer's Representative and the Contractor. If required by the Employer's Representative, the Contractor shall consult the services of an independent consultant experienced in gaseous tunnelling. Re-entry and resuming of the Work shall be prohibited until the Employer's Representative has authorised re-entry.

If the ventilation system is for any reason not in operation for a period greater than 2 hours, a start-up procedure shall be invoked. This requires that the tunnel shall not be re-entered until one complete air change in the tunnel has taken place and the tunnel atmosphere is shown, by monitoring, to be safe.

Persons re-entering after shutdown must carry instruments to detect the presence of dangerous gases and the sufficiency of oxygen, and these must be used continuously during re-entry.

9.3.1 Checking & Inspection

During each shift, the following checks shall be made:

- The fan or fans shall be checked for heat, unusual noise and vibration. The results shall be reported and remedial action shall be taken if required.
- The ventilation ducting shall be checked for damage and the joints checked for integrity. The results shall be reported and remedial action shall be taken if required.

- The atmospheric monitoring system shall be checked at both local and remote stations and the results shall be recorded.

The air flow quantities shall be checked at both the face on a weekly basis. These figures shall be recorded and compared with the calculated flows. Any shortfall shall be made good.

The ventilation records shall be maintained and be made available for inspection by the Employer's Representative.

9.3.2 Control of Dust Silica and Noxious Gases

To reduce the amount of dust, only wet drilling will be allowed and during mucking, muck piles shall be kept constantly damp by sprinkling with water. The use of high pressure water jets for this purpose is not permitted.

Air Samples for this purpose shall be taken within 10 days of commencing underground excavation, at 30 days intervals thereafter and within 20 days following major changes in tunnel excavation operation or whenever required by the Employer's Representative. Samples shall be taken from actual working areas. The sampling and testing shall be performed by a qualified person or laboratory to be proposed by the Contractor and approved by the Employer's Representative. A copy of the test results shall be submitted to the Employer's Representative within 2 weeks of the sampling date.

In general, the concentration of fine dust (diameter less than 0.005 mm) may not exceed the value of 8.0 mg/cum of air and in relation to the silicon dioxide SiO_2 content in the rock this value is lowered in compliance with Table 3.

Table 3: Maximum admissible fine dust concentration with respect of SiO_2 content in the rock

per cent per weight	mg/m³ air
1-15%	8.0
15-20%	6.0
20-30%	4.0
30-60%	2.0
60-80%	1.5
80-100%	1.3

The Contractor shall take necessary measures and install appropriate equipment in agreement with the Employer's Representative if the concentration of fine dust exceeds the limits stated in Table 3 above.

Use of internal combustion engines, other than approved mobile diesel powered equipment will not be permitted in underground construction Sites.

9.3.3 Lighting

Floodlighting on the site surface shall be adequate for the safe operation of the site. It shall be shrouded where necessary to ensure the light is directed to areas within the site, and to avoid nuisance.

Lighting in the tunnel shall extend the full length and not be less than that required for safe working and access. Lamps shall be located with an interval of 25 m.

An alternative source of power and emergency lighting system shall be provided to allow emergency securing operations and evacuation safely in the event of a primary power failure as specified in Clause 3.5.1. An adequate number of hand lamps shall be located at key points underground.

The Contractor shall also provide suitable movable lamps to illuminate any area in Underground Works including areas for instrumentation and where the Engineer may wish to carry out inspection and rock mechanics tests or instrumentation.

Lighting illumination by flame is strictly not permitted in the underground Works.

9.4 Monitoring

9.4.1 General

The Contractor shall submit to the Employer's Representative for agreement a detailed method statement for instrumentation and monitoring, including instrumentation layout, trigger, design and allowable values and the procedures for evaluating the monitored data.

The Contractor shall appoint within his site team an experienced Monitoring Employer's Representative who shall lead the Contractor's monitoring team. The Monitoring Employer's Representative shall present the results of the previous day's monitoring in the daily monitoring meeting as per 8.4 with the Employer's Representative where they shall be presented to the Employer's Representative by the Monitoring Employer's Representative.

The frequency of such review meeting may be increased if requested by the Employer's Representative. The Contractor's Site Manager shall attend monitoring review meetings if requested by the Employer's Representative.

The accuracy and precision of the required measurement will depend on the purpose of the monitoring.

Assessments shall be carried out to establish the zone of influence due to tunnelling works and to determine the likely damage that will occur to existing above-ground and subsurface infrastructure.

The outcome of the assessments shall determine the type and amount of monitoring that will be required.

Instrumentation and monitoring for the tunnel and appurtenant structures shall be carried out with the following instruments but not limited to:

- Theodolites/ Total station and reflectors
- tape extensometer and convergence pins
- borehole extensometers (multiple-point) strain gauges

- load cells
- radial pressure cells tangential pressure cells
- temperature gauges

All instrumentation operating on electrical, mechanical or hydraulic systems shall be accompanied by individual test certificates, and shall be tested in the presence of the Employer's Representative prior to installation, unless specifically stated otherwise.

The installation of instruments may interfere with the overall construction progress. The Contractor shall make provision for such interferences in his construction schedule. He will not be entitled to any compensation or extension of the Time for Completion by reason of any such delays, including repair and replacement of damaged instruments if the damage is due to construction procedure of Contractor.

No material shall be installed prior to the Employer's Representative's approval. However, approval by the Employer's Representative of the Contractor's proposals and drawings or data shall not relieve the Contractor from his sole responsibility to meet all the requirements.

9.4.2 Ground Movement Monitoring

Unless otherwise provided in the Contract, the Contractor shall monitor the effects of tunnel construction at the surface, including all ground movements and the effects on all structures, including the Works. Where specifically requested, the subsurface effects, including movements of the water table, shall also be monitored.

Monitoring shall be referenced to stable survey stations located outside the zone of influence of the Works and not subject to ground movement. Such benchmarks and coordinated stations shall be established and agreed with the Employer's Representative before any ground is excavated and before any ground treatment or dewatering takes place. They shall be checked at intervals during the duration of the Works.

The Contractor shall observe record and analyse the readings to establish trends in movement and reconcile movements measured with those predicted. He shall provide a copy of all recorded results to the Employer's Representative. He shall make available results to the Employer's Representative in accordance with an agreed program. However, movements greater than predicted shall be reported to the Employer's Representative immediately.

Prior to construction Works commencing, a defect survey shall be carried out of all structures within the zone of influence and a schedule of defects shall be prepared. This schedule shall be agreed by the Contractor and the owner of the structure, or his representative, prior to the start of construction. Existing pipelines, tunnels and services shall be regarded as structures.

During the execution of the Works, defects which have been scheduled shall be inspected and monitored as necessary. Defects which arise during the course of the Works shall be recorded. The Contractor shall keep records of such inspections and a copy shall be available to the Employer's Representative.

Monitoring of settlement, scheduled defects and defects arising during the course of the Works shall continue at agreed intervals for a period of at least 6 months after completion.

9.4.3 Tunnel Excavation Monitoring

The Contractor shall survey, monitor and record tunnel and shaft construction as it proceeds to form a record of the Work. Monitoring shall generally be per unit of advance and include line, level, cross-sectional accuracy, shift advance and total advance.

Where grouting is carried out, the type, volume and pressure of grout shall be recorded.

All information recorded by the Contractor shall be provided to the Employer's Representative on a daily basis unless another interval has been agreed.

3-dimensional deformations of the tunnel lining shall be monitored by means of optical methods. The points to be observed are marked by targets or reflectors mounted on standard convergence bolts.

Where the Contractor considers that any corrective action he may take will exceed the tolerances in the Contract, he shall so inform the Employer's Representative and obtains his agreement. Measurements shall be carried out with a free-stationed high precision electronic theodolite/ Total station as laid down in Clause 8.9.2 with integrated coaxial EDM device. The flow of data shall be fully automatic. The software shall allow determination of displacements in an absolute coordinate system with an accuracy of min ± 1.0 mm.

The Contractor shall determine the elevation of tunnel crown or any other point as directed by the Employer's Representative during tunnel excavation to monitor vertical settlements and bottom heaves and to be able to interpret and figure the absolute amount of displacements together with convergency readings out. Pins or bolts shall comply with Clause 8.9.1. The method of performing the level measurements shall be such as to ensure an accuracy of ±1 mm.

Necessary conclusions shall be drawn from the geotechnical measurements, from their magnitude, alterations and tendencies about stability of the primary lining and surrounding rock, performance of the initial support applied and utilization of the supporting elements.

The locations and spacing between geotechnical measurement sections depends on geological conditions, frequency of geological alterations, rock mechanical behaviour, length of tunnels, primary stress conditions and size of tunnels. The location of designed measurement sections shall be modified during tunnelling according to the local geological conditions and the experience gained during tunnel driving and as required and approved by the Employer's Representative.

The strata exposed in the tunnel face shall be mapped and recorded where possible, and the nature of the excavated material shall be noted in all cases. The Clause 7.3.4 applies accordingly. The Contractor shall keep copies of all recent face records at the workface for the information of supervisory personnel.

All significant groundwater ingress shall be recorded and monitored.

All atmospheric testing shall be recorded and monitoring for all gases carried out in compliance with Clause 7.7.3.

9.5 Daily Review Meeting

The monitoring instrumentation shall be read on a regular basis – as per drawings and monitoring plan – and the results shall be made available for a daily review meeting (DRM) attended by the senior members of the Contractor's and the Employer's Representative's staff. Input into the meeting shall also include current geotechnical investigations, face logs and any recent non-conformance reports relating to the tunnel construction.

This DRM shall be held daily during the excavation of the tunnels at the site unless otherwise agreed by the Contractor and the Employer's Representative.

The minimum team attending the meeting shall include the following persons:

- Monitoring Contractor's Representative
- Monitoring Employer's Representative
- Contractor's Representative
- Employer's Representative

At the meeting the Contractor shall present the current results of all monitoring equipment of the tunnels and adjacent structures respectively together with trends in these results and comparison with the deformations predicted by the calculations. Additionally the Contractor shall present the installed support measures and results from the geological mapping including information as defined in Clause 7.3.4.

The purpose of the daily review meeting is to assess the behaviour of the ground in order to:

- Confirm the design assumptions
- Confirm that the construction methods are appropriate for the ground conditions
- Provide early warning of potentially unpredicted behaviour determine the likely cause of adverse behavior
- Confirm the safety of the applied construction method

The outcome of the meeting shall be a report, the Required Excavation and Support Sheet (RESS) as per Clause 8.6, agreed by the Contractor and the Employer's Representative, which states that tunnelling may continue as proposed, or gives the requirements for modifications to the tunnelling (e.g. support measures, shorter advances, smaller headings etc.).

The Contractor shall keep minutes records of the monitoring meetings. The minutes of the construction monitoring meetings shall be signed by the attendees. Monitoring results shall be attached to the minutes and recorded on site. All records from these meetings including face logging and monitoring results shall be kept and be available for inspection until the termination of the Contract.

9.5.1 Key Performance Indicators

A key performance indicator (KPI) system shall be developed for monitoring movements so that actions can be taken in a timely manner, thereby ensuring that damage to existing structures and subsurface infrastructure is within calculated predictions.

The KPIs to be used to guide construction shall relate to specific monitoring activities as follows:

- in-tunnel convergence monitoring (SCL)
- ground movement monitoring
- monitoring of adjacent and overlying structures
- geological mapping

The KPI values specified in the design documentation shall be used to indicate whether there is cause for concern during tunnel construction or not. To ensure that the response is appropriate for any specific concern, certain procedures shall be implemented when a KPI is exceeded. These are summarised below.

- A full review of the lining performance shall be conducted for the relevant tunnel section and checked against the KPI values. This includes checks on the ground/soil conditions, the quality of construction and the monitoring results provided by the Contractor.
- A comprehensive review of the trends for monitoring data specific to the area of concern shall be carried out by the Contractor and the Employer's Representative.
- The Contractor shall assess the extent to which the deformations comply with the SCL serviceability and extreme limit conditions.
- Together with the Employer's Representative, the Contractor shall decide whether changes in the SCL excavation are required. This is an interactive process that will determine whether it is safe to proceed with construction or if there is reasonable cause for concern, the extent to which it is necessary to implement additional measures or emergency procedures. These measures will be included in a new RESS.
- The Contractor and Employer's Representative shall implement the Action Plan, the emergency response to implement contingency measures. If there is reasonable cause for concern, it is emphasized that the response must be rapid.
- The performance of the tunnel is kept under continuous review until the monitoring data indicate that KPI trends show a stable condition.

At least three trigger values shall be established: a green, amber and red limit. The green limit marks the boundary of normal behaviour. The amber marks the boundary of serviceability while the red trigger should be set below the ultimate capacity of the lining. The Contractor's Action Plan should include pre-planned contingency measures that can be taken if a trigger value is exceeded.

If a trigger value is reached, first the site team should check that the reading is correct and consistent with the readings from other instruments. If the trigger has really been breached, then contingency measures will be instigated, in accordance with a predefined Action Plan and as directed in the DRM. The contingency measures are designed to correct any anomalous behaviour.

9.5.2 Required Excavation and Support Sheet (RESS)

Based on the design and the evaluation of the results of monitoring, a RESS will be issued as the outcome of the Daily Review Meeting (DRM) as per Clause 8.4. In the absence of any approved changes, the RESS will reflect exactly what is shown on the relevant design drawings.

The RESS shall be prepared and endorsed by the Contractor's Site Manager, Who is responsible for the tunnelling works, the designer and the Employer's Representative on site. Unless all the three signatures are obtained, the proposals indicated on the RESS shall not be implemented.

The RESS shall address, but not necessary be limited to, the following matters:

the tunnel section (chainages) to which the RESS is applicable

- the support to be installed the excavation sequence
- the method of working related to ground support including staging of application of sprayed-concrete layers and lapping of reinforcement
- monitoring to be installed in the tunnel section in question measures to be taken during stoppage of works
- other instructions relevant to the tunnel section in question reference to relevant design drawings
- ground conditioning

A copy of the RESS will be given to the foreman in charge of the work in the tunnel and shall be kept at the working face.

A RESS is required for every advance per round of the tunnel excavation.

If, for any reason, the approved design method of working is changed, then this will be reviewed prior to the DRM and, subject to acceptance by the Employer's Representative, a new RESS will be issued.

9.5.3 Contingency Measures and Emergency Procedures

The Contractor shall determine contingency measures to deal with potential hazards that may affect the Works. The Contractor shall submit for approval to the Employer's Representative an Action Plan which shall detail the actions, procedures and contingency measures to be followed in the event that the monitoring system shows unacceptable levels of deformation/movement if potential hazards occur.

Hazards to be addressed include:

- changing ground conditions
- excessive movement of the linings
- excessive ground movement
- excessive settlement of the existing structures
- unplanned stoppages
- mechanical excavation plant failure
- insufficient labour resources
- Failure of services to underground works (air, light, power, etc.)
- Incidents within underground works
- delay in supply of sprayed concrete (SCL)

In underground construction works, changes tend to be progressive with evidence of structure or ground behaviour becoming apparent before failure occurs. For this situation a system of hierarchical trigger levels will be appropriate. This allows proportionate response to adverse indications from monitoring.

Trigger levels will be based on the results of assessments of at-risk infrastructure. If the assessment indicates that the at-risk infrastructure is unlikely to be able to tolerate the change due to the Works, then triggers will be set based on the levels of change that will be tolerable.

There may be some situations where change is less progressive and monitoring may simply be required to give a yes/no response. In these cases reporting is simple and systems of triggers are not appropriate.

9.5.4 Probing Ahead

Where required the Contractor shall be responsible for probing ahead of the tunnel face in order to prove or investigate the ground. The selection of plant for probing shall be agreed with the Employer's Representative and shall take the probable nature of the ground ahead and its water-bearing capacity into account. Probing shall be carried out in such way to allow modification of the excavation and support according to the encountered ground conditions. The number of probes, the diameter of drilling, their positions in the face and angles with respect to the tunnel drive shall be governed by the actual ground conditions and the machinery in use. The maximum probed distance ahead of the face shall be governed by the ground conditions and the degree of uncertainty with distance. The diameter of probe holes shall be not less than 38 mm. The used flush shall be suitable for the type of ground conditions anticipated and the machinery in use. An accurate and systematic record of probe hole positions (positions in the face and angles with respect to tunnel drives), drill penetration rate, drill parameters (percussion, torque, thrust), flush (colour, percentage return), drilling sounds (loud, quiet, intermittent), water strikes and interpretation of the nature of the ground ahead shall be noted at the time the holes are bored and a copy provided to the Employer's Representative. Full facilities shall be provided for the Employer's Representative to inspect probing work in progress.

9.6 Primary Support Measures

9.6.1 General

Generally the primary support measures are installed immediately after the performed blasting round and a break of work prior to support construction is not permitted. The type and amount of tunnel support is directly related to the Rock Classification as established. The initial support associated with the established rock classification system is shown on the Employer's design drawings. The Contractor may design his own tunnel support. However, as a consequence of variations from the anticipated rock conditions the support systems as shown on the Contractor's design drawings for each Excavation Class may require modifications and adjustment during construction as directed by the Employer's Representative.

The Contractor shall ensure that support elements will be installed or applied in such a manner and sequence as to prevent disintegration and loosening of the rock mass surrounding the excavated tunnel.

Comprehensive records, containing all particulars of the tunnel support actually installed and its performance in the course of the works shall be prepared and maintained by the Contractor and made available to the Employer's Representative on a daily basis. These records shall include type, quantity and location of installed support elements, the clearance profile after installation of support, deviations from the designed support systems, observations of excessive deformations, shotcrete cracking, etc. Observations of excessive deformations, shotcrete cracking, etc. shall be reported immediately to the Employer's Representative.

The Contractor shall keep a record of the chainage of each face position and shall keep this record updated as the face progresses. This record shall be available for consultation at any time at a convenient location close to the relevant face.

The Contractor shall record the results of all tests performed on the rock bolts prior to, during and after their installation, and submit these documents to the Employer's Representative.

The records as defined above in this Technical Specification will be submitted daily to the Employer's Representative for review and approval. The Contractor has to check the rock mass support measures by on-going visual inspection. Surfaces of water sensitive rock mass shall be sealed immediately with adequate measures. The Contractor shall apply shotcrete on rock masses which tend to local overbreak immediately.

Structural support consisting of wood is only permitted temporarily. It is not permitted to leave wooden support in the shotcrete or concrete layer.

Damaged rock mass support system due to re-profiling shall be reconstructed subsequently (see also 9.12).

The Contractor has to provide an adequate amount of rock mass support systems and required equipment on the site; hence no delays of excavation shall occur. Prior to the beginning of excavation the required rock supports shall be provided by the Contractor on the site.

Blasting round lengths, time schedules, construction sequences, quantity and location of installed support elements shall be constructed as per drawings. Deviations from the designed support systems shall be reported immediately to the Employer's Representative and shall be approved.

The Contractor shall in case of emergency be obliged to undertake independently such support measures as he deems necessary without the prior consent of the Employer's Representative. In such cases the Contractor shall inform the Employer's Representative immediately.

Rock mass support is defined as follows:

- Primary support: is defined as the support which is installed systematically within the heading, bench and invert zone in order to ensure the short term integrity of the underground excavation and safety of personnel during excavation. The installation of primary support is an essential element of the excavation cycle.
- Final lining: is defined as support which is installed subsequent to the primary and supplementary support and which does not form part of the normal excavation cycle. It serves as the permanent lining of the tunnel and shall be a cast in situ concrete lining plain or reinforced according to structural requirements.

The final lining may be installed in any section of the tunnel, with the Employer's Representative's approval, at any time after convergence measurements show that movement in the rock in the immediate vicinity has stabilised.

9.7 Rock Bolts

9.7.1 General

Unless otherwise defined herein, rock bolts shall comply with the following Indian Standards or their equivalent International Standards:

- IS: 1786:2008 Specifications for high strength deformed-steelbars and wires for concrete reinforcement
- IS: 2062 Steel for general structural purposes

Rock bolts are untensioned steel bars threaded at one end and provided with a face plate, shim plates and a conical seated washer and nut or split or deformed steel tubes. Steel bars shall be grade 500 N/mm², deformed type-2 bars complying with BS 4449. Threaded parts of bars, nuts and seatings shall comply with the requirements of BS 4190. Face plates shall be of a dish shape in steel to the appropriate standard and shall have a hem-ispherical seating with centralised slot to suit dimensions of the rock dowels.

Where required, the bar and components shall have corrosion protection and the thread-ed end shall be sealed by an end cap.

Rock bolts shall be installed according to the length, direction, placement and number as per approved design drawings for each relevant Excavation Class unless otherwise determined by the Employer's Representative. Rock bolt length, direction, placement and number shall be adjusted to the Ground Type.

Comprehensive records about details of the installation of rock bolts during drives, such as reference number, grout consistency, drilling depth, length, inclination and type of rock bolts, deviations from the theoretical position, type and time of grouting, time of tightening, special observations, details of tests carried out, geological ground condition, etc. shall be kept for each rock bolt and round by the Contractor and countersigned by the Employer's supervisо-ry personnel. Copies of these records should be submitted to the Employer's Representa-tive.

The trademark of rock bolts and anchors to be installed shall be approved by the Em-ployer's Representative. A quality assessment is required, unless common anchor steel and anchor plates were used. The Contractor's construction execution shall comply with the manufacturer's specifications and recommendations regarding drilling, installing, testing and maintenance of rock bolts.

The characteristic bearing capacity of the anchor plate and the connection between the an-chor and anchor plate shall be equal to the characteristic bearing capacity (P_{tk} according to BS EN 1537) of the anchor steel.

The diameter of the drillings and the drilling technique shall be adjusted to the anchor type and Ground Type. Holes for the installation of bolts shall be drilled straight and with an accuracy of ±10°.

The drilling hole shall be flushed and cleaned with compressed air or water immediately prior to the installation of the bolt. The used technique shall be adjusted on the Ground Type (e.g. bore holes drilled in swelling ground no water flushing is permitted).

The water pressure during drilling may have an inadequate impact on the surrounding ground (e.g. decrease of mechanical strength properties) due to this the water pressure may be reduced or dry drilling may be conducted as directed by the Employer's Representative.

Unless instructed otherwise, rock bolts shall be installed and tightened prior to the excavation of the next bench or round excavation. The tension force shall be determined by the Employer's Representative after completion of the initial testing program.

The Contractor shall provide torque wrenches of a type acceptable to Employer's Representative. All impact and torque wrenches shall be calibrated once every month.

The grouted hole shall be completely filled with grout. This shall be done by filling the drilled hole from the bottom of the hole and withdrawing the grout slowly, always maintaining the hose embedded in the grout. A regular surface shall be provided to seat the face plate by trimming rock surfaces or forming pads of quick-setting mortar. Where mortar pads are required they shall be of adequate thickness and extend beyond the face plate by 25 mm all round at that thickness before being chamfered at 45°. Care shall be taken to ensure that the mortar does not interfere with the installed bolt.

9.7.2 Bearing Plates

Rock bolts shall have face plates which shall be of a dish shape in steel to the appropriate standard and shall have a hemispherical seating with centralised slot to suit the dimensions of the rock bolts.

Bearing plates shall be flat or dished steel plate of minimum dimensions of 150 x150 x 10 mm conforming to IS: 2062, or as otherwise recommended by the manufacturer and approved by the Employer's Representative. Bevelled or hemispherical washers shall be used and nuts shall be heavy hexagonal type. For rock bolts that are permanently exposed, the bearing plates shall be coated before installation with an anti-corrosion protective coating compound. Any defects in the coating shall be adequately recoated after installation. The outer ends of the rock bolts, nuts and washers shall also be coated with anti-corrosion compound after installation and tensioning. The remaining portions of all rock bolts shall be clean and free of all deleterious materials.

Anchor plates, directed by the Employer's Representative to be checked, shall be held free until the check for the section is completed.

9.8 Grouted Bolts

9.8.1 Specifications

Grouted rock bolts (SN-bolts) shall consist of deformed reinforcing steel bars with a corrugated surface and one end shall be fitted with a suitable thread which is to receive an anchor plate and a fixing nut.

High quality cement shall be used for the grouting. The anchor shall reach 40 % of the characteristic bearing capacity (=Pt_k according to BS EN 1537) after 6 hours and 100 % of the characteristic bearing capacity after 12 hours.

Bolts shall have a minimum load capacity as defined in the design drawings. The load capacity shall also apply to the thread, nut, anchor plate and coupling, if any.

Washers and nuts shall allow the secure transfer from the anchor force to the anchor plate.

Where required, the bar and components shall have corrosion protection and the threaded end shall be sealed by an end cap.

9.8.2 Installation

Boreholes for all rock bolts shall be drilled to the depths as required by the lengths of rock bolts specified for the respective Excavation Class and at diameters which ensure best workability for grouting, coupling and installation. The minimum diameter of the boreholes shall be 10 mm larger than the diameter of the installed rock bolts/couplings. Holes shall be drilled to produce straight holes of the required length and with an accuracy of ±10°.

The boreholes shall be cleaned out by flushing with compressed air or with clean water to remove all drill cuttings, sludge and debris prior to fixing the rock bolt. The amount of water flushing shall be kept to an absolute minimum. The installation of rock bolts shall follow the drilling and preparation of the borehole within 3 hours.

Prior to the installation of the rock bolt, the entire borehole shall be filled with cement mortar by inserting the grout hose to the full depth of the hole and withdrawing as the grout is pumped in. The nozzle shall be kept buried in the grout as the pipe is withdrawn so that air is displaced as the hole is filled. The grouting shall start at the bottom of the hole. For grouting of vertical anchors, the consistence of the mortar shall be chosen that no mortar leakage from the hole is appearing.

The bolts are inserted in the drilling hole after filling with cement grout and therefore fully bonded with the surrounding rock. The outer end shall be fitted with a suitable thread to receive an anchor plate, a washer and a fixing nut to allow the secure transfer of the anchor force to the anchor plate. The anchor plate is fixed on the bearing surface within 2 rounds behind the face or at least 6 hours with the anchor nut to achieve an approximate force of 20 kN. This force shall be applied by a calibrated torque wrench.

In case of confined working space and/or great length of rock bolts, coupling shall be permitted. The number of coupled parts shall be kept to a minimum. However, the load capacity of such coupled rock bolts shall not be less than that of a standard integral rock bolt. Special attention shall be paid to the grouting procedure in order to ensure full embedment of the bolt by grout.

9.9 Frictional Bolts

9.9.1 Specifications

Frictional bolts (e.g. Swellex or similar) are mechanically folded steel tubes with immediate bearing capacity after installation in the pre-drilled borehole as high water pressure (~300 bar) inflate the tube and adapt its shape to the irregularities of the borehole (split set bolt, expandable bolt or similar).

Steel anchor plates with a minimum size of 150x150 mm (thickness as required) allow the transfer of the anchor force at the anchor head to the shotcrete or rock surface. The fric-

tional bolts shall have a minimum breaking load of 200 kN or higher as defined in the design drawings.

9.9.2 Installation

Boreholes for the rock bolts shall be drilled to the depths as required. The boreholes shall be cleaned of all drill cuttings, sludge and debris.

The installation of rock bolts shall be done not later than two hours after drilling of the borehole.

For inflation of bolts, equipment as recommended by the manufacturer of the bolts shall be used. After applying the water pressure, the water shall be drained into the excavation.

9.9.3 Self-Drilling Bolts

Self-drilling bolts are a combined system of a rock bolt with typical diameters lagrer than 32 mm outer diameter and a drill rod.

The system enables the installation of rock bolts in case of collapsing boreholes. Grouting of the bolt is conducted through the internal grouting canal.

The installation of self-drilling bolts shall be in accordance to the manufacturer's instructions and requirements.

9.9.4 Grout

Grout constituents shall comply with Clause 9.10.4 and Clause 10.1.3 of this Specification.

Cementitious grouting material shall be injected starting from the furthest point of the drilled hole so that the dowel is completely encased in grout. Grout shall not be used after a period equivalent to its initial setting time. Where cement grout is used, a set of six cubes of cement grout shall be taken when each series of rock dowels is in progress. Sampling, preparation, curing and testing shall be in accordance with BS EN 196. Half the cubes shall be tested at 1 day and the remainder at 28 days. The average compressive strength determined from any group of cubes shall exceed the specified characteristic strength by:

1 N/mm² for cement grout tested at 1 day

3 N/mm² for cement grout tested at 28 days.

10 Shotcrete

Shotcrete shall be mixed, charged, applied, cured and tested according to given Specifications which are based on “Specification for tunnelling” by British Tunnelling Society. Additionally to these Specifications and where these specifications do not cover any aspect the “Guideline for Sprayed Concrete”, Austrian Society for Concrete- and Construction Technology, 2005, Austria. Enclosed in Addendum-2 shall be applied.

10.1 General

70 days prior to any shotcrete application the Contractor shall submit detailed description of shotcrete to the Employer’s Representative for review and approval such as:

- Number and type of equipment used for mixing, batching and applying shotcrete
- Manufacturer's certificates detailing any proposed admixture, inter alia, accelerator admixture and the Contractor's proposals for the use of such admixtures
- Mix design

The Contractor shall, 45 days prior to commencement of the actual work of spraying concrete or as otherwise approved, submit results of preconstruction tests of sprayed concrete with the actual materials, inclusive of admixtures, mixed in the proportions proposed for the Works for approval. The Contractor shall make available testing, production and application records daily to the Employer’s Representative when concrete is applied. The application records shall contain information on when, where and how much sprayed concrete was applied in each operation. The sprayed concrete shall comply with the BS EN 14487-1 Sprayed concrete, except as noted otherwise below. The requirements listed below generally refer to high-quality temporary or permanent sprayed concrete.

This specification is primarily for the use of wet-mix sprayed concrete but in certain circumstances dry-mix sprayed concrete may be suitable. Sprayed concrete shall be applied by either the wet or dry process as appropriate to the circumstances. All aspects of the application of sprayed concrete shall be subject to the agreement of the Employer’s Representative. Particular emphasis shall be placed on the provision of adequate ventilation.

The compressive strength of shotcrete in-situ (taken from the tunnel lining or from panels sprayed in the tunnel) shall develop progressively to a final strength according to the minimum requirements specified as per the J2 class shown in the figure below [As per Austrian Guidelines]. Uniaxial compressive strength tests shall be done in accordance with the provisions stipulated in Clause 9.11.3. The strength development due to suitability tests must exceed the specified in-situ strength by a factor of 1/0.85 (=1.18) .The sprayed concrete mix design shall, unless otherwise stated, comply with the characteristic strengths specified by the detailed design for early-age and long-term loading. The 28-day-strength (cube) of shotcrete shall be minimum 25 N/mm². The strength development of shotcrete shall be such to meet 2 N/mm2 after 4 hours.

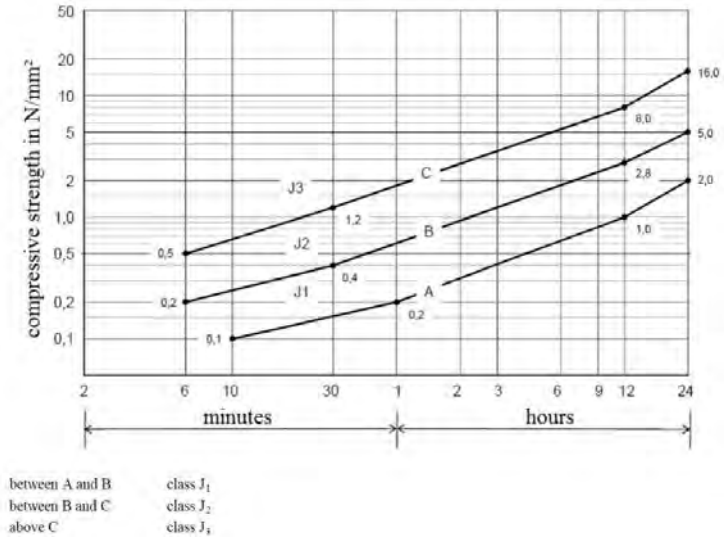


Figure 2 : Early strength development of sprayed concrete

10.2 Mixing

The Contractor shall develop a sprayed concrete mix and a plan for its production and application. Constituent materials shall comply with those listed within this Section.

The mix for shotcrete shall be designed by laboratory tests and field trials as indicated in Clause 9.11.3 of this Specification to meet the requirements for strength development and final strength.

Batching and mixing shall be carried out by equipment capable of properly mixing materials in sufficient quantity to maintain the continuous application of sprayed concrete and to the accuracy defined in BS EN 14487-2.

All measuring equipment shall be maintained in a clean serviceable condition and shall be zeroed daily and calibrated once in a month.

If required according to the support category additional fibres shall be at a stage in the mixing suitable for the sprayed concreting equipment. Fibres shall be added and mixed in a manner to avoid clumping and bending of fibres. Any fibre clumps in the mix shall be diverted and removed by means of a screen placed over the sprayed concrete hopper. Fibres shall be uniformly distributed throughout the mortar matrix without isolated concentrations.

10.3 Aggregates

Aggregates for sprayed concrete shall comply with BS EN 12620 and the Section 10.1.3.1 of this Specification.

The aggregates shall be clean, strong, durable, suitably graded and shall not contain detrimental amounts of dust, mud, clay or organic impurities. The aggregate shall be checked for chemical reactions, such as alkali-aggregate reaction, with latent hydraulic binders and admixtures, especially accelerators.

The grading and moisture content of the individual fractions of the aggregate shall be checked and recorded daily. The total chloride content shall not exceed 0.35 %. The coarse aggregates shall not contain a large quantity of long stone pieces. The maximum size of the aggregates shall not exceed 16 mm for the dry-mix process and 12 mm for the wet-mix process unless otherwise agreed with the Employer's Representative. The grading shall lie within the grading range in compliance with the Austrian Guideline on Sprayed Concrete given in Table 4 below.

Table 4: Range of the grain size distribution for grain sizes 0/8 and 8/11

Maximum grain size [mm]	passing the screen in [m%]
11	95-100
8	85-95
4	65-75
2	45-55
1	30-40
0,5	18-25
0,25	8-12
0,063	2-6

Frozen aggregates shall not be used. Minimum temperature of the aggregates shall be 5° Celsius.

During rainy and cold weather periods the aggregates shall be stored under cover for at least 48 hours before being used, in order to reduce the water content.

10.4 Admixtures

Admixtures may be used in sprayed concrete. Admixtures shall be compatible with each other and the mix. Details of the mix design and technical data demonstrating compliance with BS EN 206-1 and BS 8500 shall be submitted to the Employer's Representative for approval.

Accelerating admixtures shall be compatible with the cement used. The compatibility shall be tested in the laboratory and in field trials to achieve the required properties for setting and strength development as specified in Clause 9.11.3 of this Specification.

Admixtures shall be free of chlorides such that the percentage of chlorides shall not exceed 0.1% by weight.

The required characteristic values and consistency of delivery to the site shall be agreed in writing with the manufacturer of each admixture before commencement of concrete spraying. Storage conditions and usage of admixtures shall comply with the manufacturer's recommendations.

Written confirmation of the stability of admixtures with the mix water shall be provided prior to commencement of site trials.

The content of SO_3 shall not exceed 4.8% by weight of total binder content.

Only liquid alkali-free accelerators (pH value between 3.0 and 8.0 and having alkali content less than 1% by weight Na_2O equivalent) shall be used unless pre-bagged dry mix is used where powdered accelerator has already been mixed in. Only the minimum quantity of accelerator necessary shall be permitted in normal concrete spraying operations. At no stage in the strength development should the strength of the accelerated mix drop below 0.7 times the strength of the unaccelerated concrete mix. The dosage rate to be used is evaluated following the suitability tests carried out in compliance with the characteristic compressive strength requirements of Clause 9.11.3 of this Specification. Compliance with this Clause shall be demonstrated by site trials. Any addition to this dosage rate shall not exceed 1% of the cement content of the mix design by weight. The dosage rate may be reduced if required for down hand and vertical spraying positions. Automatically device shall be used to add the accelerating admixture. Actual dosage shall be decided by laboratory tests. At least one set of tests shall be performed each month.

Testing of accelerators and the base mix with respect to acceleration of setting, early strength and decrease of strength at a later age (28 days), shall take place in due time before commencement of concrete spraying.

Setting time of the Portland cement and accelerator shall be determined in accordance with BS EN 196-1 and 196-3. The results should be:

- initial set <3 min
- final set <10 min

Additives for the improvement of performance, workability etc. may be added with the approval of the Employer's Representative.

Additives intended to be used shall be included in the tests as described in Clause 9.11.3 of this Specification. Accelerating admixtures shall be used to meet the requirements for setting and strength development of shotcrete applied in-situ. Laboratory testing of the selected type(s) of accelerator shall be carried out at dosages as recommended by the manufacturer, to establish the variability of the above properties with dosage. Accelerators showing excessive variability with dosage will not be permitted. Accelerators delivered to site shall be tested at least once every two months for their reaction with the Portland cement used, with particular reference to the setting behaviour and strength decrease after 28 days. The stability of accelerators during storage shall be visually inspected at similar intervals. Storage times and working temperature ranges shall be in accordance with the manufacturer's recommendations. The manufacturer's safety instructions shall be observed.

Plasticisers and retarders complying with BS EN 934-2 may be used to reduce the quantity of the mixing water and to improve the pumpability of the concrete. The effects and optimum dosages of plasticisers and retarders shall be determined by site trials.

The influence of the plasticisers and retarders within the concrete mix shall be checked regularly for setting time, water reduction and development of strength. These values shall be compared with the results from the pre-commencement trials.

Compatibility of plasticisers and retarders with Portland cements, latent hydraulic binders and accelerators shall be verified by observation and site trials.

Hydration control admixtures may be used to control the hydration of the mix as appropriate to expedite construction of the Works. The effects and optimum dosages of hydration control admixtures shall be determined by site trials.

Compatibility of hydration control admixtures with Portland cements, latent hydraulic binders and accelerators shall be verified by observation and site trials. Hydration control admixtures shall be used in accordance with the manufacturer's instructions.

Dosing of admixtures by hand shall not be permitted.

10.5 Cement & Additions

Portland cement shall conform to the requirements of BS EN 197-1 or National Standards and must be suitable for sprayed concrete application. The cement content shall be designed to meet the strength requirements of shotcrete applied in the field. As a minimum, Portland cement shall be CEM I, strength class 42.5; class N and R are both appropriate. The Portland cement fineness shall not be less than 350 m2/kg and C3A content not less than 5%. The minimum Portland cement content shall be 360 kg/m3. The minimum total binder content shall be 400 kg/m3. In order to determine a suitable dosage rate of accelerating admixtures, suitability tests shall be carried out

Table 5: Maximum level of additions (in percentage of binder)

Cementitous Material	Maximum Addition
Silica fume (solids)	15% of Portland cement
Pulverised fuel ash	30% of Portland cement
GGBS	30% of Portland cement

Pulverised fuel ash and ground granulated blast furnace slag shall conform to BS EN 450-1 and BS EN 15167 respectively and may also be included in the mix provided.

Silica fume shall be in the form of water slurry and shall comply with BS EN 13263- 1.

Silica fume (microsilica) shall comply with the following requirements:

- The content of SiO_2 by weight of dry mass shall be not less than 85%.
- The silica fume shall not contain more than 0.4% elemental silica (by weight of dry mass) or any deleterious materials such as quartz, rust and/or cellulose fibres.
- The specific surface area shall not be less than 15000 m²/kg.
- The carbon content shall not exceed 2% and the total alkali content as Na_2O equivalent shall not exceed 2%.
- SO_3 content (by weight of dry mass) shall be less than 2%.
- pH value shall be between 5.5 and 1.0.
- The viscosity shall be 20 seconds with a 4 mm viscosity cup in accordance with British Board of Agreement Certificate 85/1568 and the relative density shall be between 1.3 and 1.4.
- The activity index shall be at least 100% after 28 days.

Testing to establish compliance with items above shall be carried out on a monthly basis.

Silica fume shall be regularly agitated by circulation pumps prior to use.

The compatibility of silica fume and liquid admixtures shall be established by carrying out appropriate accelerated testing procedures agreed with the Employer's Representative.

The optimum content of silica fume shall be determined during site trials.

10.6 Water

Water shall comply with the Clause 10.1.3.5 in this Specification.

For the dry-mix shotcrete, the water content shall be controlled by the nozzleman to suit the conditions of the shotcreting surface and location of application. An indication that the water/cement ratio is in the correct range will be, that the shotcrete will seem to have a slightly shining appearance immediately following application.

For the wet-mix shotcrete, field trials shall be carried out to determine and establish the suitable water/cement ratio.

Due to aggressive mountain water, admixtures shall be defined in agreement with Employer's Representative.

The water/cement ratio range for permanent sprayed concrete shall be not more than 0.50.

10.7 Application

10.7.1 General

Details of all equipment to be used shall be made available to the Employer's Representative prior to commencement of site trials. The sprayed concrete nozzle and ancillary equipment shall be of an adequate capacity for the volumes to be applied.

The equipment selected and approved by the Employer's Representative will be capable of maintaining the ratio of concrete and accelerator as selected from the trials and approved by the Employer's Representative. The actual ratio of accelerator to selected concrete shall be identified at the nozzle, and take into account the filling efficiency of the equipment and the efficiency of the accelerator dosage equipment to overcome the air and concrete pressure at the nozzle while spraying at typical outputs and air flows.

Equipment shall be thoroughly cleaned at least once per shift. The spray nozzle shall be checked for wear and where necessary replaced. Transport pipes consisting of hoses and pipes shall be designed to convey the concrete efficiently and without leakage or blockage. The transport pipes shall have uniform diameter appropriate to the mix characteristics determined by site trials and be free of any dents or kinks between the sprayed concrete machine and the nozzle.

Working area for sprayed concreting shall be well illuminated and ventilated. Dust pollution shall be minimised by choice of appropriate equipment and by means of additional ventilation, water sprays and by maintaining equipment in good order. Protective clothing and dust masks shall be provided for and used by all persons present during spraying.

The equipment shall allow for air and water in any combination to be available for preparation of surfaces and/or cleaning of finished work.

The Contractor shall enable the Employer's Representative access to the sprayed concrete Works at all times, and shall allow the Employer's Representative access to inspect the excavated ground surface prior to spraying if requested.

10.7.2 Proficiency of Nozzlemen

Nozzlemen shall hold relevant certificates of competence issued by the Contractor or written evidence of previous satisfactory work indicating compliance with EFNARC Nozzleman Certification Scheme, ACI 506R-03 (USA) or similar National Standards to the approval of the Employer's Representative. Each crew shall demonstrate acceptable proficiency in the application of sprayed concrete to trial areas before being employed on the Works to the agreement of the Employer's Representative.

Subject to the Employer's Representative's agreement, tests for proficiency may be combined with trial mix tests.

Tests for proficiency shall use the equipment selected for use in the Works where practicable.

10.7.3 Applying

Rock or previously applied shotcrete surfaces to be shotcreted shall be carefully cleaned of all loose material, scale and other contaminations. It may be necessary to use compressed air and a water jet.

Where groundwater flow could interfere with the application of sprayed concrete or cause reduction in the quality of sprayed concrete. The Contractor shall take all action necessary to control groundwater. Such action shall include the channelling of water by means of pipes etc.

In order to prevent the build-up of water pressure behind fresh sprayed concrete, apparent water shall be drained through the concrete, either with appropriate drainage holes or by other approved methods, e.g. by installing a perforated drainpipe or drainage channel covered with filter fabric and extending as approved from the leakage area to the drainage system. Such drains must be secured to the rock surface.

Drainage holes shall be drilled in the sprayed concrete lining where the build-up of water pressure may occur, and where drainage was not installed prior to the placement of sprayed concrete. The diameter and spacing of such holes shall be as directed by the Employer's Representative.

The optimum distance between nozzle and surface of application is 1.0 to 1.3 meter. The nozzle shall be positioned at right angles to the surface of application. Two nozzles shall be used at least for regular tunnel heading.

The sprayed concrete shall emerge from the nozzle in a steady uninterrupted flow. Should the flow become intermittent for any cause, the nozzleman shall direct it away from the work until it becomes constant again.

For vertical and near-vertical surfaces application shall commence at the bottom and the leading edge of the work shall be maintained at a slope. Downward spraying shall be

avoided where possible. The nozzle may be inclined sufficiently to ensure reinforcement is properly embedded.

The projected shotcrete thickness (d_S) shall be equal to the summation of thicknesses of each shotcrete layer. The Contractor shall determine the thickness of the shotcrete layers. The maximum shotcrete layer thickness is 20 cm, thicker layers shall be constructed with sub-sequences. Subsequent layer(s) must not be applied before the previous layer has developed sufficient strength to support the additional layer(s). These additional layers shall be completed within a period not exceeding three days.

Lattice girder, roof ties, wire mesh and other reinforcement shall be embedded in shotcrete as shown on the tunnel design drawings. The minimum cover of wire mesh and re-bars applied at the inner side of a shotcrete lining shall be 4.0 cm. Voids behind reinforcement and steel ribs must be avoided.

The shotcrete lining shall be constructed in a way that all bolts and anchors are fully covered with shotcrete of the primary lining. The surface of the primary lining must be smooth enough for the application of the water proofing system according to the specification of the water proofing system.

If more than one layer of reinforcement is installed, the second layer shall not be positioned before the first one is embedded and covered completely with shotcrete.

No rebound shall be shotcreted to avoid structural weaknesses in the lining. Rebound shall be removed immediately after finishing of each shotcrete application. The rebound shall be removed, in particular at horizontal shotcrete connections due to separate excavation sequences and at all construction joints, if necessary by pneumatic hammers, prior to further application of shotcrete.

All joints in the sprayed concrete lining shall be as specified in the Design.

The surface to receive sprayed concrete shall be damp but shall not exhibit free water.

The temperature of the mix before placing shall not be below 5°C and shall not exceed 35°C unless special provisions are made. Spraying shall not be undertaken when ambient temperature is below 5°C unless special measures can be taken to provide protection against frost until the sprayed concrete has developed a compressive strength of at least 5 MPa.

The surface of the shotcrete lining can follow the rounded surface of the rock mass including corners and edges. The minimum thickness of the shotcrete lining as given in the design drawings must be reached in every point of the lining.

Cracks in the shotcrete induced by shear failure shall be removed and a clean connecting face shall be constructed prior to further shotcreting.

The base mix concrete may be used up to 2 hours after the addition of water to the cement provided that the sprayed concrete can be applied satisfactorily. Any unused material after this time shall be discarded. This period may be extended by the use of hydration control admixtures, subject to the approval of the Employer's Representative.

10.8 Reinforcement – Wire Mesh

10.8.1 General

The reinforcement for primary support measures shall be in compliance with Clause 10.4 of this Specification.

Cutting of reinforcement for better placing due to edges is permitted; hence additional reinforcement in these sections is required.

Welded wire mesh fabric shall be installed in surface excavations in conjunction with sprayed concrete, as shown on the drawings, or as directed by the Employer's Representative. Chain link fabric may be used for surface applications only if previously approved by the Employer's Representative.

10.8.2 Specification

Welded wire mesh fabric shall conform to the requirements of IS: 4948 and shall have a mesh size of 150 x 150 x 6 mm as shown on the drawings, or as required by the Employer's Representative.

The diameter of additional steel bars shall be limited to 14 mm according to Austrian Guideline "Sprayed Concrete". The characteristic yield strength of the welded wire mesh shall be 500 N/mm².

10.8.3 Installation

Welded wire fabrics shall be installed in such way so that it follows as close as possible the irregularities of the excavation surface or previous layers of shotcrete. It shall be firmly fixed to prevent vibration and change of position during spraying of shotcrete. The use of wooden pegs or pins for attaching the wire mesh to the rock surface shall not be permitted. Welded wire fabrics shall be installed in the longest practical length. The overlap for welded wire fabrics applied in the shotcrete lining shall be at least twice the pitch distance in circumferential direction. In longitudinal direction, the overlap shall be at least one pitch distance for the first layer of fabric and at least twice the pitch distance for the second layer of fabric.

A minimum concrete cover at the tunnel side of 4.0 cm of all wire mesh layers shall be provided.

10.9 Lattice Girder

10.9.1 General

Lattice girders shall be installed to maintain the designed shape of the opening and if necessary, provide an immediate support at the working face over the length of the last excavation completed. The lattice girder mainly functions as reinforcement. If necessary, the installation of steel arches or lattice girders shall also prevent ground loss and shall improve load distribution.

For the application of support arches and lattice girders the following shall be taken into account:

- axial stress and bending moment in the steel arch ribs induced by the ground loads
- lateral stability and bracing of steel arches or lattice girders method of installing the steel arches or lattice girders
- method of blocking and spacing of blocking points
- bearing capacity of the ground at the toe of the arch ribs
- the stand-up time of the unsupported part of the excavation the groundwater regime and permeability of the ground

10.9.2 Specification

Lattice girders shall consist of three primary bars, connected by stiffening elements to the manufacturer's design or as shown on the drawings. They shall be designed so as to:

- facilitate sprayed concrete penetration into and behind the girder, thereby minimising the creation of projection shadows and/or voids
- provide good-quality bonding between the steel and sprayed concrete, to form a composite structure acting as a continuous reinforced concrete lining
- make allowance for the specified tolerances including convergence

Stiffening Elements: A minimum of 5% of the total moment of inertia shall be provided by the stiffening elements. This percentage is calculated as an average along the repeatable lengths of the lattice girder. To ensure stability against buckling, the maximum spacing between the stiffening elements shall be less than three times the cross-sectional height of the girder.

Dimensions and tolerances: The lattice girders shall be fabricated to meet minimum clearances and tolerances shown under consideration of accuracy of placement during construction, manufacturing tolerances and of lining deflection following installation. Prior to installation, each girder shall be inspected as specified below and all measurements taken shall be recorded along with any comments. Any changes in the inspection frequency must be authorized by the Employer's Representative following a review of previous inspection results.

Each girder inspection shall check the following criteria:

- That the girder is fully identified with the girder type and the unique traceability reference.
- That the girder links and sinusoidals are in the correct positions and are adequately welded.
- That the reinforcement and plate types and sizes are as specified on the drawings.

When inspecting weld quality, the following criteria shall be used:

- The reinforcement shall be free from undercut in excess of 1 mm.
- The weld metal deposition shall be even and blend smoothly with the bars.
- The weld metal shall be free from cracks and porosity.

The chord length shall be checked by measuring the distance from the outer edge of the connection plate to the corresponding point on the connection plate at the other end of the girder. The measurement shall be taken to the nearest millimetre.

The chord height shall be checked by placing a tight cord across the centreline of the girder between the outer edges of the end plates then measuring the height from the chord to the inside edge of the lower main bar. The measurement shall be taken to the nearest millimetre. Where the girder consists of a double radius the chord lines shall be taken along the outer edge of the connection plates to the point at which the radius changes.

Lattice girders shall also comply with the following tolerances:

- The erected lattice girders shall not deviate from the design shape and position by more than -0 mm and +50 mm.
- Lattice girders shall be fabricated to include an allowance for 10 mm of convergence.

Fabrication: Each of the primary bars of the lattice girder segment shall be composed of only one piece of high-yield steel (minimum grade 500 N/mm² characteristic yielding strength). Secondary bars are either plain round profile or deformed high yield steel (minimum grade 500 N/mm² characteristic yielding strength).

The connection elements at the end of the girder segments shall be constructed of flat or angle steel to BS EN 10025:2004, grade S275JR. Connections between lattice girder segments shall be bolted as shown on the drawings. Welded connections between segments shall not be permitted. Nuts and bolts supplied are to be grade 8.8 or higher. The connections shall transfer the maximum tension load of the steel bars.

All welding shall be carried out in accordance with BS EN 1011-1:2009.

10.9.3 Installation

The single steel bar is situated at the outer side of the profile. The lattice girder is usually separated in five elements. Three elements form the top heading arch and two elements are placed as bench segments. The arch elements are connected with screwed head plates which are welded onto the main steel bars. The connection has to transfer the (tension) forces in the steel arch bars. The lattice girders have to be embedded entirely in shotcrete.

A minimum 50 mm thick sprayed concrete layer must be in place before the installation of the lattice girders. Under no circumstance lattice girders shall be installed under unsupported ground.

Lattice girder segments shall be secured by use of steel wedges, concrete spacers, mortar sacks and/or other appropriate means to maintain position during application of sprayed concrete. The means of support shall be subject to the approval of the Employer's Representative. No wood blocking shall be used.

Lattice girders shall be firmly fixed in their final position against the excavation prior to application of sprayed concrete. Lattice girders shall be sufficiently clear of the excavation and final internal profile of the structure to accommodate the required sprayed concrete cover.

Lattice girder segments shall have butt plates and the method of installation shall ensure tight connection of all elements.

Immediately prior to concreting, casting or spraying, the lattice girder shall be rendered clean and free from deleterious matter.

10.10 Forepoling

10.10.1 General

To support the excavation roof (tunnel crown) forepoling elements are installed if required at the upper part of the tunnel excavation face. Forepoling shall be applied in rock and soil conditions which tend to produce overbreak, collapses or material inflows immediately following excavation. Forepoling shall be applied locally or systematically, as the circumstances require for the safety of the works and for preventing overbreak. The installation of forepoling always requires the erection of lattice girder. They shall be driven from the supporting frame in a slightly upwardly inclined direction at the crown of the heading and should penetrate at least half a set beyond the next excavation cycle.

Forepoling shall be applied as shown on the approved detail design drawings by the Contractor or as instructed by the Tunnel Designer's Representative and/or the Employer's Representative.

Forepoling shall be properly supported by the lattice girder and the shotcrete above the lattice girder. Therefore, the shotcreting of the gap between lattice girder and the shotcreted sealed rock surface along the area of forepoling shall be completed after the installation of forepoling.

Spacing between consecutive forepoling pipes or bars around the crown of the excavation profile shall not exceed the maximum distance specified on the approved design drawings, and shall be reduced if the actually prevailing geological conditions at the tunnel face require to do so.

Great care shall be taken to prevent the disturbance of face and supports in general during the forepoling cycle.

10.11 Grouting

Grouting operation is defined as follows:

- contact or cavity grouting, at pressures up to 300 kPa, to fill voids between final concrete lining and primary sprayed concrete lining, or between the primary lining and rock
- consolidation grouting or strata grouting, at pressures up to 6 MPa, of the rock surrounding the excavated space, which shall commence after completion of contact grouting, where applied
- consolidation grouting or strata grouting in the heading zone, at pressures up to 6 MPa, in zones of sheared and disturbed material or of high water inflow
- final grouting of temporary drainage holes

10.11.1 General

The Contractor shall prepare a detailed grouting Specification to suit best the actual conditions encountered. This grouting specification shall be submitted to the Employer's Repre-

sentative for approval unless otherwise agreed or directed by the Employer's Representative. The Tunnel Designer's Representative shall specify the maximum pressures to be used for grout injection at each location. The pressures specified are subject to approval by the Employer's Representative.

Records of all details of grouting works such as location, inclination, diameter of boreholes, drilling time, equipment used, results of water pressure tests, mix, quantity, pressure of grouting, development and special events during grouting operation etc. shall be kept by the Contractor, countersigned on site by the Employer's supervising personnel and submitted to the Employer's Representative.

Where necessary due to the nature of the ground conditions or where adverse water conditions are anticipated, the requirements for the use of special grouts shall be stated in the Contract.

Special grouts supplied by proprietary manufacturers may be used subject to agreement with the Employer's Representative.

Preconstruction grout trials shall be undertaken to demonstrate that the required setting times and strength gains will achieved. Details of the trials and results shall be submitted to the Employer's Representative.

Quality control of grout mortar shall be in compliance with Clause 9.11.2 of this Specification as directed by the Employer's Representative, water pressure tests shall be carried out.

10.11.2 Drilling

Grout holes shall be drilled either with percussion type or rotary type drilling equipment, depending on Ground Type.

The diameter at the bottom of the grout holes shall not be less than 35 mm. For percussion drill holes the diameter of the drilling bit shall be at least 8 mm larger than the diameter of the couplings used for the drill rods.

Only water shall be used for flushing during drilling unless directed otherwise by the Employer's Representative. All holes shall be thoroughly cleaned immediately after drilling using water and/or air under pressure. After washing, downward holes shall be kept plugged until the commencement of grouting operation.

10.11.3 Mixing

All grout mixes shall be prepared using high speed, high shearing action mixers to produce a grout of uniform consistency.

General-purpose cement grout shall be mixed in accordance with the proportions given in Table 6 . The water content shall be kept to the minimum required to ensure a smooth, fluid mix.

Table 6: Mix proportions for cement grout

Class	Proportion by mass		
	Cement	Sand	Pulverised Fuel Ash (PFA)
G1	1	-	-
G2	1	3	-
G3	1	10	-
G4	1	-	10
G5	1	-	4
G6	1	-	0,5

When, prior to pumping, mixed grout is to be stored for short periods, purpose made agitator tanks shall be used. Grout shall be used within 1 hour of mixing.

When clay or bentonite additives are used, separate mixing tanks shall be provided for mixing and agitation.

Grouts containing polymer additives shall only be mixed in a colloidal-type mixer.

Water meters shall be provided for accurate measurement of water used for mixing. Pressure gauges, safety valves, by-pass valves etc. shall be provided where required on mixers, agitators, pumps and injection hoses.

Special grouts from proprietary manufacturers shall be mixed and used in accordance with the manufacturers' instructions.

10.11.4 Materials

The following types of grout mixes may be used:

- Neat cement grout, possibly with admixture
- Cement-sand grout, possibly with admixture
- Cement (with silica fume) grout with or without sand
- Micro-cement grout
- Chemical grouts (polyurethane or epoxy)

General the constituents of the grout (cement, water, sand and admixtures) shall comply with the requirements given in Clause 10.1.3 unless specified otherwise hereinafter.

10.11.5 Cement

Cement for grouting purposes shall in general be rapid Portland type in accordance to ENV 197.

Micro-cement for grout shall be milled from pure Portland cement clinker and shall have a minimum blaine specific area of 900 m2/kg with 95% of all particles < 10µm and with a maximum particle size of30µm

10.11.6 Sand

If sand is required in the grout mix design, it shall comply to the following gradation (Table 7).

Table 7: Sand gradation used for grout mix

Sieve size in mm	Percentage passing by weight
2.00	100
1.00	90 – 100
0.50	50 – 80
0.25	18 – 48
0.125	7 – 25
0.063	0 – 3

10.11.7 Additives

Silica fume for grout shall be micro fine powder with an average particle size less than 0.5 µm. Pulverised fuel ash (PFA) shall not be used as a constituent of grouts which contain sulphate-resistant cement.

10.11.8 Admixtures

Only admixtures tested prior to the start of grouting work and approved by the Employer's Representative may be used. The approval and Manufacturer's certificates or guarantees will not be accepted as relieving the Contractor of his responsibility for the suitability of any admixture.

If admixtures or chemicals are proposed for use in grout, the Contractor shall transmit all relevant manufactures certificates (including toxicity, health, safety and environmental certification) to the Employer's Representative for review prior to any grouting measures.

Details of accelerating and retarding agents for proposed inclusion within the grout mix shall be submitted to the Employer's Representative for agreement. Any such proposal shall be submitted in conjunction with a statement which outlines the Contractor's interpretation of ground behaviour during tunnel construction.

10.11.9 Grouting

All hoses and piping should be of a small diameter to ensure a high velocity flow without segregation.

Grouting operation shall be performed without major interruptions. In case of an interruption before completion of grouting (plant breakdown), the hole shall be washed with clean water.

Grouting in the tunnel shall be performed in a manner that pressures are equally distributed and do not overstress the initial tunnel lining.

In case of any grout communicating between holes, grouting shall be done simultaneously or holes where grout issues shall be plugged.

Grouting is completed, when the required pressure can be kept constant over a period of 10 minutes.

10.11.10 Cavity Grouting of In-situ Lining

The Contractor shall grout all cavities, voids and spaces remaining unfilled outside the in-situ concrete lining. Grouting of a section of lining will not be allowed until that section has achieved its design strength.

Procedures for cavity grouting of in-situ lining to tunnels with a waterproof membrane shall be subject to agreement with the Employer's Representative.

Grout for cavity grouting shall be in compliance with this Specification, except where otherwise agreed by the Employer's Representative, who may direct that large voids be filled with other materials. The grout consistency shall be sufficiently fluid, but not more as, to ensure that the grout flows freely under low (<100 kN/m²) pressure into all parts of the space to be filled via grout pipes or grout holes provided for the purpose.

The injection points shall be provided and used for cavity grouting at an average of at least one per 2.5 linear metres of tunnel and more frequently in any areas of excessive overbreak. Vent pipes shall be provided extending to the highest points of cavities. The injection points for cavity grouting in arched roofs shall be located within 500 mm of the crown unless otherwise agreed by the Employer's Representative.

The Contractor's proposals for the installation of grout pipes shall be submitted to the Employer's Representative for agreement. Grout pipes and grout holes for cavity grouting shall be at least 40 mm internal diameter.

Grouting shall be carried out by equipment similar to that used for segmental tunnel grouting. Grouting pressures shall be such as not to damage the Works or any other property.

Grout pipes shall not remain within 25 mm of a finished concrete internal surface, and when no longer required all injection holes in concrete linings shall be filled with dry pack mortar to within 25 mm of the finished concrete surface and finally made good.

Control grouting, to verify that voids have been completely filled with grout, shall be carried out where directed by the Employer's Representative.

10.11.11 Consolidation or strata grouting

Consolidation grouting of the rock shall be carried out in sections of the Tunnel structures as shown on the drawings or as directed. Additionally, consolidation grouting may be required during the excavation works, in order to consolidate the heading face or seal off inflow of groundwater.

Strata grouting shall start with neat cement grout. Depending on the grout consumption the water/cement ratio may be reduced subsequently. In case of large grout consumption, injections shall be continued with cement mortar grout. Final injections shall be done with neat cement grout again.

Grouting of a hole will be considered as complete when the rate of grout consumption at the maximum grouting pressure is less than an amount set by the Employer's Representative, or otherwise directed.

Upon completion of grouting, the packer shall remain in the hole and the pressure maintained until the grout has attained its initial set.

11 Testing

11.1 Rock Bolts

The required bearing capacity of rock bolts is to be ensured by pull out test procedures, in agreement with the Employer's Representative. The pull out tests shall be conducted with a hydraulic press, in appearance of the Employer's Representative. The test results shall be recorded and forwarded to the Employer's Representative for review.

The equipment for pull out test procedures shall be provided and maintained by the Contractor during the whole construction phase.

11.1.1 Suitability Test

A detailed suitability test program elaborated by the Contractor set up on basis of BS EN 1537 shall be approved by the Employer‘s Representative prior to all testing work. Deviations from the European Standard shall be approved by the Employer‘s Representative.

Suitability tests in different ground types and with all types of bolts shall be conducted prior to the commencement of tunnelling. The tests shall be performed in similar geological ground conditions as expected during tunnel excavation. The location of the bolts to be tested shall be selected by the Employer‘s Representative.

A minimum of five bolts of each type shall be tested. Depending on the testing procedure and the test results the Employer‘s Representative may require further bolts to be tested.

Adequate testing equipment shall be provided to record bolt elongation, movement of the bolts and tension forces.

The bolts shall be installed in the designed manner and the external anchor resistance (R_a according to BS EN 1537) shall be determined. The anchor shall be stressed to the external anchor resistance R_a or to the proof load P_p. The proof load P_p is defined to 0.8 P_{tk} (= characteristic bearing capacity according to BS EN 1537).

For each type of rock bolt information of type, testing equipment, location and installation records, applied testing loads and records of deformation shall be forwarded to the Employer‘s Representative. For failed pull-out tests, the evaluation and interpretation of test results as specified in BS EN 1537 and proposed action shall be submitted to the Employer‘s Representative.

Based on the suitability tests and considering the economical respects the Constructor shall define the rock bolt types in agreement with the Employer‘s Representative.

With specific order of the Employer's Representative rock bolts with a smaller proof load P_p (according to BS EN 1537), due to smaller shaft friction may be installed. The characteristic anchor resistance R_{ak} of the rock bolt is therefore determined with the factor R_a (according to BS EN 1537) based on the suitability tests. Further quality testing is based on the characteristic anchor resistance R_{ak}.

11.1.2 Quality tests during tunnel excavation

The Employer‘s Representative will select 5 % of all rock bolts, which shall be tested. The test quantity can be reduced to 3 % of all rock bolts, in case of on-going positive test results and in agreement with the Employer‘s Representative. The Employer‘s Representative may order additional quality tests in case of a high failure rate of the rock bolts with no additional costs for the Employer. The quality tests shall be conducted in attendance of the Employer‘s Representative and only with hydraulic presses. The test results shall be documented and forwarded to the Employer‘s Representative for review.

The bearing capacity of rock bolts shall be ensured by pull out tests. The testing stress is 80 % of the critical strength (= characteristic bearing capacity P_{tk} according to BS EN 1537) of the bolt system.

Bolts which fail the tests or which are pulled out shall be replaced. For each failure, the Employer‘s Representative shall require further bolts to be tested in the vicinity.

11.1.3 Grout Mortar

Prior to acceptance tests of rock bolts, tests with available cements and sands shall be carried out to determine an appropriate mix design to achieve the specified strength and a proper workability in association with the grouting equipment used.

Additives may be used to improve workability. The influence of the additive on the strength development shall be followed by tests. The grout mortar shall be tested on cubes 5 x 5 x 5 cm. The cubes shall be cured in water. Five numbers of cubes shall be prepared for each compressive strength test. The resultant strength is the average evaluated from the three remaining values after elimination of the highest and the lowest value.

During construction, cube sample shall be taken weekly from the grouting hose at the nozzle. Preparation and evaluation shall follow the procedure as described above.

11.1.4 Shotcrete

The testing procedure and quantity of tests shall be in accordance to Addendum 2: “Guideline for Sprayed Concrete”, Austrian Society for Concrete- and Construction Technology, 2005, Austria.

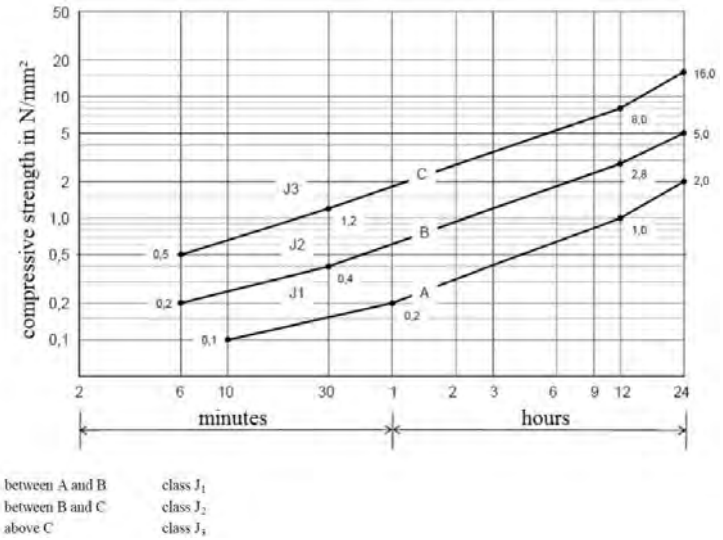
An Employer’s Representative shall be on site at all times to check the consistency of materials and workmanship with the design intent, and to ensure that ground and groundwater conditions are in accordance with design assumptions. The Contractor shall establish a procedure to respond effectively to changes in ground and groundwater conditions from the design assumptions.

The Contractor shall establish and maintain the instrumentation and monitoring required by the design. The Contractor shall establish a procedure that will enable prompt and regular review and effective response to the results from the instrumentation and monitoring. The shotcrete lining designer shall be included in the monitoring review procedure.

11.1.5 Strength

The compressive strength of sprayed concrete after 28 days shall be in accordance with BS EN 206-1, with minimum concrete strength class C25. According to BS EN 13791 a reduction factor of 0.85 can be applied for cores from in-situ concrete. The early-strength development shall conform to figure below, unless otherwise specified in the detailed design.

Figure : Sprayed concrete early strength development for a C25 mix,



The concrete shall not show any decrease in strength with time.

11.1.6 Field suitability tests – preconstruction tests

Prior to first application of shotcrete mixture in the tunnel the field suitability tests under construction conditions using concrete components intended for executing the construction job shall be performed and approved by the Employer's Representative. Field suitability tests determine the early and final strength of the intended shotcrete mixture. If the conditions or the mixture of the shotcrete vary to the tested ones, the field suitability test has to be repeated.

The equipment proposed for the application of concrete in the Works shall be used for the trial. The trial will establish whether the selected equipment is capable of efficiently mixing concrete, accelerator and air at the nozzle, and is capable of positioning the nozzle at a suitable distance and orientation to the surface geometry of the structure to which the concrete is to be applied.

For each mix design a trial mix shall be sprayed into test panels (3 Nos. per trial mix). Different dosages of the accelerating admixture shall be tested following the recommendation of the accelerator manufacturer.

If a particular quality of finish is required other than as sprayed, the trials will evaluate the methods and tools to be used to achieve the required finish and the Employer's Representative will approve the method and quality of finish achieved.

The compressive strength development up to 1.2 N/mm^2 shall be determined indirectly by the Penetrometer using a plunger of 3 mm diameter according to Addendum 2, Clause 12.3.1.

The compressive strength development in the range between 2 and 16 N/mm^2 shall be determined using the bolt-driving method according to Addendum 2, Clause 12.3.2.

The compressive strength above 10 N/mm^2 shall be determined by crushing of cylindrical shotcrete specimens. After spraying, the test panels shall be covered and not be moved for 18 hours after spraying. Cores for strength testing shall be obtained from the panels between 18 hours and 1 day. The cores for determination of final strength shall be stored in water until 3 days before testing. The specimens shall have a diameter of 100 mm and be cut to a height of 100 mm. The average value of five test results shall exceed the strength specified in Clause 9.3.1 by 5 N/mm2.

If required by the Employer's Representative, the trial shall include the construction of the proposed joints including layer joints and advance joints.

Should any mix fail to produce satisfactory sprayed concrete, the Contractor shall repeat the construction of test panels and test the same mix, plant and labour or make such adjustments as he considers as necessary.

11.1.7 Quality control tests

The performance requirements shall be set by the Designer.

The strength class of the shotcrete shall be ensured by the quality tests. If the strength class of the tested shotcrete is smaller than the required one, adequate measures shall be performed to secure the shotcrete strength. The Employer's Representative shall, in the event of repeated failure in Quality Control, require the Contractor to adjust the mix to achieve the required strength. A new quality test shall be performed if differences in the mixture of the shotcrete will be taken.

In sections where the strength class can't be ensured, the thickness of the shotcrete layer may be increased, by order from the Employer's Representative, based on following equation:

$$d1 = \{(F/M)-1\}*d$$

F is the required compression strength in N/mm², M is the measured compression strength in N/mm², d is the required theoretical shotcrete thickness in cm and d_1 is the additional required shotcrete thickness in cm.

The Contractor shall keep a record, in a form to be agreed with the Employer's Representative, of all tests on sprayed concrete, which shall be kept on site identifying the tests with the section of work to which they relate.

The testing procedure and quantity of tests is according to the Austrian Guideline "Sprayed Concrete". A summarize is given by following clauses.

Site-specific calibration is required for the strength tests of young sprayed concrete as per BS EN 14488-2.

Every 500 m³ of shotcrete delivered to the site, the early strength of shotcrete up to 30 minutes and at 1 day shall be tested. The test results shall comply with the requirements for early strength given in Clause 9.3.

Every 500 m³ of shotcrete delivered to the site, the in-situ final strength of shotcrete shall be tested. The specimens shall be prepared by means of core drilling at random places from the tunnel lining after 1 to 3 days but as close as possible to 24 hours after placing. The specimens shall have a diameter of 100 mm and be cut to a height of 100 mm and water stored until 3 days before testing. The average 28 days strength of five cores shall exceed the strength specified in Clause 9.3

Where the nominal required sprayed concrete thickness is less than 100 mm, the cores for the compressive strength testing shall be taken from areas where the actual thickness is greater than 100 mm. Alternatively additional sprayed concrete thicknesses shall be applied in selected areas agreed by the Employer's Representative for subsequent coring of test specimens.

All required drillings for the testing procedure shall be filled with concrete subsequent.

11.1.8 Measures on strength failures

Failure of 1 day compressive strength tests: 1) Inform the Tunnel Designer's Representative and the Employer's Representative, 2) Immediate examination of tunnel lining in suspect area, 3) Immediate examination of elements concerned in making, transporting and placing of shotcrete, 4) Assess the results of the geotechnical monitoring program to determine any correlation between non- conformance and tunnel deformation behaviour, 5) Prepare to take further tests at three days, 6) Take further compression tests as soon as possible, 7) The Contractor may propose measures for strengthening of the area for approval of the Employer's Representative

Failure of final strength: 1) Inform the Tunnel Designer's Representative and the Employer's Representative, 2) Further cores shall be taken from the tunnel lining in the vicinity of the failed specimen to establish the area of non-conformance, 3)Assess the results of the geotechnical monitoring program to determine any correlation between non-conformance and tunnel deformation behaviour, 4) The Contractor shall propose measures - if any - for strengthening of the area for the approval of the Employer's Representative

11.1.9 Thickness of shotcrete

Measures to establish the total thickness of shotcrete shall be set up by the Contractor and approved by the Employer's Representative. These may include visual guides installed prior to shotcreting or holes drilled after completion of shotcreting.

All required drillings for the testing procedure shall be filled with concrete subsequently.

The thickness of shotcrete is defined as a minimum thickness, consequently the shotcrete shall not be less than nominal design thickness at any place. 5 independent tests shall be done per every 500 m³ of applied shotcrete per construction element (e.g. tunnel lining, slope support…).

11.2 Cross Section Check of Primary Lining

11.2.1 Tolerances

No reduction of the theoretical thickness of the inner concrete lining is permitted unless it is approved by the Employer's Representative. To achieve this requirement, no support elements such as shotcrete, anchor heads, steel ribs etc. may protrude into the theoretical inner concrete lining, as shown on the drawings.

The primary lining must be constructed outside the inner lining and inside the overbreak-line at any point.

In the area of the invert and the foundation beams no rock parts or rock peaks may protrude into the theoretical excavation line.

For tunnel sections with no concreted invert arch the Contractor shall excavate the bottom level of the invert with an accuracy of +0 to -100 mm related to the theoretical excavation line of the invert.

If the bottom excavation level, after the clearing of all detritus material, is more than 100 mm below the designed theoretical excavation line, the Contractor shall backfill such areas up to the designed, theoretical level by means of sub-base material or as directed and approved by the Employer's Representative.

For tunnel sections with a concrete invert arch no reduction of the designed, theoretical thickness of the concrete structure is permitted. Over excavation must be compensated with structural concrete for the invert arch as specified or as directed by the Employer's Representative. The inside face of the invert arch may deviate not more than +/- 50 mm in elevation from the theoretical cross section.

11.2.2 Profile Control

The final geometry of the primary lining shall be checked solely and systematically by the Contractor in order to accommodate the designed nominal thickness of the inner concrete lining. After incremental displacements are smaller than the permitted displacement velocity and prior to the water sealing construction, the Contractor shall measure the excavated profile by electronic means, or another method approved by the Employer's Representative.

Provision is made for the final concrete lining to be cast using a rail mounted shutter running on footing beams constructed to the designed longitudinal alignment levels and cross falls at each side of the tunnel.

It is the Contractor's responsibility to ensure that the minimum clearance for the final lining, as shown on the drawings, is provided. In order to establish deviations from the theoretical profile the Contractor shall provide a gantry furnished with a template set to show the minimum profile required to give the nominal thickness of the final concrete lining. The gantry shall be designed to move along the rail tracks to be used for the movement of the tunnel shutter and is to provide access for the marking out of the areas of the initial lining which protrude into the minimum clearance zone.

The Contractor shall submit full details of the design of the gantry with its template for the approval of the Employer's Representative. On approval the Employer's Representative will

issue instructions with regard to the systematic checking of the geometry of the template during profiling operations.

The Contractor may prefer to use advance surveying techniques and data processing to establish the final clearance profile. The Contractor shall define a method of marling out areas of deviation from the theoretical profile to be approved by the Employer's Representative.

The clearance checking of the primary lining shall not commence until the rate of convergence at any of the adjacent monitoring stations is more than 2 mm per month.

Any deviations from the theoretical clearance profile shall be made good, either by providing extra shotcrete or inner lining concrete in the case of excess clearance, or by re-profiling any parts of the tunnel support protruding into the clearance profile. Contractor is responsible for these Works without any extra payments. The remedial works shall be in agreement with the Employer's Representative. No re-profiling shall be carried out without approval by the Employer's Representative. If the thickness of the re-profiling layer is more than 1/3 of the primary lining thickness or if an area is larger than 5 m² detailed procedures including structural stability proof shall be elaborated and shall be reported in a written document to the Employer's Representative prior to commencement for approval. The Structural safety of the tunnel shall not be endangered due to re-profiling and is secured by geotechnical measurements prior, in between and afterwards. Measurement equipment in the re- profiling area shall be replaced in adequate vicinity.

Records shall be kept for each stage the remedial measures executed.

The final clearance profile shall be recorded at intervals in longitudinal direction and points along the periphery of the tunnel as proposed by the Contractor in agreement with the Employer's Representative.

The final checking of the clearance profile after completion of re-profiling and surface shall be done in presence of the Employer's Representative.

11.3 Concrete Work

11.3.1 Concrete

Concrete shall be mixed, charged, applied, cured and tested according to given Specifications which are based on "Specification for tunnelling" by BTS and the Indian Standards. For the tunnel inner lining and where these Specifications do not cover all aspect the Addendum 1 - "Guideline for Inner Shell Concrete", Austrian Society for Concrete- and Construction Technology, 2006, Austria shall be applied.

11.3.2 General

All structural elements must be designed for fire load if required based on according to the above mentioned standards and guidelines.

The final lining cross section geometry shall be checked and the tolerances shall be in accordance with these Specifications.

If squeezing ground conditions are observed during primary lining construction, stress gauges and pressure cells shall be installed in the final lining to monitor the actual stress-strain

condition of the final lining. Minimum three stress gauges and pressure cells shall be installed in cross sections where squeezing ground conditions are encountered or as directed by the Employer's Representative. Records shall be kept available at site and submitted to the Employer's Representative for review.

Concrete and concrete constituents and all materials and operations relating to concrete shall meet the requirements of the Indian Standards Code of Practice for Plain and Reinforced Concrete IS 456 unless otherwise specified herein and as required by the Employer's Representative.

Where concrete is to be placed in aggressive ground, appropriate ground investigation shall be undertaken to identify the nature of the chemical composition of groundwater and ground.

The grade and properties of the concrete used in each part of the work shall be as stated on the drawings or in the Specification.

No material shall be added to ready-mixed concrete at the site unless approved by the Employer's Representative. Full responsibility shall be taken for ensuring that any materials added to ready-mixed concrete on site not causes the concrete to fail the quality control testing requirements of this Specification. Items made from such concrete which fail the quality control testing shall be rectified. Concrete is not permitted to contact to aluminium during mixing, conveying and placing.

Concrete Requirements

Concrete mixed by the Contractor or any other Sub-Contractor shall comply with the exposition classes and strength classes as defined in the approved detailed design drawings and BS EN 206-1.

The maximum chloride content of concrete shall be in accordance with IS 456.

Chloride content class for concrete containing steel reinforcement shall be Cl 0.20 (maximum Cl content by mass of cement 0.20%) and for concrete containing pre- stressed steel reinforcement Cl 0.10 (maximum Cl content by mass of cement 0.10%), unless otherwise directed by the Employer's Representative.

Consistence of concrete mix, other than concrete mix used for tunnel lining, shall be in compliance with IS: 456.

11.3.2 Concrete Composition

Aggregates

Aggregates shall be supplied only from sources approved by the Employer's Representative. The Contractor shall demonstrate compliance with laboratory tests that shall be made at regular intervals to confirm the suitability of aggregate. Approval of a source shall not be constructed as constituting acceptance of all materials from that source.

The quality of all aggregates used in the work, including processing such as washing, classifying, screening, rescreening crushing and blending, necessary to meet the required Specifications, shall all be subjected to acceptance of the Employer's Representative.

Aggregate shall be free from earth, clay, loam and soft, clayey, shaley or decomposed stone, organic matter and other impurities and shall be hard and dense.

Aggregates shall not contain any other matter likely to affect the long-term durability of the concrete. Reference is to be made to the BRE Digest 330 for guidance in reducing the risk of deleterious alkali–silica reaction to the absolute minimum.

Mineral aggregates shall comply with IS: 383 and BS EN 12620 respectively.

Tests shall be carried out in accordance with International Standards, as appropriate, and the results shall comply with the limits given therein, or as otherwise specified. Testing will be carried out to BS EN 932, BS EN 933, BS EN 1097 and BS EN 1744 as appropriate.

If necessary, fine aggregate shall be washed to remove excess fines.

Coarse aggregate shall be washed at the aggregate source. However, further washing at the batch plant may be required if the aggregate is found to be unacceptable to the Employer's Representative.

Coarse aggregate shall be tested for drying shrinkage characteristics in accordance with BS EN 1367-4. The drying shrinkage shall not exceed 0.075%.

Coarse aggregate delivered to the batching plant shall have an uniform and stable moisture content.

The acid-soluble sulphate (SO_3) level shall not exceed the values specified in BS EN 12620.

The alkali reactivity of aggregates in combination with the proposed cement shall be tested in accordance with IS 383 and IS 2386.

The maximum permitted level of equivalent acid-soluble chloride ions (Cl^-) for any single constituent or combination of the constituents of the concrete in the hardened mix shall not exceed the limits given in BS EN 206-1.

Total estimated sulphate content (SO_3) shall comply with the limits given in BS EN 206-1.

The water-soluble chloride ion content of the sand and coarse aggregate, combined in the proportions intended for a particular mix, shall not exceed the values given in IS-2386; Methods of test for aggregates for concrete.

Hardness and abrasion characteristics of the aggregate will comply with BS EN 12620.

Water absorption shall not exceed the permitted value in BS EN 12620.

Where specific thermal characteristics of the mix are required, the aggregate will be appropriately selected and tested in accordance with BS EN 1367.

Each size of aggregate shall be stored separately in drained concrete-based bins or on stages to prevent intermixing and the inclusion of foreign materials.

The size of aggregates shall be in accordance with IS 456 such as to establish the required properties of the concrete best. The grading of aggregates shall conform to IS:383.

Cement

The Contractor shall submit cement and cementitious material manufacturers' certificates in accordance with the relevant Standard. Details of all cements and cementitious materials shall be supplied including any alternative sources that might be used. The Contractor shall show that the quantity and quality required can be attained and maintained throughout the construction period. Any cement type proposed for usage in the Works shall be approved by the Employer's Representative.

Cement shall comply with the requirements as per:

- IS 269 Ordinary Portland Cement, 33 Grade
- IS 8041 Rapid Hardening Portland Cement
- IS 8112 Ordinary Portland Cement, 43 Grade
- IS 12269 Ordinary Portland Cement, 53 Grade
- IS 12330 Ordinary Portland Cement, 33 Grade

Requirements to be met by cement (heat build-up, water segregation, fineness, C_3A content, cement temperature) shall comply with BS EN 197.

Where Sulphate resistance is required, the selected cement will be appropriate to the required Design Chemical (DC) class.

Where specified or appropriate to use, blast furnace cements, Portland slag cements and blended ground granulated blast furnace slag (ggbs) cements will comply with the blending proportions specified in BS 8500-2.

Where specified or appropriate to use, Portland limestone cements and blended limestone cements will comply with the blending proportions specified in BS 8500-2.

Cementitious materials shall have a reactive alkali content not exceeding a value of 0.6% by mass and/or the total mass of reactive alkali in the mix shall be calculated and controlled to satisfy the requirements of BS 8500-2 and the British Research Establishment (BRE) Digest 330. Certification will be supplied by the producer to demonstrate compliance with BRE Digest 330.

Cementitious materials shall be supplied in bulk, unless such cementitious materials are to be used for mortar finishing, patching or grouting. Bulk cementitious materials shall be delivered to the Site in bulk carriers which shall be clean and dry prior to loading. All carriers for bulk or bagged cement shall be equipped with watertight closures for all openings.

Immediately upon delivering to the site, cementitious materials shall be stored in dry, watertight, ventilated structures.

Cements which have exceeded the manufacturer's designated shelf life will not be used and appropriate measures shall be taken for its safe disposal or return to the manufacturer.

Admixtures

No admixtures shall be permitted without written acceptance of the Employer's Representative.

All admixtures shall be obtained from the same manufacturer to ensure compatibility between the admixtures. Technical details including data of all admixtures proposed to be used shall be forwarded to the Employer's Representative for review. The Contractor

shall carry out tests and trial mixes to determine that the admixtures are compatible with the other mix ingredients.

Unless otherwise specified by the Employer's Representative, all admixtures shall be of a liquid type.

Handling and storing of admixtures shall be in accordance with the manufacturer's recommendations. Admixtures shall be stored in weatherproof buildings at a temperature not higher than 35 degree Celsius. Mechanical agitators shall be used for those admixture solutions required by the admixture manufacturer to be agitated prior to and during use.

Admixtures shall be in compliance with IS: 9103.

Water-reducing admixtures in liquid form shall comply with BS EN 206 and BS EN 934.

Admixtures shall not be mixed together prior to introduction to the mix. The use of set-retarding and water-reducing admixtures shall be in agreement with the Employer's Representative, unless otherwise specified in the Contract. Admixtures not covered by International Standards shall not be used. Concrete containing fly ash shall not be air entrained, unless the Contractor supplies proof (from tests on trial mixes or previous production) that the amount of air entrained can be controlled within specified limits and that the compressive strength of the concrete will be satisfactory.

Additions

General suitability as a Type II addition is established for the following:

- fly ash conforming to BS EN 450-1
- silica fume conforming to BS EN 13263-1
- ggbs(Ground Granulated Blastfurnace Slag) conforming to BS EN 15167-1
- meta-kaolin with an appropriate agreement certificate

General suitability as a Type I addition is established for the following:

- filler aggregate conforming to BS EN 12620 or BS EN 13055-1
- pigments conforming to BS EN 12878

Water

Water for concrete mixing and curing shall be clean and free from injurious amounts of oil, silt, salt, organic matter, acid, alkali, sediment or other deleterious substances and shall conform IS 456-1978 and BS EN 206 respectively. Recycled water may be used provided controls are in place to demonstrate compliance with BS EN 206. The Contractor shall supply, install, operate and maintain a system for water supply for concrete, mortar, shotcrete and grout manufacture. Not less than 40 days prior to the start of concrete production, shotcrete placement, or grout injection whichever occurs first, the Contractor shall submit to the Employer's Representative details of the method by which the Contractor proposes to ensure a clean and adequate supply of water. Alternative water storage facilities shall be provided to ensure that concreting, shotcreting and grouting operations will not be hindered by a temporary breakdown in the main water supply system. The permissible limits for solids when tested in compliance with IS 3025 shall be as given in Table 8 below.

Table 8: Limits of deleterious material in water for concrete mixing

deleterious material	max. permissible limit
organic	200 mg/lit

inorganic	3000 mg/l
sulphates (SO4)	500 mg/lit
chloride (Cl)	500 mg/lit
suspended matter	2000 mg/lit

The pH value of the water shall not be less than 6.

Fibres

Fibres are generally accepted for use in concrete conforming to BS EN 206-1 and BS 8500 if the fibre conforms to BS EN 14889, an European Technical Approval.

Fibre-reinforced concrete will be trialled and tested to ensure it meets the designers' requirements before inclusion in the works. Historical data of the same fibre and dosage will be accepted in place of trials provided the data are deemed appropriate.

Temperature

Every effort shall be made to maintain the temperature of concrete during manufacture, placement and curing as per IS 7861 (Part I & II) unless otherwise specified herein.

The concrete temperature at the time of placing shall not exceed 27°C nor be less than 5°C. Fresh concrete temperatures of 13°C to 18°C are most favourable. Concrete and concrete constituents may be heated to reach the preferable concrete temperature. Heating of concrete or concrete constituents shall under no circumstances increase the concrete temperature above 27°C.

Aggregates shall be heated uniformly and carefully; all frozen lumps, ice and snow shall be eliminated before entering the concrete mix; average aggregate temperature shall not exceed 60 °C and maximum spot temperature shall be below 100 °C. Frozen aggregates shall not be used.

Mixing water shall not be heated exceeding 60°C.

To avoid surface cracking caused by heat generated during setting of concrete, the temperature difference between a measuring point at the surface and a measuring point in the centre of a concrete body, or 1000 mm inside the surface if the body is more than 2 m thick, shall be less than 20°C, if not otherwise approved by the Employer's Representative. The location of the measuring point at the surface plane shall be defined as 10 mm inside the surface on a perpendicular projection of the structure member's centre point to the surface plane.

Temperature difference across construction joints shall be less than 15 °C at the time of concrete placement.

The maximum temperature during setting of concrete shall not exceed 40 °C except it is approved by the Employer's Representative.

Mix Design

The selection design and quality control of mixes shall be carried out by the Contractor or on his behalf by the manufacturer.

The Contractor shall design concrete mixes for each class of concrete. The concrete mixes shall be designed to produce a workable plastic mixture with the lowest slump that will suit

the specified condition at the time of placement and will produce concrete of uniform consistency that conforms to the requirements specified for the various parts of the works.

In order to minimize thermal cracking, the cement content of all classes of concrete shall be the minimum necessary to produce the specified strength, permeability, freeze-thaw resistance and temperature rise requirements.

11.4 Mixing and Batching

General

The Contractor shall provide at the site, modern and dependable, automatically or semi-automatically controlled batching and mixing plant or plants, in an "as new" condition, capable of supplying concrete in accordance with the Specifications and at a continuous rate adequate to meet the requirements of his schedule for concrete placement. Each plant shall have not less than two concrete mixers, each with a separate power and drive system with a standby generator and other equipment to ensure a continuous supply of concrete during concrete placement operations.

Batching

The Contractor shall provide, operate and maintain all necessary equipment and plant required to determine accurately and to control the amount of each separate ingredient entering the concrete mix. The actual amount of fine aggregate, each size of coarse aggregate, cement, fly ash, admixtures, ice and water entering each batch of concrete shall be determined by automatic weighing of each ingredient separately and not cumulatively. All constituents shall be weighed or metered in compliance with the limits prescribed in BS EN 206.

Proportioning of concrete mixes shall be in accordance with IS 456-1978 and IS 4925.

Admixtures shall only be introduced using purpose-made equipment accurately calibrated. Where such equipment is unavailable, and where agreed with the Employer's Representative, alternative dosing methods to the manufacturer's recommendations may be adopted.

Water shall not be added to concrete after it has left the mixer unless controlled, recorded and agreed with the Employer's Representative.

Where fibre reinforcement is added to the concrete mix, this shall only be introduced using purpose-made equipment.

All necessary measures shall be taken to prevent charging the batching plant with frozen aggregates. Aggregates in bins at the batching plant shall be kept above zero degrees Celsius at all times. Heating and cooling equipment shall be provided with sufficient capacity to heat or cool the water and aggregates to a uniform temperature so that the concrete will meet the placement temperature requirements.

Free access for testing and inspection of the cementitious materials shall be provided. The batchers shall be arranged that the loading cycle cannot start again as long as materials remain in the batchers.

A thermometer shall be installed in the cement day bin such that the operator can see readily the temperature of the cement at the time of batching.

The plant shall be equipped with a batching recorder which shall print the mass or volume for each material in each batch, identify the concrete mix being batched, the size of each batch in cubic meters, and the time and date of batching. The records shall be submitted to the Employer's Representative at the end of each shift and shall become the property of the Employer's Representative.

The accuracy of the measuring and weighing equipment shall be maintained so that the indicated mass does not vary by more than 0.6 per cent from the true mass throughout the range of use.

The measuring and weighing equipment shall be capable of being operated to control the delivery of materials so that the combined inaccuracies in feeding and measuring do not exceed the limits in Table 9.

The Contractor shall provide standard certified test weights and any other auxiliary equipment required for checking the operating performance of each measuring and weighing device. Unless otherwise required by the Employer's Representative, check tests of equipment used for measuring water, cement and the admixtures shall be made at intervals not exceeding one month. Check tests of measuring and weighing equipment used for measuring fine and coarse aggregate shall be made at intervals not exceeding two months. The tests shall be made in the presence of the Employer's Representative and the Contractor shall make such adjustments, repairs or replacements as the Employer's Representative may deem necessary to secure satisfactory performance before further use of the measuring or weighing equipment will be allowed.

All aspects of the batching and mixing operation including quantities of aggregates, cement, fly ash, admixtures and water shall be automatically recorded.

Table 9: Batching tolerances

cement	2,0 % per weight
fine aggregates	3,0 % per weight
coarse aggregates	3,0 % per weight
admixtures	2,0 % per weight
water	1,5 % per weight

Mixing

The mixing plant shall combine fine aggregates, each size of coarse aggregates, cement, fly ash, admixtures, ice and water into a uniform mass and shall discharge the mixture without segregation.

The batching and mixing plant shall have capacity of batching and mixing concrete at a rate in excess of the Contractor's peak placing requirements. A standby mixer with a capacity of not less than 40% of the peak placing requirements shall be available at all times for use during critical concreting operations.

A mixer timer with an automatic lock which will not release the discharging mechanism until the completion of a pre-set mixing time shall be provided on all mixers.

Separation of coarse aggregate from the mortar shall be avoided by arranging the discharge mechanism so that the concrete will fall vertically into the receiving container or hopper.

Mixers shall be examined by the Contractor at regular intervals to ensure that wear on the blades and liners does not allow dead spots or agglomerations of mortar around the sides of the mixer. Mixers shall be cleaned of any hardened materials which have built up on the insides. Should a mixer at any time produce unsatisfactory results, in the opinion of the Employer's Representative, its use shall be discontinued until it is repaired or replaced.

Mixer performance tests shall be performed on all mixers, as soon as the equipment is in operating condition at the start of the Work, at least once every 30 days during the course of the Work and at any time the Employer's Representative suspects any type of operating difficulties with the machinery. At the end of the mixing period prescribed by the Employer's Representative for the test, two samples of concrete shall be taken.

When necessary mixing times shall be increased until the required uniformity and consistency of the concrete is adequate. Mixers shall not be used if they produce unsatisfactory concrete.

Conveying

Concrete shall be conveyed from the mixer to the place of final deposit without segregation, contamination, loss of ingredients, loss of entrained air, loss of slump or damage from exposure. Trucks, buckets, belt conveyors, pumps, chutes and drop pipes may be used for conveying concrete and shall be of such size, design and condition as to ensure a continuous and even supply of concrete at the point of delivery. Alternative methods will be required to prove their success in conveying concrete rapidly, without segregation and the loss of materials. All conveying equipment shall be supported independently of the forms.

Concrete conveying equipment shall be checked by means of site trials prior to general use for its ability to deliver uniform concrete as per Clause 10.1.11.1. Slump tests shall be made on samples of concrete taken from the first and last one-tenth of a batch of mixed concrete. If these slumps differ by more than 25 mm, the equipment shall not be approved for use until the condition causing the inconsistency is corrected. Concrete conveying equipment used shall be examined daily for accumulations of hardened concrete or mortar, or for wear of the blades. Where necessary, the uniformity test may be repeated.

The time elapsed between completion of the mixing of the concrete at the plant and its discharge at the forms shall not exceed 45 minutes for concrete agitated while in transit and 30 minutes for non-agitated concrete. These basic limits apply in the case of non-set-retarded concrete. For set-retarded concrete the limits may be increased. Open conveyances shall be covered against the weather when required by the Employer's Representative.

Dispatch tickets or a record direct from the batching plant recorder shall be furnished to the Employer's Representative with each batch of concrete recording the serial number of ticket, date, batch number, truck number, amount and class of concrete, location of placement, and time of mixing. At the end of each day or shift, the Contractor shall supply the Employer's Representative with a written report concerning the quantity of each class of concrete and the number of batches produced.

Equipment to be used to convey the concrete shall not contain hardened concrete or foreign materials.

In general, the use of chutes to convey concrete will not be permitted, except that chutes less than 3 m in total length may be used with acceptance of the Employer's Representative. The delivery end of the chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with fresh clean water before and after each run, the water used for this purpose being discharged outside the form.

Concrete in the walls and arches of tunnel linings shall be placed by a displacement type pump or by other approved methods by the Employer's Representative. The equipment used in placing the concrete, and the method of its operations, shall be in a way to permit introduction of the concrete into its final location without high- velocity discharge and resultant segregation.

Concrete pumps shall have a variable speed control and shall be capable of pumping concrete containing 20 mm aggregate through delivery lines not less than 75 mm diameter and for a distance required for placement within the works to meet requirements of this specification.

Placing

General

The Contractor shall develop a detailed plan of concrete lifts for each structure which shall show the location of all construction joints and all concrete lifts in the structure and shall take reinforcing steel bars, embedded parts and water stops into account. The submission shall include calculations supported by laboratory and full scale test data showing how the temperature control requirements will be achieved. The plan for each structure, which shall include detailed drawings, shall be submitted to the Employer's Representative not less than 80 days prior to the start of concrete placement in that structure and not less than 20 days prior to the submission of reinforcing steel bar placement drawings, bar bending schedules and bar lists for that structure. The Employer's Representative shall have the right to require the Contractor to move the location of any construction joint if the location proposed by the Contractor will have an adverse effect on the design and performance of the structure.

The construction joints shown on the drawings shall not be moved unless the Contractor can satisfy the Employer's Representative that there is justification for the relocation and that there will be no adverse effect on the performance of the structure.

After the Contractor's plan for construction joints and concrete lifts has been approved by the Employer's Representative no additional joints shall be incorporated into the Works unless approved by the Employer's Representative. Details of proposed additional joints shall be submitted to the Employer's Representative not less than 60 days prior to concrete placement at the location of the proposed additional joints.

Concrete shall not be placed in any part of the Works until the foundations, previously placed concrete, formwork, reinforcing steel bars, embedded parts and water-stops in that area have been inspected by the Employer's Representative and permission has been given by the Employer's Representative for concrete placing to proceed. Concrete shall be placed only in the presence of the Employer's Representative.

All surfaces to be in contact with the in-situ concrete lining shall be thoroughly cleaned and scaled of all loose or defective material.

The surfaces of water-proofing membranes shall be thoroughly cleaned to remove any loose and foreign materials. They shall be cleaned by washing with a stream of air and water, but care shall be taken not to displace the membrane or its fixing and seals.

Concrete shall not be placed in still or running water and shall not be subjected to the action of running water until the concrete has set.

All formwork shall be true to form, securely made and supported, and joints shall be sealed to prevent the loss of cement from the mix. Where required, grout pipes shall be incorporated for pressure relief and subsequent grouting.

Concreting shall not commence until the formwork has been inspected and agreed with the Employer's Representative.

The build-up of water pressure behind uncured linings shall be prevented. Concrete shall be placed continuously in each length of formwork. Concrete shall be protected from rain during placement.

The time between batching and complete discharge shall be less than 90 minutes and shall be such that the concrete can be placed and consolidated without the addition of extra water. The time between batching and complete discharge shall be reduced to a maximum of 60 minutes when the air temperature exceeds 25 degrees Celsius.

In order to reduce bleeding, slump shall not be higher than necessary to achieve proper placement and consolidation.

The depth of concrete placed in each lift shall be as shown on the Contractor's drawings. All concrete shall be deposited in approximately horizontal layers 50 centimeters in thickness at such a rate that the formation of cold joints will be prevented. Each new lift of concrete shall be placed on the oldest exposed lift.

Hardened or stiff concrete shall not accumulate on reinforcing steel or formwork.

Partially hardened concrete shall not be re-tempered with or without additional aggregate, cement or water.

Once concrete placing has started it shall be carried on as a continuous operation until the placing of the lift is completed. The rate of placing shall be such that each successive layer can be vibrated and bonded into the previous layer.

When concrete is placed on an inclined surface, the placing operation shall begin at the lower end of the slope and shall progress upward.

The sequence of work within the tunnels or shafts shall be arranged as that no damage occurs to permanent linings. The proposed sequences and methods of operations shall be agreed with the Employer's Representative.

Before any concrete is placed for tunnel linings the Contractor shall demonstrate to the Employer's Representative that his concrete mix, equipment and working methods are capable of producing fully compacted concrete to the required surface finish. If required by the Employer's Representative, this shall take the form of a trial length.

Preparation

Immediately after the removal of blasted rock, excavated rock surfaces against which concrete will be placed shall be scaled and cleaned to remove unclassified material, loose, broken and detached rock fragments and unsound, slaked, deteriorated and closely fractured rock which remain in the excavated surface of the rock. Where required by the Employer's Representative, scaling and cleaning shall be followed by dental excavation to remove the unclassified material remaining in open and debris filled joints, cracks, fissures, seams, crevices, faults, shear zones and other relatively narrow openings. The purpose of scaling, cleaning and dental excavation is to produce a sound, intact, tightly anchored rock surface.

Scaling, cleaning and dental excavation will require the use of manual labour, with hand held pneumatic tools, shovels, bars, trowels, compressed air jets, high pressure water jets, brooms, brushes and other hand held tools. High pressure water jets shall not be used.

Foundation surface of the rock, concrete and shotcrete shall be protected against weathering and the deleterious effects of frost action, rain, groundwater seepage and construction equipment until concrete placement commences.

Shotcrete in underground works shall be cut back so that no shotcrete protrudes inside the concrete pay line (see 7.6 and 9.12).

Rock, shotcrete and concrete surfaces against which concrete is to be placed shall be kept continuously damp for a period of not less than 24 hours immediately prior to concrete placement.

Surfaces of reinforcing bars, forms and embedded parts shall be cleaned of all dried mortar, grout, oil and all other coatings except epoxy coating and galvanizing.

Immediately before concrete is placed, forms shall be inspected to ensure that the forms are accurately placed to the specified tolerances and are sufficiently rigid and braced to prevent movement during concrete placement and that all reinforcing bars are in the correct position and secured against movement during the placing operation. Chemicals shall not be used to remove ice or hardened concrete from the forms.

In hot weather or concreting on surfaces which are highly water absorbent, the surfaces against which concrete is to be placed, including reinforcement and formwork, shall be lightly sprayed with water to prevent excessive absorption of water from the fresh concrete. Pre-wetted surfaces shall be free from excessive water before concreting.

Placing

The concrete shall not be placed until the rate of convergence at any of the adjacent monitoring stations is less than 4 mm per month, unless otherwise approved by the Employer's Representative.

Concrete shall be placed while still sufficiently plastic for adequate compaction and shall be carefully worked around all reinforcement and embedded fixture and corners of the formwork.

Concrete shall be inspected at the point of placing.

There shall be no vertical drop greater than 1.5 m except where equipment such as tremie pipes and chutes satisfactory to the Employer's Representative to use to confine and control

the falling concrete. Horizontally movement of concrete exceeding 1.0 m by the use of vibrators is not permitted.

Concrete shall be placed as close as possible to its final position, in continuous near level layers not exceeding 500 mm. Each layer shall be compacted before succeeding layers are placed. The depositing of large quantities of concrete at any one point and running or working it along the forms will not be allowed.

Placing equipment shall be operated by experienced operators only. In general, the concrete placing shall continue uninterrupted until the structure is filled over the entire length of the formwork. In the event of equipment breakdown or if for any other unavoidable reason placing is interrupted, the Contractor shall thoroughly compact the concrete to a reasonable level or flat slope while the concrete is plastic. The concrete at the surface of such cold joints shall be cleaned with a high-pressure air water jet before the concrete achieves a primary set, to provide an irregular clean surface free from laitance. Prior to restarting concreting, the surface shall be wetted. The work shall be carried out in a way that a sound dense homogeneous structural element is produced.The concrete which forms the openings to caverns and niches or other recesses shall be placed concurrently with the concrete in the parent tunnel at the same cross section. Concrete shall not be subjected to disturbance between 4 hours and 24 hours after placing.

Consolidation

As concrete is being placed, it shall be compacted thoroughly and uniformly by means of vibrators, supplemented by hand spading, ramming, and tamping to produce dense, homogeneous concrete, that is at its maximum density, that is in complete contact with forms, that is effectively bonded to the reinforcing steel bars and the embedded parts and that has smooth formed surfaces, free of air pockets and blemishes.

Concrete shall be consolidated with the aid of approved immersion type mechanical vibrators complying with IS 2505. Immersion vibrators shall be a minimum of 40 mm in diameter and shall be capable of transmitting vibration to the concrete at frequencies in excess of 150Hz or 4000 rpm and shall visibly affect the concrete at a radius of 300 mm. At least one vibrator in working order shall be held in reserve for emergency use. Concrete vibrators shall not be used for moving concrete. Vibrators shall be operated as nearly as practicable in a vertical position. The vibrating head shall be allowed to penetrate under its own weight until it can re-vibrate the top 5 centimeters of the underlying concrete layer. The vibrator shall be withdrawn slowly to avoid the formation of voids and shall be carefully positioned to avoid contact of the vibrating head with the formwork. Vibrators shall be inserted at uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator. Vibrators shall be held stationary until the concrete is consolidated and then withdrawn slowly. The concrete ingredients shall not be allowed to segregate and no laitance shall be allowed to appear on the surface. Vibrators shall not come in contact with nor disturb embedded parts, waterstops, reinforcing steel bars and formwork.

Particular care shall be taken with the compaction of concrete surrounding water bars to avoid honeycombing and to prevent the displacement of the water bar. Care shall also be taken to avoid displacement of pre-fixed pipes, block-outs, thermocouples and the like.

Where placing concrete for tunnel linings formwork vibrators shall be used for compacting concrete in the tunnel arch above the highest openings in the formwork. They shall be operated at intervals of not more than 1.2 m behind the advancing slope of the concrete in the shoulders and crown of the arch. The location and operation of the vibrators shall be carefully coordinated with the withdrawal of the discharge line so as to avoid settlement and flow of the concrete from the filled crown.

Finishing

The surface of formed and unformed concrete shall be within the specified allowable deviations from the lines, slopes, elevations and dimensions shown on the drawings and shall be smooth and uniform in texture and free from streaks, discoloration and surface irregularities to the extent specified herein. Any damage to finished concrete resulting from the action of removing from work or any other cause shall be repaired to the satisfaction of the Employer's Representative.

Formed Surfaces:

Table 10: Formed concrete finishes

F1	No specific requirement
F2	The irregularities in the finish shall be no greater than those obtained from the use of wrought thickness square-edged boards arranged in a uniform pattern. Fins shall be removed and imperfections shall be made good.
F3	The resulting finish shall be smooth and of uniform texture and appearance. The formwork lining shall leave no stain on the concrete and shall be so joined and fixed to its backing that it imparts no blemishes. It shall be of the same type and obtained from only one source throughout any one structure. The Contractor shall make good any imperfections in the finish. Internal ties and embedded metal parts shall not be used

All formwork joints for F2 and F3 finish shall form a regular pattern.

Unformed Surfaces:

Table 11: Unformed concrete finishes

U1: Screened finish	The concrete shall be levelled and screeded. No further work shall be applied to the surface unless it is a first stage for a wood float or steel trowel finish.
U2: Wood float	A pre-screeded finish shall be floated with light finish pressure using a wooden float to eliminate surface irregularities.
U3: Steel trowel finish	A steel trowelled finish shall be first wood-floated and then trowelled under firm pressure with a steel float to produce a dense, smooth, uniform surface. The final surface shall be free from trowel marks.

When required by the Employer's Representative and before commencing concreting the Contractor shall prepare a trial panel to demonstrate that the required surface finish can be achieved by the equipment and methods proposed. The panel shall be filled with the proposed concrete compacted by the method to be used in the work. When agreed with the

Employer's Representative the trial panel shall be retained and will form the benchmark against which all Works concrete shall be prepared. Where the concrete surface is to receive waterproofing it shall be in accordance with the waterproofing system manufacturer's recommendations. Permanently exposed concrete surfaces shall be protected from rust marks and all kinds of stains. After removal of the formwork no treatment, other than that approved for curing, shall be applied to the concrete until its surfaces have been inspected by the Employer's Representative. Where any surface fails to comply with the Specification in respect of finish, dimensional tolerance, or in any other way, the Contractor shall rectify the work as agreed with the Employer's Representative. The Contractor shall be responsible for preventing any damage to the finished concrete surfaces, and shall adopt any necessary protective measures to prevent subsequent staining from any cause.

Curing

The concrete shall be protected from damage due to load overstress, heavy shocks, excessive vibrations and the effects of rain and running water particularly during the curing period. Curing and protection of concrete in cold weather shall be carried out in compliance with IS 7861 Part. All concrete should be allowed to cure by methods which will ensure the production of concrete of the specified quality. Curing materials and methods shall be compatible with any subsequent waterproofing. In general, concrete shall not be placed when the temperature at the location of the Work is below, or likely to fall below, 5°C before the section of work can be completed except in emergencies. Concrete shall be continuously moist cured from the time that the concrete has hardened sufficiently to prevent damage to the surface finish and shall be continued for not less than 14 days for concrete not containing fly ash and 21 days for concrete containing fly ash or until fresh concrete has been placed on or against the concrete surface or until a membrane curing compound has been applied. All material and equipment required for adequate curing and protection shall be on hand before concrete placement begins. Concrete shall be protected from exposure to rain for 12 hours, from exposure to the sun for 72 hours and from exposure to flowing water for 14 days. For concrete surface temperature below 5°C, the duration of curing shall be extended for the number of days the temperature has been below 5°C. Concrete shall be moist cured by maintaining the surfaces continuously wet for the duration of the specified curing period. During the curing period concrete shall not be intermittently wetted and allowed to dry. Curing water temperature shall not exceed 25 grade Celsius or above the expected minimum ambient temperature of the curing period. At least 14 days prior to the use of curing compound, full details of the proposed compound shall be submitted to the Employer's Representative for review. Such details shall be accompanied by test certificated to show that the compound will give satisfactory results for the proposed application. Curing compound shall be wax-based compounds and shall be approved by the Employer's Representative. The compound shall be applied in strict accordance with the manufacturer's Specifications and shall be applied as soon as the surface water has disappeared. Curing compounds shall be delivered to the Site in suitably labelled containers to enable identification of the batch number and date of manufacture. Curing compounds shall comply with the requirements of ASTM C309. For each curing compound proposed for use in the Works, the Contractor shall obtain a Certificate of Compliance from the supplier, supported by test certificates from a laboratory with appropriate registration, certifying that the curing compound complies with this Specification. The curing compound shall be applied by a pressurised sprayer to give a uniform cover. The sprayer shall incorporate a device for con-

tinuous agitation and mixing of the compound in its container during spraying. The curing compound shall be applied using a fine spray at a rate of 0.2 litres/m² and per coat or otherwise directed by the Employer's Representative. The application rate shall be checked by calculating the amount of curing compound falling on felt mats, each approximately 0.25 m^2 in area, placed on the concrete surface. Two coats shall be applied at the full rate. The curing compound shall be applied to unformed surfaces immediately after completion of all finishing operations, and to formed surfaces within half an hour of the removal of formwork from the section.

Joints

Joints in concrete are either movement (deflection, expansion or contraction) joints or construction joints. All construction joints shall comply with IS 11817. Joints shall be formed on horizontal or vertical planes except for joints in tunnel linings which shall be formed on radial planes. Joints in horizontal planes, which intersect with exposed surfaces making an angle of 45° or more with the horizontal, shall be truly horizontal. Joints in horizontal planes, which intersect with exposed surfaces making an angle of less than 45° with the horizontal, shall be formed to provide at least 75 mm of surface normal to the slope of the surface. Construction joints shall be positioned only where agreed with the Employer's Representative. The Contractor's proposal on constructions joints shall be given on lift drawings submitted to the Employer's Representative for review. Formed construction joints shall be formed using purpose-made stop ends. Expanded metal stop ends shall not be used. Unformed construction joints shall be formed using a grout check or similar so that the exposed edge is a crisp true line. The joint surface shall be either: brushed using water to remove laitance and expose the aggregate without disturbing it, treated with retarder and then water-jetted to remove laitance and expose the aggregate to a depth of not less than 3 mm without disturbing it, or lightly roughened by light chipping or needle-gunning of set concrete. Hacking of set concrete shall not be permitted. Construction joints shall be clean and damp, with no standing water, immediately before wet concrete is placed against them. At horizontal construction joints on exposed surfaces forms shall be constructed with strips to produce a straight joint at the exposed surface, unless otherwise directed. Movement joints shall be constructed as shown on the drawings. The Contractor shall provide the various joint components and install these in accordance with the drawings and the manufacturer's recommendations, or as directed or approved by the Employer's Representative. Any material used for expansion joint filler shall be approved by the Employer's Representative. Sealing compound is applied as surface sealant for movement joints or other boundaries of construction elements. The compound shall be polyurethane-rubber type or other type approved by the Employer's Representative. 56 days prior of any sealing compound is applied, the Contractor shall submit a sample of the proposed sealing compound together with the manufacturer's technical data and the details of the recommended method of application for approval.

Water Stops

Water stops shall be installed as shown on the drawings or as directed by the Employer's Representative. Detailed information on all water stops, their properties, installation and standard support, shall be submitted to the Employer's Representative for approval. Only approved water stops shall be used in the Works and the manufacturer's regulations and instructions shall be followed. All joints of sealing strips shall be welded by the

appropriate device to the tensile strength at least 80% of the initial material. Prior to any concrete work the water stops shall be placed as given in the drawings and adequate measures shall be made to prevent a dislocation of water stop due to concreting works. Thermoplastic sunken sealing strips for construction joints shall be in compliance with DIN 18541.

Quality Check & Tolerances

The Contractor shall keep logs on all his concrete activities, i.e. production, placing, supervision and production control, inspection and testing. These logs shall be available to the Employer's Representative for examination at any time. The Contractor shall supervise and inspect the concrete works so as to fulfill the provisions of this Specification. This applies to the inspection of materials and products, of concreting execution, of false work and formwork, of reinforcement, of concreting operations and of pre-cast concrete elements. The Employer's Representative may at any time, unless critical concrete work is done, inspect and test any Contractor's equipment intended for batching, mixing, transporting, placing and testing concrete.

Trial Mix Testing

In conjunction with the design of concrete mixes, the Contractor shall complete a laboratory trial mix program for each class of concrete. The trial mix program will be used to confirm to the satisfaction of the Employer's Representative, that the proposed concrete mix designs will produce concrete having the properties required by the Specification with minimum cement content.

Unless otherwise agreed with the Employer's Representative, field trial mixes shall be prepared under full-scale site conditions at least 35 days before the commencement of concreting and tested in accordance with IS 10262, BS EN 12350 and BS EN 12390. For each concrete plant proposed by the Contractor the field trial mixes shall be tested separately. The field trial mixes shall be tested to determine compliance under statistical evaluation where required by BS EN 206. An acceptable value for the limits of the required properties shall be established during the trials which shall thereafter be used to monitor the Quality Control of the mixes and set the standard of compliance. In the event quality control tests indicate that concrete below the specified standards is being produced, the Employer's Representative may order such adjustment of mix design, additional quality control, or other measures as it may deem necessary to raise quality to specified standards. If, at any time during the Work, the Contractor proposes to change or modify the source, type or quality of any concrete material or materials for the selected concrete mix designs, the laboratory testing program shall be repeated for each class of concrete affected by the proposed change.

Detailed test results on the concrete mix designs with changed or modified materials shall be submitted to the Employer's Representative not more than three days after the completion of each test. The 28 day compressive strength test results and details of the changes or modifications to the concrete mix designs proposed by the Contractor shall be provided to the Employer's Representative before the changed or modified concrete mix designs are used to produce concrete for the works.

The following minimum values of samples shall be taken for trial mix testing:

- nine compression test cylinders (3 for each of 3, 7 and 28 days)

- six shrinkage test prisms
- three test cubes (200 mm) or slabs (200 mm x 200 mm x 120 mm) for water permeability testing according to DIN 1048 Part 5
- one specimen for sulphate and chloride testing

Conformity Control of Concrete

In the event the specified strength criteria are not met, the Employer's Representative may, if he deems it necessary, require that the unacceptable concrete be cut out and replaced. The conformity control of strength parameters required shall be demonstrated in accordance with BS EN 206-1. Specimens tested to demonstrate compliance will be cubes, cylinders or prisms appropriate to the testing standards and BS EN 206-1.Test samples shall be made, cured, stored, transported and tested according to BS EN 12350 and BS EN 12390. Spot samples will not be used to evaluate strength parameters. Concrete cube test results will be acceptable if statistical analysis of the results meets the requirements of BS EN 206-1.Concrete shall be tested for durability properties by means of absorption and capillary suction (sorptivity) tests where appropriate. An appropriate test method will be agreed by all parties before testing is undertaken.

Compaction factor, slump, Vebe, flow table or other workability tests shall be carried out as required during concreting of permanent works to control workability at the batching plant and at the site of the pour. The degree of workability shall be as specified or as determined during the trial mixes. Permitted tolerances shall be in accordance with BS EN 206. Samples tested will be either spot samples or composite samples taken in accordance with BS EN 12350-1 and the appropriate tolerances for compliance will be applied in each case.

Where inspection reveals non-conformity, appropriate measures shall be taken in accordance to EN206-1 and in agreement with the Employer's Representative.

Production Control of Concrete

All concrete shall be subject to production control by the Contractor in accordance to EN 206. All data of production control shall be recorded by the Contractor and made available to the Employer's Representative at any time.

Tolerances

Surface finishes shall generally conform to the types and tolerances indicated in Table 11-A unless otherwise specified herein, as shown on the drawings or as required by the Employer's Representative. The Contractor shall carry out a cover meter survey over all reinforced concrete surfaces within 24 hours of removal of formwork. The cover survey shall be undertaken on a 500 mm grid over the whole structure. Access for the Employer's Representative to verify cover meter surveys shall be provided. The deviation of the inner face of the concrete lining according to the theoretical cross section may in general not exceed 50 mm to the inner side. At the lower side wall (walkway level/cable duct) the deviation of the inner face is limited to the inner side in order to maintain minimum dimensions of the cable ducts. Pre-cast concrete cover plates for the cable ducts shall be fabricated based on the as-built survey results. No tolerance will be permitted inside of the specified clearance profile for vehicles or pedestrians.

In any case and for all specified deviations permitted, the specified theoretical thickness for the inner concrete lining as well as the specified clearance profile for the roadway and the walkways shall be maintained.

Niches, recesses and similar structures are to be constructed with a tolerance of +/- 50 mm related to the designed stationing.

Pre-cast elements and other structural elements are to be constructed and placed with a tolerance of +/-15 mm, related to the theoretical tunnel cross section.

Table 11-A: Types and tolerances for finishing of concrete surfaces

Type of finishing	General areas of application and method of forming	Tolerances in mm
F1	Formed surfaces of construction joints and other surfaces which will not be permanently exposed, including surface upon or against which backfill or concrete is to be placed. Minor blemishes caused by entrapped air or water will be accepted. In general the surface will require no treatment after form removal, other than repair of defective concrete and specified curing, or treatment as specified for construction joints.	+10
F2	All permanently exposed formed surfaces for which type F3 finish is not specified. For which sheating or lining shall be placed so that joint marks on the concrete surface will be in general alignment, both horizontally and vertically, and conform to a standard pattern. Immediately on the removal of forms, all unsightly ridges or fines shall be removed, all holes left by removal of ends of form rods shall be neatly filled with mortar and surfaces treated to meet the required tolerances by tooling and rubbing. In general, not more than 50 air voids of 5-15 mm diameter per m' will be accepted. Air voids exceeding 15 mm in diameter shall be repaired. When filling holes and repairing defective areas of permanently exposed surfaces, effort shall be made to match the colour of the concrete. The use of release agents which may permanently stain or discolour the finished surface will not be permitted.	+5 -5
F3	Formed surfaces which will be exposed to flowing water. These surfaces shall be hard, smooth and dense, free from offsets, pits, voids, air holes and irregularities and shall be chipped, ground and thoroughly cleaned as necessary to conform to the required tolerances.	+3 -3
U1	Unformed, screeded surface which will be covered by fill materials, static water or concrete. Type U1 finish shall be used as the first stage. Types U2 and U3 as finishes. Finishing shall consist of sufficient levelling and screeded to produce an even, uniform surface meeting the required tolerance.	+10 -10

Type of finishing	General areas of application and method of forming	Tolerances in mm
U2	Unformed surfaces not permanently concealed by fill or concrete or not required to receive Type U3 finish. Floating by means of hand or power driven equipment shall be started as soon as the screeded surfaces has stiffened sufficiently, and shall be the minimum necessary to produce a surfaces that is free from screed marks and that is uniform in texture. If type U3 finish is to be applied floating shall be continued until a small amount of mortar without excess water is brought to the surfaces so as to permit effective trawling.	+5 -5
U3	Unformed, screeded surfaces which will be exposed to flowing water. This finish shall be applied by steel trawling after the concrete has hardened enough to prevent excess of fine materials and water from blemishes, ripples and trowel marks. After the surface has nearly hardened, it shall be trowelled once more until the surface is hard and glossy in appearance.	+3 -3

Repair of Damage

All irregularities on concrete surfaces shall be repaired to produce smooth, uniform surfaces that conform to the tolerances specified herein for the finishes shown on the drawings.

The Contractor shall notify the Employer's Representative not less than 24 hours prior to the start of any concrete repairs.

Surface irregularities shall not be repaired until they have been inspected by the Employer's Representative. The Employer's Representative will inspect the surface irregularities and determine whether the surface irregularities shall be repaired by cutting out the concrete to a depth of 75 millimeters beyond the reinforcing bars and filling the cavity with cement mortar or concrete, or whether the concrete shall be cut out to a shallower depth and the cavity filled or patched with cement mortar or saran latex dry pack mortar or epoxy sand mortar, or an alternative mortar approved by the Employer's Representative. The Employer's Representative will also determine the extent to which concrete shall be cut out, the shape of the resulting cavity, the material that is to be used for the repairs and whether the filling shall be secured with keys, dovetails or anchors. Reinforcing steel bars shall not be cut.

Should the concrete exhibit any form of cracking at 28 days, in excess of 0.l5mm width, it shall be brought to the attention of the Employer's Representative. The Employer's Representative may, at his discretion and based on the particular crack location, require that the crack be repaired. Where so instructed, the concrete shall be repaired using an epoxy injection system or other approved method of permanent crack repair. Repairs using an epoxy injection system shall not be performed for at least 56 days from the original date of concrete placement.

Repairs shall be performed only in the presence or on direction of the Employer's Representative.

The Contractor shall repair all leakage spots in concrete joints or elsewhere in agreement with the Employer's Representative.

11.5 Lean Concrete

The strength class C15 shall be applied for wet lean concrete. With the following constituents:

- Cement shall be in accordance with Clause 11.4.2.1
- Water/cement ratio shall be in accordance with Clause 11.4.2.2
- Aggregates shall be in accordance with Clause
- Consistence shall comply with Clause 11.4.3.1.

Wet lean concrete shall be spread uniformly, without segregation and without varying degrees of pre-compaction. The concrete shall be struck off to a level so that the surcharge is sufficient to ensure that after compaction the surface is at the required level.

The spread wet lean concrete shall be compacted using internal or external vibration, or a combination of both to meet the required density. At transverse and longitudinal construction joints between two separately constructed slabs, the previously laid slab end or edge shall present a vertical face before construction of subsequent slabs. Longitudinal joints in wet lean concrete shall be staggered by at least 300 mm from the position of longitudinal joints in any superimposed concrete slab, and by 1m for transverse joints. Curing of wet lean concrete shall comply BS EN 12390-2 as appropriate. The density shall be determined as in Clause 11.4.3.3 and sampling shall be as specified therein.

The surface of the wet lean concrete after compaction and finishing and before overlaying shall be free from ridges, loose material, pot holes, ruts or other defects. The surface of wet-laid concrete bases shall be roughened before the application of any curing compound by brushing with a wire brush or stiff broom.

Trial concrete mixes shall conform with BS 8500-2 for designed concretes for strength class 15 and above, unless recent data relating entirely to the proposed concrete, satisfies the requirements of the Specification.

At least 10 days before the start of the main wet lean concrete works a trial length of at least 400 m² for mechanised construction and 30 m² for hand-guided methods shall be constructed. The trial length shall be laid to assess the suitability of the proposed material, plant, equipment and construction methods to meet the requirements of the Specification. The main construction in the Permanent Works shall not start unless the trial length complies with the Specification. If any trial length does not conform to the Specification another trial length shall be constructed. Trial lengths not complying shall be removed unless they can be rectified to comply with the Specification. After satisfactory completion of the trial, the material, plant, equipment and construction methods shall not be changed unless the Contractor lays a further trial length to assess the suitability of the proposed changes or agrees the changes with the Employer's Representatives.

11.6 No-Fines Concrete

No-fines porous concrete shall be used for the surround of ground water drainage pipes in tunnels at locations indicated on the drawings. No-fines porous concrete shall be composed of ordinary Portland Cement and 37.5 mm single size aggregate complying with Clause 10.1.3.1.

The ratio of aggregate to cement shall be 8:1 by volume or 10:1 by mass. The concrete shall be mixed by machine or by hand to a uniform colour and consistency before placing. The quantity of water used shall not exceed that required to coat all of the aggregate particles without forming excess grout. No fines concrete shall be compacted by hand.

12 Reinforcement

12.1 General

The items of work falling within the scope of work under this section shall be in accordance with the Indian and European Standards Specification (Latest edition) given under:

- IS:280-1978: Specifications for mild steel wire for General Engineering purposes
- IS:432-1966/82: Specifications for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
- IS:432 (Part I): Mild steel and medium tensile bars
- IS:432 (Part II): Hard drawn steel wire
- IS:456-1978: Code of practice for plain and reinforced concrete
- IS:814-1974: Specifications for covered electrodes for metal arc welding of structural steel
- IS:814 (Part I): For welding products other than sheets
- IS:814 (Part II): For welding sheets
- IS:1139-1966: Hot rolled mild steel medium tensile steel and high yield strength deformed bar for concrete reinforcement
- IS:1786-1979: Specifications for cold worked steel high yield strength deformed bars for concrete reinforcement
- IS:2502-1963: Code for practice for bending and fixing of bar for concrete reinforcement
- IS:5525-1979: Recommendations for detailing of reinforcement in reinforced concrete constructions
- IS:9417-1979: Recommendations for welding cold-worked bars for reinforcement concrete constructions
- BS EN 10080: Steel for the reinforcement of concrete. Weldable reinforcing steel. General
- BS 4449: Steel for the reinforcement of concrete – Weldable reinforcing steel Bar, coil and decoiled product
- BS 4482: Steel wire for the reinforcement of concrete products. Specification BS 4483: Steel fabric for the reinforcement of concrete

The Contractor may adjust the position of lap joints to fit in with available stock lengths, or construction joints, subject to the Employer's Representative's agreement to the altered positions. The Contractor shall amend the bending schedules, as necessary, to allow for such alterations. Reinforcement shall be obtained from a Certificated Authority for Reinforcing Steels Quality Assurance approved supplier and the Contractor shall provide copies of the manufacturer's certificates of test results relating to the steel reinforcement to be supplied.

Reinforcing steel bars and welded steel wire fabric may be stored outside in an approved manner provided that they do not rust and are placed on sleepers which will prevent the steel from coming into contact with the ground and a protection against contact with aggressive elements is provided.

Reinforcing steel bars shall be free from dirt, oil, flaky rust, loose mill scale and any other coating that would destroy or reduce the bond with the concrete.

Tying wire shall be 1.6 mm diameter soft annealed mild steel, and when fixed shall not project into the concrete cover.Where the Contract so requires, the Contractor shall produce bending schedules.

12.2 Placing and fastening

Placing and fastening of reinforcement shall comply with IS 456 unless specified otherwise herein. All reinforcement shall be accurately placed, securely fixed and adequately maintained in the positions shown on the drawings. The reinforcement shall be fixed so that the cover specified on the drawings is achieved, subject to the tolerances specified therein. Reinforcing steel bars shall be installed as shown on the drawings and shall be solidly attached to the formwork. Reinforcing steel bars shall be tied together with wire ties to form a rigid grid which shall be supported in its required position, on chairs and with spacers and hangers. The wire ties shall be used in a staggered pattern at a spacing not exceeding 60 centimeters. Reinforcing steel bars shall be accurately placed within the specified tolerances and shall be secure against displacement during concrete placement. Reinforcement shall not be re-bent on site unless agreed with the Employer's Representative. The minimum clear distance between parallel reinforcing steel bars shall be the nominal diameter of the reinforcing steel bars or 1.25 times the maximum size of the coarse aggregate, whichever is the greater, provided that the minimum clear distance between parallel reinforcing steel bars in beams shall not be less than 30 millimeters and in columns shall not be less than 50 millimeters. Spacer blocks shall be of comparable strength, durability and appearance to the surrounding concrete and shall be factory produced. Site-produced concrete or mortar cover blocks shall not be used. Spacers and chairs shall ensure that the reinforcement is correctly positioned, be as small as possible consistent with their purpose, and designed so that they will not overturn or be displaced when the concrete is placed. Wire cast in the block for the purpose of tying it to the reinforcement shall be as specified below.

Prior to placing reinforcement on rock or gravel foundation, the foundation shall be covered with at least 50 mm thick layer of concrete or other approved cover. Tying wires shall be 1.6 mm soft annealed iron wire unless drawings require the use of stainless steel tying wire. Where stainless steel tying wire is required it shall be1.2 mm diameter stainless steel wire throughout the structure. Projecting ends of ties or clips shall not encroach into the concrete cover.

Overlap between adjacent sheets of welded wire fabric shall be a minimum of 2 squares.

Concreting shall not commence until the reinforcement has been inspected in accordance with the Inspection and Test Plan.

12.3 Splicing

Joints or splices in reinforcing bars shall generally be made at the positions shown on the drawings, but the contractor would be permitted to make joints or splices at positions other than those shown on the drawings, providing that such positions are approved by the Employer's Representative-in-Charge and that joints and splices in adjacent bars are staggered if directed by the Employer's Representative-in-Charge. Approval of such additional splices will generally be restricted to splices not closer than 8 m in horizontal bars or 4 m in vertical bars measured between mid-points of laps. The number of splices shall be kept to a minimum.If the Contractor proposes to use mechanical couplings for reinforcing bars, he shall submit samples of the proposed coupling to the Employer's Representative for approval not less than 60 days prior to their proposed use.

12.4 Formwork

General

Material and workmanship shall comply with IS 456 and IS 14687.

The supply of all labour, supervisors, Contractor's equipment and materials and the execution of all work necessary to design, supply, fabricate, erect, treat, support, brace, use, remove and dispose of formwork for retaining and forming concrete structures as specified herein and as shown on the drawings shall be provided by the Contractor.

Not less than 60 days prior to the start of fabrication of formwork and falsework for each structure or part of a structure, the Contractor shall submit to the Employer's Representative design calculations and erection drawings showing the formwork and falsework for that structure or part of the structure. The general method and system proposed shall be submitted in detailed drawings of the formwork to the Employer's Representative for agreement.

The erection drawings shall indicate the method and schedule of construction, member sizes and type, grade and quality of materials, the arrangement of joints, splices, liners and locations of temporary openings and embedded parts. Details of mechanical equipment that will operate or be supported on the false work shall be submitted with the erection drawings. Design assumptions, loads and allowable stresses shall be indicated on the erection drawings.

All formwork shall be dimensioned, constructed and securely braced as to prevent displacement.

All joints in the formwork and between the formwork and previous work shall be sufficiently tight to prevent loss of liquid from the concrete. Formers for all chases, grooves, recesses, etc. shall be securely fixed as part of the formwork. No part of the concrete shall be cut away for any such item, or for any other reason, without the Employer's Representative's agreement The face of the formwork shall be clean and applied with non-staining release agent. The agent shall not touch reinforcement, or items to be embedded, and shall not be allowed to collect in the bottom of the formwork, or flow onto previously placed concrete. Before any concrete is placed, the Contractor shall examine and clean out the formwork and ensure that the specified reinforcement cover is attained. Where cyclical casting, e.g. in-situ concrete tunnel lining, striking times may be agreed with the Employer's Representative following criteria determined from trial lengths.

Material Requirements

The surface of steel plate formwork and steel faced lumber formwork shall be smooth and free from dents, buckles and other surface irregularities. The sheathing for steel formwork shall be steel plate not less than three millimeters thick. All bolts and rivet heads shall be countersunk. Means shall be provided to ensure a snug fit of steel plate sheathing and steel faced sheathing against previously hardened concrete so as to provide smooth joints.

Lumber used for formwork shall be free from warp, loose knots and decay and shall be sawn straight and dressed smooth.

Plywood shall be non-warping and non-wrinkling and shall be manufactured with water-proof glue. Only plywood sheets with identical length and width shall be used.

Fillers for repairing and reconditioning formwork shall be subject to approval by the Employer's Representative. All filler material shall be sanded flush and sealed with an approved sealer to prevent adhesion to the concrete.

Tunnel Formwork

Formwork for tunnel lining shall be constructed in such lengths that each concrete placement can be completed without cold joints.

Concrete pads, pedestals and other means to support tunnel formwork shall be subject to approval by the Employer's Representative on the basis of the effects of such supports on the structural properties of the tunnel section and on the finish of the lining.

Formwork for tunnel lining above the invert shall be provided with rows of openings along each side. The bottom row shall be located with the centreline of the openings above the longitudinal construction joint at the invert. Successive rows shall be located on two meters centres above the next lower row. The rows of openings shall be staggered. Openings shall permit access for inspection and vibration of concrete being placed behind the formwork. Each row of openings shall be provided with a platform for access to the openings. Openings shall be located at a minimum spacing of 2.5 meters along the tunnel centreline and up the tunnel walls. Openings shall be not smaller than 45 by 60 centimetres, with the long dimension parallel to the centerline of the tunnel.

Execution

Preparation

Formwork shall be constructed in strict accordance with the erection drawings after they have been reviewed by the Employer's Representative and shall produce concrete conforming to the lines, slopes, elevations and dimensions and with the surface finishes shown on the drawings. Joints between formwork sections shall be sufficiently tight to prevent loss of mortar from concrete. Formwork shall be securely tied and anchored to maintain shape and position and to avoid warping and bulging. Formwork for curved surfaces shall be constructed so as to conform accurately to the required curvatures of the surfaces within the allowable tolerances specified. Formwork joints shall fit together without gaps greater than two millimeters at any point. The joint marks on the concrete surface in the water passages shall follow in general the line of water flow. Forms shall be placed so that the joint marks on concrete surfaces will be in alignment both horizontally and vertically and the joint marks between surfaces shall be smooth.

Installation

Formwork shall be braced to maintain its position and shape. Formwork and false work shall be arranged for ease of dismantling and stripping to ensure that its removal will not damage the concrete. Formwork blocking and supports to be left permanently in the concrete shall be fabricated of steel.

The interior surfaces of formwork shall be covered with colourless mineral form oil or other bond breaking compound approved by the Employer's Representative. The bond breaking compound shall be applied before reinforcing steel bars are placed. Form oil or bond breaking compounds shall not come in contact with reinforcing steel bars or with concrete surfaces on which additional concrete, epoxy mortar or any bonded coating is to be placed.

Tolerances

Formwork and falsework shall be constructed, located, supported and braced in such a manner that the finished surfaces of concrete structures are within the allowable construction tolerances as defined in Clause 10.1.11.4 of this Specification.

Concrete Placement

Temporary openings shall be provided in the formwork at any place where necessary to facilitate concrete placement, insertion of vibrators, cleaning and inspection. The temporary openings shall be closed with removable panels that are flush with the formwork surface on the inside. Immediately before concrete is placed, formwork shall be inspected to ensure that it is accurately placed, rigid, tight, clean and free from foreign matter.Inspection of formwork by the Employer's Representative and approval to proceed with concrete placement shall not relieve the Contractor of his responsibility for safety and accuracy of the Work. Any repairs of concrete due to faulty or inaccurate formwork shall be done by the Contractor at no additional cost to the Employer.

Quality Control

The alignment and position of formwork shall be checked frequently during concrete placement. Any misalignment shall be corrected by wedging and shoring. Formwork and false work may be reused, provided that the material is undamaged and the surface in contact with concrete is cleaned and is capable of producing the required surface finish. Timber and plywood formwork shall not be repaired with metal patches.

Removal

Formwork shall be removed in such a manner as to prevent concrete spalling and to produce sharp and clean joints. Formwork shall be eased, struck or removed in such a manner that the structure is not distorted, damaged or overloaded. Except where otherwise agreed with the Employer's Representative, formwork shall not be eased or struck until:

- the concrete has attained sufficient strength to support itself in the position cast without deformation or
- a minimum period in line with Section 6 of ENV 13670-1
- vertical forms and formwork for tunnel crown lining may be removed when the concrete has attained a compressive strength of min 6 MPa, deduced from the strength development of comparable test specimens cured under similar conditions

- 10 hours after concrete placing unless measures are taken to prevent excessive cooling and drying. These measures shall be agreed with the Employer's Representative

Design and Installation Criteria

Formwork and false work shall be designed to withstand, safely and without distortion, all loads that will be applied before, during and after concrete placement. The design loads shall include wind, concrete, equipment and personnel. Formwork shall be designed to permit the concrete to be deposited as nearly as practicable directly in its final position and shall have access facilities that will allow inspection, checking and clean-up of the surface of the preceding concrete placement and inspection and vibration of the concrete.

13 Pavement

13.1 General

The Contractor shall furnish all materials, equipment and labour necessary for permanent roadwork as shown on the drawings or as directed. The design for the permanent roadwork will be provided by the Employer. The Contractor shall design and furnish all materials, equipment and labour necessary for construction roads or tracks to other work sites, to spoil areas, to installation areas and to camps to the extent that he considers necessary for his activities. These roads shall be constructed at the minimum standard necessary for the Contractor to safely execute the Works. The layout and design for all temporary roadwork shall be provided by the Contractor and approved by the Employer before the work commences.

The Contractor shall place compacted and treated, if necessary, selected backfill, either from required excavations or approved borrow areas, to completed structures as shown on the drawings or as directed. The Clause 6.7 for backfill material shall be applied accordingly.

All permanent road work, materials, workmanship, quality, construction tolerances, testing and etc. shall be carried out in accordance with the "Specifications for Road and Bridge Works" by Ministry of Road Transport and Highways (MoRTH 2000), unless otherwise spec ified in the drawings or as directed by the Employer's Representative. This requirement applies to both the road outside the tunnel or portal buildings/structures as well as that inside these. The main Clauses of the "Specifications for Road and Bridge Works" (MoRTH 2000) which shall be applied are summarized in this Specification.

Tolerances

The design levels of pavement courses shall be calculated from the vertical profile, cross falls and the pavement course thicknesses as described in relevant drawings. The level of any point on the constructed surface of the pavement courses shall be the design level subject to the appropriate tolerances stated in Table 11-B.

Table 11-B: Tolerances in surface levels of pavement courses

Pavement course	Tolerances
General Adjacent to a surface water channel1	± 6 mm + 0-10 mm
Base under concrete pavement surface slabs laid full thickness in one operation by machines with surface compaction	± 10 mm
Unbound sub-base layer	+ 10-30 mm

1: Where a surface water channel is laid before the adjacent road pavement layer the top of that layer, measured from the top of the adjacent edge of the surface water channel, shall be to the given tolerances.

Notwithstanding the tolerances permitted in surface levels of pavement courses, the cumulative tolerance shall not result in a reduction in thickness of the pavement, excluding the sub-base and filter layer, by more than 15 mm neither from the specified thickness nor a reduction in the thickness of the bituminous surface course by more than 5 mm from that specified. For checking compliance with this Clause, measurements of the surface levels of all courses shall be taken on a grid pattern in agreement with the Employer's Representative.

The longitudinal regularity of the surfaces of surface courses, binder courses and concrete slabs shall be such that the number of surface irregularities is within the relevant limits stated in Table 19. An irregularity is a variation of not less than 4 mm or not less 7 mm of the profile of the road surface as measured by the rolling straight-edge set at 4 mm or 7 mm as appropriate or equivalent apparatus capable of measuring irregularities within the same magnitudes over a 3 m length. No irregularity exceeding 10 mm shall be permitted. Prior to checking any final road surface it shall be cleaned of loose or extraneous materials. These operations shall be carried out without damaging the surface of the pavement as soon as possible and within 3 days of construction of the pavement. Compliance with Table 12 shall be checked by the rolling straight-edge along any line or lines parallel to the edge of pavement on sections of 300 m at regular intervals in agreement with the Employer's Representative, whether or not it is constructed in shorter lengths. Sections shorter than 300 m forming part of a longer pavement shall be assessed using the number of irregularities for a 300 m length pro - rata to the nearest whole number. Pavements shall be measured transversely for irregularities at regular intervals in agreement with the Employer's Representative, by a 3 m long straight-edge placed at right angles to the centre line of the road. The maximum allowable difference between the pavement surface and the straight-edge shall be 3 mm. A 3 metres long straight-edge shall be used to check longitudinal surface regularity for all lengths of base layers under concrete pavement slabs laid full thickness in one operation by machine with surface compaction.

The maximum allowable difference between the surface and the underside of the straight-edge, when placed parallel with or at right angles to the centre line of the road, shall be:

- 3 mm for pavement surfaces
- 10mm for bases under concrete pavements

Table 12: Maximum permitted number of surface irregularities

	Surfaces of each lane of carriageway, each hard strip and each hard shoulder for each irregularity limit				Surfaces of lay-bys, service areas for each irregularity limit			
Irregularity limits	4 mm		7 mm		4 mm		7 mm	
Length [m]	300	75	300	75	30	75	300	75
Number of irregulari-	40	18	4	2	60	27	6	3

Rectification

Where any pavement area does not comply with the Specification for regularity, surface tolerance, thickness, macrotexture depth, material properties or compaction, the full extent of the area which does not comply with the Specification shall be made good and the surface of the pavement course shall be rectified in the manner described below:

- *Unbound base layer:* The top 75 mm shall be scarified, reshaped with material added or removed as necessary, and re-compacted. The area treated shall be not less than 30 m long and 2 m wide or such area as necessary to obtain compliance with the Specification.

- *Bituminous bases:* With coated macadam or asphalt bases, the full depth of the top layer as laid shall be removed and replaced with fresh material laid and compacted in accordance with the Specification. Any area so treated shall be at least 5 m long and the full width of the paving laid in one operation. Alternatively for low areas in bituminous bases, the Contractor may make up the level with additional binder course material.
- *Concrete slabs:* Concrete slabs shall be rectified by planing, grinding or bump cutting. Large depressions, which cannot be dealt in this way, shall be rectified by cutting out the surface and replacing by a thin bonded surface repair. Where the slab cannot be rectified as above, the full depth of slab shall be removed and replaced with a slab constructed in compliance with these

Specifications. Remedial works involving the placing of fresh concrete shall be completed in sufficient time for the concrete strength which have to be developed as specified before that section of pavement is opened to traffic.

13.2 Unbound Sub-Base Layer

General

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base as necessary according to lines, grades and cross sections shown on the drawings or as directed by the Employer's Representative.

The sieve size distribution shall be in compliance with Table 13 as per MoRTH.

Table 13: Grading for unbound sub-base layer

Designation	Per cent per weight passing
75.0 mm	-
53.0 mm	100
26.5 mm	70-100
9.5 mm	50-80
4.75 mm	40-65
2.36 mm	30-50
0.425 mm	15-25
0.075 mm	3-10

The unbound mixture shall satisfy the minimum CBR value of 25 when it is compacted and finished.

When directed by the Employer's Representative, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content and any other tests for the "quality" of materials, as may be necessary and required by the Employer's Representative.

Laying

Unbound mixtures in a frozen condition shall not be incorporated in the Works but may be used, if acceptable, when thawed. Unbound mixtures shall not be laid on any surface which is frozen or covered with ice.

The unbound mixtures of grading specified herein (Table 20) shall be placed and spread on the prepared surface evenly. Unbound mixtures shall be spread using a paving machine or a suitable spreader box and operated with a mechanism which levels off the material to an even depth.

Material up to 225 mm compacted thickness shall be spread in one layer so that after compaction the total thickness is as specified. Material of compacted thickness greater than 225 mm shall be laid in two or more layers and the minimum compacted thickness of any such layer shall be 110 mm. Where the layers of unbound mixtures are of unequal thickness, the lowest layer shall be the thickest layer.

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted by sprinkling water uniformly and at controlled quantities to variable widths of surface or other means approved by the Employer's Representative so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS:2720 (Part 8). While adding water, due allowance shall be made for evaporation losses.

Compaction

Compaction shall be completed as soon as possible after the mixture has been spread and in accordance with the requirements for the individual mixtures.

Compaction of unbound mixtures shall be carried out by a method the Contractor demonstrates at site trials that compacted density achieved is at least 98 % of the maximum dry density for the material determined as per IS:2720 (Part 8).

The surface of any layer of material shall on completion of compaction and immediately before overlaying, be well closed, free from movement under construction plant and from ridges, cracks, loose material, pot holes, ruts or other defects. All loose, segregated or otherwise defective areas shall be removed to the full thickness of the layer, and new material shall be laid and compacted.

Site traffic

Construction plant and other traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so that damage is not caused to the sub-grade or the pavement courses which are already constructed. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials. Final excavation levels (formation level) for pavement construction shall be protected against any wear or deterioration of rock properties following site traffic by backfilling with rock material excavated in the tunnel or similar to a minimum thickness of 0.5 meters. Ponding water and traffic through ponding water shall not be allowed. Any deteriorated material shall be removed and replaced prior to pavement works as directed by the Employer's Representative. The backfill material used for protection purposes shall not be removed until immediately prior to pavement construction works. No site traffic shall be allowed to run on unprotected invert structures, temporary or final, concrete or shotcrete. Structures as such shall be protected against destruction by backfilling with suitable excavation material from the tunnel or similar with a minimum thickness of 0.5 meters. Backfilling material shall not contain boulders larger than 150 mm diameter.

13.3 Bituminous Base Layer

General

Natural, recycled unbound and manufactured (artificial) aggregates shall be clean, hard and durable and shall comply with BS EN 13043.

Irrespective of source, coarse aggregates for bituminous mixtures shall be considered suitable if:

- the resistance to fragmentation category of the coarse aggregate as defined in clause 4.2.2 of BS EN 13043 shall be LA30 or better for natural aggregates and LA50 or better for blast furnace slag or
- Crushed rock aggregate has a Los Angeles Value greater than 30 but less than 35, where evidence can be presented to the Employer's Representative of previous satisfactory use of the source in asphalt.

Natural and manufactured (artificial) aggregates recovered from a previous use in an unbound form shall comply with the requirements of this Clause.

The freezing and thawing (soundness) category, as defined in BS EN 13043, clause 4.2.9.2, shall be MS25 unless otherwise specified herein. The water absorption value of the coarse aggregate shall be determined in accordance with BS EN 13043, clause 4.2.9.1. If the water absorption value of the coarse aggregate is greater than WA242, the soundness test shall be carried out on the material delivered to site. The requirements for water absorption do not apply to blast furnace slag aggregate.

Before work commences, the Contractor shall submit a method statement to the Employer's Representative that includes:

- Laying and compaction procedures for each layer – including paving speed and paved width; size, type and number of rollers; and number of roller passes.
- The joint formation procedures for each layer – including the location of longitudinal and transverse joints; and the method(s) of treating upstanding edges.

3.1.1 Placing

In order to exclude moisture from interfaces and ensure full interlayer bonding, the surface of all bituminous material shall be kept clean and uncontaminated. If any surface becomes contaminated, it shall be made good by cleaning and if this proves impracticable, by rectification.

Prior to placing bituminous material on any new or existing bound substrate, a bond coat or tack coat shall be applied in accordance with Clauses 920 or 942, as appropriate.

Hot bituminous mixtures shall be transported in accordance with the requirements of BS 594987 and shall remain covered whilst awaiting tipping.

Wherever practicable, hot bituminous mixtures shall be spread, levelled and tamped by a self-propelled paving machine. The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously.

Hand placing of hot bituminous mixtures shall be restricted to the following circumstances:

- For laying regulating courses of irregular shape and varying thickness.

- In confined spaces where it is impracticable for a paver to operate.
- For footways.
- At the approaches to expansion joints at bridges, viaducts or other structures.
- For laying mastic asphalt.

The method of laying shall be such that the finished mat is free from dragging, tearing and segregation of the material.

Dense base course asphalt concrete (formerly macadam) recipe mixtures shall be asphalt concrete conforming to BS EN 13108-1.

Bituminous mixtures shall not be laid on layers with a surface temperature beneath 5°C.

The surface tolerances shall be in compliance with Clause 11.1.1.

13.4 Concrete Pavement

General

The work shall consist of construction of unreinforced, dowel jointed, plain cement concrete pavement in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross sections shown on the drawings. The work shall include furnishing of all plant and equipment, materials and labour and performing all operations in connection with the Work, as approved by the Employer's Representative. Concrete in rigid or rigid composite pavements shall be of the class C32/40 XF4 and shall confirm to the Clauses of Chapter 10 unless given otherwise below. Prior to commencement of any concrete works the base layer shall be checked of adequate bearing capacity and elevation the tolerances are given in Clause 11.1.1. The check has to be in appropriate time prior to commencement hence measures shall be taken contemporary and no time delay may occur.

If the thickness of the base layer is not in the range of the tolerances the base layer shall be corrected. If this is not possible, the base layer shall be fully replaced. The base layer shall be clean and free of deleterious material. The concrete slab shall be laid in two layers. The surface layer shall be laid monolithically with the lower layer. The surface layer shall be not less than 50 mm thick.

Concrete Composition

The concrete composition shall comply with Clause 10.1.3 unless given otherwise below.

Cement

The cement content shall be in accordance to Table 21 and means any of the following materials or combinations below:

- Portland cement CEM I, BS EN 197-1
- Portland slag cement CEM II/A-S and CEM II/B-S, BS EN 197-1
- Blastfurnace cement CEMIII/A, CEM III/B BS EN 197-1
- Portland-fly ash cement CEM II/A-V, CEM II/B-V BS EN 197-1
- Pozzolanic cement CEMIV/A BS EN 197-1

- Portland cement CEM I BS EN 197-1with ground granulated blastfurnace slag (ggbs) for use with Portland cement CEM I
- Portland cement BS EN 197-1
- CEM I with pulverised-fuel ash (pfa) for use as a cementitious component in structural concrete BS EN 197-1

Table 14: Minimum cement or combination contents with 40 mm maximum aggregates

Min. Portland cement CEM I, BS EN 197-1 in	320
Min. other cements or combinations permitted	340
Maximum proportion of ggbs in [%]	25
Max./min. proportion of pfa in [%]	25/15
Min. CEM I content in [kg/m²] for combinations with pfa and ggbs	255

For 20 mm maximum size aggregate 20 kg/m^3 cement content per cubic meter fully compacted concrete shall be added, and for < 20mm maximum size 40 kg/m³ cement content shall be added

If the concrete layer shall be laid in two layers, the cement of the surface layer shall be limited to Class 42.5N/42.5R Portland cement CEM I in accordance to BS EN 197-1. The minimum cement content of the concrete shall be 375 kg/m³.

The cement content shall not exceed 425 kg/m³.

Water

Water from a water company supply may be used without testing. Water from other sources may be used if it conforms to BS EN 1008. The water content shall be the minimum required to provide the specified consistence for full compaction of the concrete to the required density, as determined by trial concrete mixes or other means. The maximum free water/cement ratio shall be 0.45 for strength classes C32/40 and C25/30 and 0.60 for strength classes C16/20 and C12/15.

If the concrete layer shall be laid in two layers, the free water/cement ratio of the surface layer shall be max. 0.40 for strength classes C32/40 and C25/30.

Admixtures

Concrete for pavement slab shall incorporate an air-entraining admixture complying with BS EN 934-2 in at least the top 50 mm of surface slabs. Plasticisers or water reducing admixtures shall comply with BS EN 934-2. Admixtures containing calcium chloride shall not be used.

Aggregates

Aggregates for all pavement concrete, including wet lean, shall comply with IS:383 and BS EN 12620 respectively. The aggregates shall be free from chert, flint, chalcedony or other silica in a form that can react with the alkalies in the cement. In addition, the total chlorides content expressed as chloride ion content shall not exceed 0.06 per cent by weight and the total sulphate content expressed as sulphuric anhydride (S03) shall not exceed 0.25 per cent by weight.

No aggregate which has water absorption more than 2 per cent shall be used in the concrete mix.

If the concrete layer shall be laid in two layers, the surface layer shall comply with following requirements:

- For 6.3/10 mm coarse aggregate or 4/8 mm coarse aggregate the amount of aggregate retained on the 10 mm sieve and 8 mm sieve respectively shall not exceed 3% by mass. The aggregate passing the 6.3 mm sieve and 4 mm sieve respectively shall not exceed 10% by mass.
- The fine aggregate grading shall comply with the 0/2 (FP) or 0/1 (FP) grading in BS EN 12620 except that not less than 99% of the mass of the material shall pass the 2 mm sieve.
- The coarse aggregate shall comprise at least 60% by mass of the oven dry constituents of the concrete.
- The polished stone value (PSV) and the aggregate abrasion value (AAV) of the coarse aggregate determined in accordance with BS EN 1097-8 shall be PSV_{50} and AAV_{15}. The Category of flakiness index of the aggregate is FI_{15}. The resistance to fragmentation of the coarse aggregate shall be of class LA_{20}. The resistance to freezing and thawing shall be of class F_1 for the coarse and fine aggregates.

Concrete Requirements
Consistence (Workability)
The consistence shall be determined by the Degree of Compatibility (Compaction Index) test in accordance with BS EN 12350-4, or the Vebe test in accordance with BS EN 12350-3. Alternatively for concrete class C16/20 or below, consistence may be determined by the slump test in accordance with BS EN 12350-2. The sampling for all concrete classes shall be undertaken in accordance with BS EN 12350-1 and the rate of testing in accordance with Table 12 of BS EN 206-1. Consistence shall be carried out at the point of placing, in conjunction with tests for strength and any tests for air content. The consistence shall be maintained at the optimum within the limits specified in BS EN 206-1.

If any determination of consistence gives a result outside the tolerance, a further test shall be made immediately on the next available load of concrete. The average of the two consecutive results and the difference between them shall be calculated. If the average is not within the tolerance or the difference is greater than 0.1 for CI or 20 mm for slump or 6 seconds for Vebe, subsequent samples shall be taken from the delivery vehicles, which shall not be allowed to discharge into the Works until compliance with the Specification has been established.

Air content
The concrete shall meet the requirement for exposure class XF4 in BS EN 206-1. This shall be achieved by the use of an air-entraining agent. The minimum quantity of air in air-entrained concrete as a percentage of the volume of the concrete shall be as in Table 15.

Table 15: Minimum air content with respect to max. aggregate size

max. aggregate size in [mm]	min. air content in [%]
20	3.5
40	3

The air content shall be determined at the point of delivery to the paving plant by the pressure gauge method in accordance with BS EN 12350-7, at the rate of one determination per 300 m² of slab or at least 6 times per day, whichever is the greater, in conjunction with tests for consistence and strength. For areas less than 300 m² the rate shall be at least one determination to each 20 m length of slab or less constructed at any one time or at least 3 times per day. If the air content is outside the specified limits in BS EN 206-1, the Contractor shall remove the concrete from the Works.

The air-entraining agent shall be added at the mixer by an apparatus capable of dispensing the correct dose within the tolerance for admixtures given in Table 14, to ensure uniform distribution of the agent throughout the batch during mixing.

Density (Manual of Contract Documents for Highway Works)
The density of a saturated core cut from the full depth of the concrete pavement shall not be less than 95% of the average density of at least six fully compacted saturated moulded specimens made from the same concrete and tested at the same age.

The density of the concrete pavement shall be determined in accordance with BS EN 13877-2. The density of a saturated core cut from the full depth of the concrete pavement shall be determined in accordance with BS EN 12390-7. The determination of the saturated density of the fully compacted moulded specimens shall be in accordance with BS EN 12350-1, BS EN 12390-1 and BS EN 12390-2.

The core shall have an average diameter of at least four times the nominal maximum aggregate size, and in any case at least 100 mm diameter. Where different concrete mixes are used in separate layers, the density of each layer shall be separately determined by splitting or cutting the cores between the layers.

If the density of any core is below the minimum required, the concrete across the whole width of the slab constructed at the time relating to that core shall be removed. In unreinforced concrete the whole slab length between joints shall be removed. For reinforced slabs, in order to determine the limit of the defective area of concrete which shall be removed, additional cores shall be taken at 5 m intervals on each side of any defective core until concrete of satisfactory density is found. Defective areas shall be made good with new material in accordance with the Specification. In calculating the density, allowance shall be made for any steel in the cores. Core holes shall be reinstated with compacted concrete with mix proportions of 1 part of Portland cement CEM I: 2 parts of sand: 2 parts of 10 mm single sized coarse aggregate by mass.

Pavement concrete strength
Sampling and testing for and compliance with the specified characteristic core strength of designed concretes shall be undertaken by compressive strength testing in accordance with

BS EN 13877-2 on cores cut from the full depth of the slab. No correction for maturity shall be applied to the 7 day or 28 day strength.

Concrete cores of the appropriate size shall be taken, cured and tested in accordance with BS EN 12504-1 with the exception that the core shall be cured under water at 20°C ±2°C as soon as practically possible. The sampling rate shall be as designated in BS EN 13877-2 for Category 2, three cores shall be taken from areas of concrete of up to 3000 m² and one additional core for every further 1000 m² of concrete laid. An exception to the above sampling rate is that in the trial slab at least six cores shall be taken, three to be tested at 7 days and three at 28 days. The end preparation of the core shall be by grinding and the height/diameter (h/d) ratio of the tested specimen shall be between 1 and 2.

If during the construction of the trial length the average corrected core compressive strength, from the three cores, falls below the 7 day corrected core compressive strength given in Table 23, then either the cement content of the concrete shall be increased by 5% by mass, or a further trial slab shall be constructed using an improved compaction technique and/or an increased cement content. The increased cement content shall be maintained at least until the three corresponding 28-day core strength tests have been assessed. If the cement content is increased, the concrete shall be adjusted to maintain the required consistence.

Table 16: 7 day corrected core compressive strength

Concrete Class	7 day corrected compressive strength for CEM I concrete in [N/mm²]	7 day corrected compressive strength for CEM I with pfa or ggbs concrete in [N/mm²]
C32/40	32	26.8
C25/30	25	20
C16/20	16.5	13
C12/15	12	10
C8/10	7.5	6.5
C6/8	5	4

Overlapping groups of four consecutive 28 day corrected core strengths shall be used for assessing the pavement for compliance with the criteria in Table A.1 of BS EN 13877-2. The pavement shall be accepted if the criteria in Table A.1 are satisfied for four results derived from strength tests on cores taken from the constructed pavement. Conformity control of the concrete will be the responsibility of Contractor.

Finished Surface Requirements

The finished surface of the pavement shall comply with the requirements of Clause 11.1.1. Where a pavement area does not comply with the Specification in any respect, the full extent of the surface which does not comply shall be rectified in accordance with Clause 11.1.2

After the final regulation of the surface of the slab and before the application of the curing membrane, the surface of concrete slabs to be used as running surfaces shall be brush-macrotextured in a direction at right angles to the longitudinal axis of the carriageway. The

macrotexture shall be applied evenly across the slab in one direction by a brush not less than 450 mm wide. The macrotexture shall be uniform both along and across the slab.

The macrotexture depth shall be determined by the volumetric patch technique as described in BS EN 13036-1. Tests shall be taken within 100 m of commencement of paving and thereafter at least once for each day's paving at the times after construction as given below and in the following manner: 10 individual measurements of the macrotexture depth shall be taken at least 2 m apart anywhere along a diagonal line across a lane width between points 50 m apart along the pavement. No measurement shall be taken within 300 mm of the longitudinal edges of a concrete slab constructed in one pass.

Macrotexture depths shall be as required in Table 17.

Where the required macrotexture depth is found to be deficient the Contractor shall make good the texture across the full lane width over lengths necessary to comply with the requirements of Table 17, by retexturing the hardened concrete surface as described in Clause 11.4.14.

Table 17: Required macrotexture depth and tolerances

Time of test		Required macrotexture depth in	
		Specified value	Tolerance
between 24 hours and 7 days after the construction of the slab or until the slab is first used by vehicle	an average of 10 measurements	1.0	±0.25
not later than 6 weeks before road is opened to public traffic	an average of 10 measurements	1.0	+0.25 -0.35

13.4.2 Transverse Joints

General

Transverse joints shall be provided in unreinforced and jointed reinforced concrete slabs and shall be contraction, expansion or warping joints at spacing of 25 times the plate thickness and with a maximum of 5.0 m, such that for unreinforced concrete slabs the length/width ratio shall be not greater than 1.5.Joints in the surface slab and sub-base shall be staggered so that they are not coincident vertically and are at least 1 m apart. Transverse joints shall be straight within the following tolerances along the intended line of the joint, which is the straight line transverse to the longitudinal axis of the carriageway.

- deviations of the filler board or bottom crack inducer from the intended line of the joint shall be not greater than ± 10 mm;
- the best fit straight line through the joint groove as constructed shall be not more than 25 mm from the intended line of the joint;
- deviations of the joint groove from the best fit straight line of the joint shall be not greater than 10 mm.

Transverse joints on each side of a longitudinal joint shall be in line with each other and of the same type and width.

Concrete pavement layers shall be isolated from fixed structures by expansion joints, or earth-works or a granular layer over the structure, or by bridge-type expansion joints, or by lengths of fully flexible pavement construction. End of pavement surface slabs shall have a transition bay leading into the fully flexible construction.

Transverse joints shall have a sealing groove which shall be sealed in compliance with Clause 11.4.10.

Contraction Joints
Contraction joints shall consist of:

- a sawn joint groove complying with Clause 11.4.8
- dowel bars complying with Clause 11.4.6,
- a sealing groove complying with Clause 11.4.10.

Expansion Joints
Expansion joints shall consist of:

- a joint filler board complying with Clause 11.4.9,
- dowel bars complying with Clause 11.4.6,
- a sealing groove complying with Clause 11.4.10.

The filler board shall be positioned vertically within the prefabricated joint assemblies along the line of the joint within the tolerances of Clause 11.4.4.1, and at such depth below the surface as will not impede the passage of the finishing beams on the paving machines. The joint filler board together with the sealing groove shall provide a complete separation of adjacent slabs and any spaces around dowel bars and between the sub-base and the filler board shall be packed with a suitable compressible material after fixing the joint assembly.

Warping Joints
Warping joints shall consist of:

- a sawn joint groove complying with Clause 11.4.8,
- tie bars complying with Clause 11.4.7,
- a sealing groove complying with Clause 11.4.10.

Construction joints

Construction joints made at the end of a working day in unreinforced concrete slabs and jointed reinforced concrete slabs shall be contraction joints. In the event of mechanical breakdown of the concreting machinery, or at the onset of adverse weather, emergency joints may be formed. Emergency joints in unreinforced concrete slabs shall be contraction joints not less than 2.5 m from the preceding or succeeding joint position. The stop end formwork shall be sufficiently rigid to ensure that dowel bars and tie bars will be held in position in compliance with these Specifications.

13.4.3 Longitudinal Joints

General
Sawn or wet-formed longitudinal joints shall be provided in surface slabs between or at the centre of traffic lanes within the allowable positions as shown on the drawings, so that bay widths are not greater than 4.2 m. Joints in the surface slab, base or sub-base shall be staggered so that they are not coincident vertically and are at least 300 mm apart.

Wet-formed longitudinal joints shall consist of:

- wet-formed joint grooves complying with Clause 11.4.8,
- a bottom crack inducer,
- tie bars complying with Clause 11.4.7.

Longitudinal joints shall be constructed within the following tolerances:

- deviations of the bottom crack inducer from the intended line of the joint, parallel to the axis of the road shall be not greater than ± 13 mm;
- the joint groove shall be located vertically above the bottom crack inducers within a horizontal tolerance of ± 25 mm;
- the best fit line along the constructed joint groove shall be not more than 25 mm from the intended line of the joint;
- deviations of the joint groove from the best fit line of the joint shall be not greater than 10 mm.

Sawn longitudinal joints shall consist of joint grooves complying with Clause 11.4.8

Longitudinal Construction Joints
Longitudinal construction joints between separate slabs shall have tie bars as in Clause 11.4.7 with a joint groove as in Clause 11.4.8.

Dowel Bars
Dowel bars shall be Grade B500 steel conforming to BS EN 13877-3 and shall be free from oil, dirt, loose rust and scale. They shall be straight, free of burrs and other irregularities and the sliding ends sawn or cropped cleanly with no protrusions outside the normal diameter of the bar. For expansion joints, dowel bars shall be 25 mm diameter at 300 mm spacing and 600 mm long for slabs up to 239 mm thick and 32 mm diameter for thicker slabs. For contraction joints, dowels shall be 20 mm diameter at 300 mm spacing and 400 mm long for slabs up to 239 mm thick, and 25 mm diameter at 300 mm spacing and 600 mm long for thicker slabs.

Dowel bars shall be supported on cradles in prefabricated joint assemblies positioned prior to construction of the slab. For contraction joints, as an alternative to prefabricated assemblies, dowel bars may be mechanically inserted with vibration into the concrete by a method which ensures full recompaction of the concrete around the dowel bars and the surface finished by a diagonal finishing beam, or a longitudinal oscillating float travelling across the slab. Dowel bars shall be positioned at mid-depth from the surface level of the slab± 20 mm and centred equally about intended lines of the joint within a tolerance of± 25 mm. They shall be aligned parallel to the finished surface of the slab to the centre line of the carriageway and to each other within the following tolerances:

- for bars supported on cradles prior to construction of the slab and for inserted bars in two layer construction prior to placing the top layer:

- all bars in a joint shall be within ± 3 mm per 300 mm length of bar;
- two thirds of the bars shall be within ± 2 mm per 300 mm length of bar;
- no bar shall differ in alignment from an adjoining bar by more than 3 mm per 300 mm length of bar in either the horizontal or vertical plane;

- for all bars, after construction of the slab:

- twice the tolerances for alignment as above
- equally positioned about the intended line of the joint within a tolerance of 25 mm.

Dowel bars shall be covered by a flexible polymeric corrosion resistant coating. The coating shall be smooth and free of indentations. During coating, the bar shall be supported at each end. Minimum thickness shall be 0.3 mm. The coating shall also be able to withstand 250 hours immersion in a salt fog cabinet complying with BS EN ISO 7253, without showing any visible crazing or corrosion of the protected bar. The coated bar shall comply with the following pull out test:Four bars shall be taken at random from stock and shall be coated as required in this Clause without any special preparation. The dowel bars which have been coated shall be cast centrally into concrete specimens 150 x 150 x 450 mm, made of the same concrete mix proportions to be used in the pavement, but with amaximum aggregate size of 20 mm and cured in accordance with BS EN 12390-2. At 7 days a tensile load shall be applied to achieve a movement of the bar of at least 0.25 mm. The average bond stress to achieve this movement shall be not greater than 0.14 N/mm².For expansion joints, a 100 mm long closely fitting cap consisting of waterproofed cardboard or an approved synthetic material like PVC or GI pipe shall be placed over the sheathed end of each dowel bar. An expansion space at least equal in length to the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar by using compressible sponge. To block the entry of cement slurry between dowel and cap it may be taped.

Tie Bars

Tie bars in longitudinal joints shall be deformed steel bars of strength 415 N/m².

Tie bars for use across joints shall have corrosion protection in the form of a flexible polymeric corrosion resistant coating, bonded centrally onto 150 mm of the previously cleaned centre section of the bars. Where tie bars are to be cranked for construction joints and later straightened, the coating shall be shown to be capable of being straightened through 90 degrees without cracking.

Tie bars in warping joints and wet-formed longitudinal joints shall be made up into rigid assemblies with adequate supports and fixings to remain firmly in position during the construction of the slab. Alternatively, tie bars at longitudinal joints may be mechanically inserted by vibration from above using a method which ensures recompaction of the concrete around the tie bars.Tie bars in warping joints shall be positioned from the top surface of the slab within +20, -10 mm of the mid depth of the slab. Tie bars shall be positioned and remain within the middle third of the slab depth, approximately parallel to the surface and approximately perpendicular to the line of the joint, with the centre of each bar on the intended line of the joints within a tolerance of ± 50 mm, and with a minimum cover of 30

mm below any top crack inducer of joint groove for slabs 200 mm thick or more, or 20 mm for slabs up to 200 mm thick.

Joint Grooves

Transverse contraction or warping joint grooves shall be sawn in the hardened concrete.

Transverse joint grooves which are initially constructed less than the full width of the slab shall be completed by sawing through to the edge of the slab and across longitudinal joints as soon as any forms have been removed and before an induced crack develops at the joint. *Sawn transverse and longitudinal joint grooves*: Sawing shall be undertaken as soon as possible after the concrete has hardened sufficiently to enable a sharp edged groove to be produced without disrupting the concrete and before random cracks develop in the slab. The grooves shall be between 1/4 and 1/3 of the specified depth of the slab and of any convenient width not less than 3 mm. The sealing groove may be sawn to the required width later. Expansion joint sealing grooves shall be sealed as soon as practical after sawing. *Wet formed longitudinal joint grooves:* When slabs are constructed in more than one lane width in one operation, a joint groove shall be formed by inserting a groove former ahead of the finishing beams from dispenser. The concrete so displaced shall be recompacted by a vibrating compactor or similar device, at least 300 mm wide operating symmetrically along the line of the joint. After finishing the concrete, the groove forming strip shall be in the correct position and alignment, within 10° of the vertical, and to sufficient depth below the surface to allow for the passage of the finishing beam within the range 0-3 mm below the finished level of the slab. Groove forming strips in wet-formed longitudinal joint grooves shall be left in place. *Construction joint grooves in surface slabs:* The grooves shall be formed by fixing a groove-former or strip or cork seal along the top edge of the slab already constructed, before concreting the adjacent slab. Where the edge of the concrete is damaged, it shall be ground or made good before fixing the groove forming strip. Alternatively the subsequent slab may be placed adjacent to the first and a sealing groove sawn later in the hardened concrete to the minimum of 1/4 to 1/3 of the specified slab depth or to the manufacturer's instructions if greater, and to sufficient width to eliminate minor spalling of the joint arris, up to a maximum of 25 mm for longitudinal joints and 40 mm for transverse joints. The joint shall be sealed in compliance with Clause 11.4.10.

Joint Filler Board

Joint filler board for expansion joints and manhole and gully slab joints shall be 25 mm thick unless otherwise shown in the drawings, within a tolerance of ± 1.5 mm. It shall be a self-expanding cork seal or a firm compressible material or a bonded combination of compressible and rigid materials of sufficient rigidity to resist deformation during the passage of the concrete paving plant.

Sealing of Joint Groover

Sealing shall be carried out continuously along the full length of joint in any one rip, except for remedial areas. When hot or cold applied sealants are used the sealant shall be applied within the minimum and maximum drying times of the primer recommended by the manufacturer. Priming and sealing with applied sealants shall not be carried out when the naturally occurring temperature in the joint groove to be sealed is below 10°C except between 8°C and 10°C it may be carried out when the temperature is rising.

Inspection of Dowel Bars

Compliance with tolerances for the position and alignment of dowel bars as per Clause 11.4.6 at contraction and expansion joints shall be checked

When the slab has been constructed, the position and alignment of dowel bars and any filler board shall be measured after exposing them carefully across the whole width of the slab. When the joint is an expansion joint, the top of the filler board shall first be exposed sufficiently in the plastic concrete to permit measurement of any lateral or vertical displacement of the board. During the course of normal working these measurements shall be carried out at a rate of one joint per 1500 m length of slab or one per 5 days whichever occurs the sooner. For small areas the rate shall be one joint for up to each 100 joints.

If the position or alignment of the bars in a single joint in the slab is unsatisfactory, then the next two joints shall be inspected. If only the one joint of the three is defective, the rate of checking shall be increased to one joint per day until compliance is being achieved. In the event of non-compliance in two or more successive joints, the Contractor shall revert to the construction of trial lengths and make any necessary alterations to the concrete mix, paving plant or methods until the dowel bar position and alignment is satisfactory.

After the dowel bars have been examined, the remainder of the concrete shall be removed 500 mm on each side of the line of the joint, and reinstated to the requirements of the Specification. Alternatively, if the dowels are examined in the penultimate joint of a day's work, that joint shall be made a construction joint for the next day's work and the remainder of the concrete in the last slab may be discarded.

Curing

Immediately after the surface treatment described in Clause 1026, the surface and exposed edges of surface slabs shall be cured for a minimum period of 7 days, by the application of an approved resin based aluminised curing compound, or polythene sheeting or an approved sprayed plastic film which hardens into a peelable plastic sheet and which shall be removed before road marking and opening to traffic. Resin based aluminised curing compound shall contain sufficient flake aluminium in finely divided dispersion to produce a complete coverage of the sprayed surface with a metallic finish. The compound shall become stable and impervious to evaporation of water from the concrete surface within 60 minutes. The curing compound shall not react chemically with the concrete to be cured and shall not crack, peel or disintegrate within three weeks after application. Prior to application, the contents of any containers shall be thoroughly agitated. The curing compound shall be mechanically applied using a fine spray on to the surface at a rate of at least 0.22 l/m². For the sides of slip-formed slabs or when the side forms are removed within 24 hours and for small areas where mechanical application cannot be used, the compound shall be sprayed by hand lance at a rate of at least 0.27 l/m². The rate of spread shall be checked during construction of each trial length and for each 1000 m² of treated slab.

Exposed Aggregate Concrete Surface

In order to obtain a suitable exposed aggregate surface the main requirement shall be the removal of the surface mortar from the top of the slab to produce an exposed aggregate finish. This objective may be achieved by the application of suitable cement set retarder which is sprayed on the surface of the fresh concrete immediately after it has been levelled and finished. Retarded mortar shall be removed by wet or dry brushing generally not sooner than when the surface concrete has reached a maturity of 16 hours at 20°C or after a suita-

ble interval determined by trial. The finished surface of the pavement concrete after application of retarder shall be protected against precipitation, moisture loss, contamination and dispersal of the retarder by air movements. This protection shall be applied immediately after the application of the retarder. Where waterproof sheeting is used; it shall be laid onto the surface of the concrete immediately after the retarder has been sprayed. It shall be retained in position until immediately prior to exposing of the aggregate. The protection system shall not adversely affect either, the finish, the line or the level of the concrete surface or the even distribution of the retarder in any way. Where sheeting is used, any air bubbling or blistering shall be prevented. Brushing equipment shall be used to expose the concrete surface aggregate. Where the brushing equipment runs on the slab, the concrete shall have gained sufficient strength to avoid any damage to the concrete. Removal of the protection system shall take place as brushing proceeds. If waterproof sheeting is used as protection system, it shall be maintained in position until immediately in advance of the brushing operation. The Contractor shall complete the process of exposing the aggregate before the retarder becomes ineffective. Failure to do so shall entail the remedial measures. Sufficient brushing capability shall always be maintained on site to complete the exposure of the aggregate before the retarder becomes ineffective. An adequate back-up brushing facility shall be available on the site at all times for use in case of a breakdown of the brushing equipment. Brushing shall be used to produce an even macro texture on the surface of the slab and shall be carried out in the longitudinal direction of the concrete slab. The wheels of any brushing equipment which may run on the slab shall be fitted with tyres with a shallow tread pattern and a low inflation pressure and be sufficiently wide to avoid damage to the concrete. Within one hour of completing exposure of the aggregate the surface shall be dampened with water. A curing compound shall be applied to the entire exposed aggregate surface of the slab. In wet weather the curing compound shall be applied as soon as practicable after the rain stops. The surface may, alternatively, be covered by hessian provided it is maintained in a wet condition at all times during the curing period of the concrete. During brushing, initial interim spot check measurements of the surface macro texture depth shall be made as soon as it is considered that the required texture depth has been reached. This shall continue until the specified macro texture depth has been achieved. In the event that it is not possible to achieve the specified minimum macro texture depth by further exposure, the Contractor shall treat the surface in accordance with Clause 11.4.14 to achieve the specified macro texture depth. This treatment shall not be applied until the concrete has reached an age of 28 days. Failure to achieve a satisfactory minimum macro texture depth by mechanical means shall result in removal of the full thickness of the slab to the extent required to permit reconstruction of the slab in accordance with the Specification. Where the maximum macro texture depth is exceeded suitable remedial measures shall be employed

Trial Tests

The Contractor shall demonstrate the constituent materials, concrete proportions, plant, equipment and methods of construction that are proposed for concrete paving, by first constructing a trial length of slab, at least 150 m but not more than 300 m long for mechanised construction, and at least 30 m long for hand guided methods. The concrete proportions decided by trial concrete mixes may be adjusted during the trial but shall not be changed once the trial length has been satisfactorily completed unless the Contractor lays a further trial area to assess the suitability of the proposed changes. The trial length shall be

constructed in two parts over a period comprising at least part of two separate working days, with a minimum of 75 m constructed each day when mechanised paving plant is used and a minimum of 15 m on each day for hand guided methods. The trial length shall be constructed at a similar rate to that which is proposed for the main construction in the Permanent Works. Preliminary trial panels shall be constructed off-line incorporating a top surface of exposed aggregate concrete similar to that specified for the permanent Works. These panels shall be 20 m long and not less than 100 mm deep and the maximum intended paving width. They shall be used to enable the Contractor to determine the required application rate of the retarder and the amount of brushing required to achieve the specified macro texture depth. The trial panels may alternatively be constructed on-site, but in this case, they may only form part of the permanent Works if they meet all the requirements of the Specification, otherwise they shall be removed after they have served their purpose. The surface macro texture depth shall be determined by volumetric patch technique at approximately 2m spacing along a diagonal line across each trial panel, and shall follow the procedure described in BS EN 13036-1.The average value of each set of 10 individual measurements shall be taken as the resulting macro texture depth which shall be assessed against the Specification. At least two transverse joints and one longitudinal joint of each type that are proposed for unreinforced concrete slabs and jointed reinforced concrete slabs in the main construction in the Permanent Works shall be constructed and assessed in the trial length. If in the trial length expansion joints are not demonstrated, the first 2 expansion joints and at least the first 150 m of longitudinal construction joint for mechanised paving, or 30 m for hand guided method of construction laid in the main construction in the Permanent Works, shall be considered the trial length for these joints.The trial length shall comply for strength and density with the Specification in all respects, with the following additions and exceptions:

- In checking for compliance with Table the levels shall be taken at intervals of not more than 2.5 m along any line or lines parallel to the longitudinal centre line of the trial length.
- The maximum number of permitted irregularities of pavement surfaces shall comply with the requirements of Table for 300 m lengths. Shorter trial lengths shall be assessed pro-rata based on values for a 300 m length.
- At least 3 cores of minimum diameter 100 mm shall be taken from the slab at joints to check the lateral and vertical location of joint grooves and bottom crack inducers.
- Alignment of dowel bars shall be inspected as described in Clause 11.4.11 in any two consecutive transverse joints. If the position or alignment of the dowel bars at one of these joints does not comply with Clause 11.4.6, but if that joint remains the only one that does not comply after the next 3 consecutive joints of the same type have been inspected, then the method of placing dowels shall be deemed to be satisfactory. In order to check sufficient joints for dowel bar alignment without extending the trial length unduly, the Contractor may construct joints at more frequent joint intervals than the normal spacing required.
- If there are deficiencies in the first expansion joint that is constructed as a trial, the next expansion joint shall be a trial joint. Should this also be deficient, further trial expansion joints shall be made as part of a trial length. Deficient expansion joints shall not form part of the Permanent Works.

- Compliance with Clause 11.4.7 for the position and alignment of tie bars shall be checked by drilling additional cores from the slab unless they can be determined from cores taken for density assessment.

The Contractor shall not proceed with normal working unless the trial length complies with the Specification and any earlier defective trial lengths have been removed, unless they can be remedied to comply with the Specification. After satisfactory completion of the trial length, the constituent materials, concrete proportions, plant, equipment and construction methods shall not thereafter be changed, except for normal adjustments and maintenance of plant, unless the Contractor lays a further trial length as described in this Clause to demonstrate that the changes will not adversely affect the Permanent Works or in agreement of the changes with the Employer's Representative.

Texturing of Hardened Concrete

Worn, rain damaged or inadequately textured surface slabs shall be macrotextured by sawing grooves in the hardened concrete surface at right angles to the longitudinal axis of the pavement with machines using diamond or other abrasive cutting discs. Grooves shall be irregularly spaced and shall be not less than 2 mm and not more than 5 mm wide. The sequence of distances between groove centres in mm shall be: 40, 45, 35, 45, 35, 50, 30, 55, 35, 30, 50, 30, 45, 50, 30, 55, 50, 40, 35, 45, 50, 40, 55, 30, 40, 55, 35, 55. A tolerance of ± 3 mm shall be allowed on each of the spacings. The minimum width of grooving head shall be 500 mm and a head not providing a complete sequence of spacings shall use the number of spacings appropriate to its width commencing at the start of the sequence.

Groove depths shall be measured using a tyre tread depth gauge and measurements shall be taken as follows:

- At 10 locations at least 2 m apart along a diagonal line across a lane width between points 50 m apart longitudinally. No measurement shall be taken within 300 mm of the longitudinal edge of a slab. Where a grooved area is less than 50 m in length the locations where measurements are taken shall be as proportional to the requirements for 50 m.
- At each of the 10 locations the depth of 10 adjacent grooves shall be measured.
- The average of each set of 10 measurements shall be not less than 3 mm nor greater than 7 mm.

Slurry from the sawing process shall be prevented from flowing into joints, drains or into lanes being used by traffic and all resultant debris from the grooving shall be removed.

Weather Conditions

Road pavement materials in a frozen condition shall not be incorporated in the Works but may be used, if acceptable, when thawed. Road pavement materials shall not be laid on any surface which is frozen or covered with ice. The temperature of concrete in any pavement layer shall not be less than 5ºC at the point of delivery. These materials shall not be laid when the air temperature falls below 3ºC and laying shall not be resumed until the rising air temperature reach 3ºC unless all surfaces of the concrete slabs are protected by thermal insulation blankets laid immediately after placing and finishing the concrete. The insulation shall be placed before the temperature of the concrete surface has dropped below 2ºC and

shall be retained for a minimum of 3 days or until the concrete is assessed to have reached 50% of the specified characteristic compressive strength provided the air temperature is above 0ºC and rising at that time. Thermal insulation blankets shall be closed cell polyethylene foam sheets, minimum 10 mm thick with a 'U' value of 4 watts/mC (or K value of 0.04 watts/m Kelvin) or suitable material with an equivalent or lower thermal conductivity. They shall be sufficiently robust and capable of being held in place against variations in wind and weather conditions for the necessary curing time.

Construction Traffic

Construction plant and traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so that damage is not caused to the sub-grade or the pavement courses already constructed. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

Concrete slabs may be used by traffic when the cube compressive strength is assessed to have reached 25 N/mm². In the absence of test data establishing compliance, no vehicle with an axle loading greater than 2 tonnes shall run on concrete slabs within a period of 14 days after placing the concrete. Vehicles with rubber tyres with an axle loading less than 2 tonnes, or wheels or tracks of concreting plant, shall not use any part of a newly constructed pavement within 7 days. The above periods before traffic may run on the pavement shall be increased if the 7 day cube strength is below that what is required in the Specification. These periods shall be extended by one day for each night on which the temperature of the layer falls to 0ºC or below.

13.5 Water Proofing System

13.5.1 General

Sheet water-proofing membrane systems for the tunnel shall comprise of a geotextile fleece fixed to the primary lining substrate in combination with a sheet water-proofing membrane fastened to this; see Section 12.5 for details of installation. Waterproofing shall be applied to crown and sidewalls above footing or invert arch level. The waterproofing membrane shall always be located between shotcrete support and final concrete lining. As the underground structures referred to be not immersed below a distinct groundwater table no membrane waterproofing will be provided for tunnel inverts. Where the water-proofing system is to be divided into sectors, the waterstops should be formed of material that can be welded to the sheet waterproofing membrane.Additional drainage capacity can be provided by studded drainage membrane made from thermoplastic material (dimpled sheet) attached prior to installation of the geotextile fleece.

Waterproof membranes shall not be stored in direct sunlight prior to use. Waterproof membranes shall be protected from damage at all times especially during installation of reinforcement.

13.5.2 Geotextile Fleece

The purpose of the geotextile fleece is to protect the sheet membrane against mechanical puncture and to provide a drainage path for any ground water along the rock side of water proofing system around the tunnel structure.The geotextile, used in combination with dim-

pled sheet as strip drain is to protect the dimpled sheet and allows the inflow of ground water into the dimpled sheet drainage area.The geotextile fleece shall be a non-woven fleece and shall provide a minimum weight of 700 g/m² in accordance to the Specification set forth in Table 18.

Table 18: Requirements on geotextile fleece

Property	Requirement	Standard
Unit weight	700 g/m²	DIN 53854
Thickness at 0.02 bar	3.9 mm	DIN 53855/3
Thickness at 2.0 bar	1.9 mm	DIN 53855/3
Tensile strength	1000 N/5cm	DIN 53857/2
Extension at break	70%	DIN 53857/2
Extension at 30% of tensile strength	20%	DIN 53857/2
Resistance against acid and alkaline solutions, pH 2-13	Loss of strength max. 10%.	SN 640 550 DIN 53857/2
Resistance to Punching	2000 N	DIN 54307

The geotextile is to provide adequate protection from chemical aggression caused in the curing processes of concrete.Water transmissivity of the geotextile fleece should be designed to suit expected volume of water ingress.

13.5.3 Fixing Element

The geotextile is fixed onto the substrate with non-projecting disks. The disks are secured through the geotextile and into the substrate with shot-fired nails. The disks should be made of a compound that allows the sheet waterproofing membrane to be fully welded to the surface. In order to prevent stresses being transferred from the secondary lining to the sheet waterproofing membrane, the resistance to failure in shear of the nails and disks must be less than the shear resistance of the sheet membrane itself.

13.5.4 Waterproof Membrane

The waterproof membrane shall consist of a continuous impermeable heat-welded sheet of one of the following materials:

- soft polyvinyl chloride (PVC) unreinforced
- flexible polyolefin (FPO/TPO) unreinforced
- high-density polyethylene (HDPE) in accordance with DIN 16776 Parts 1 and 2
- ethylene copolymerical bitumen (ECB).

The membrane as supplied shall be of such dimensions and shape as will result in the minimum of on-site seam welds.

Unless otherwise stated in the Contract, the membrane shall conform to performance requirements and have properties shown in Table 19.

Table 19: Performance requirements of sheet waterproof membranes

Thickness	BS EN 1849-2	2,0 mm ±10%
Tensile Strength	BS EN ISO 527-3	16 MPa
Elongation at break	BS EN ISO 527-3	Not less than 300% (-
Resistance under water pressure	BS EN 1928 method B	5 bars at 1 hour
Root resistance	DD CEN/TS 14416	No penetration
Tear resistance	BS EN 12310-2	80 N/mm
Tensile strength of welded seam	BS EN 12317-2	Cracks occur next to the seam
Water absorption	BS EN ISO 62	<4,0%
Fire rating	BS EN ISO 11925-2	Self-extinguishing
Smoke class	BS EN ISO 11925	E

Further guidance on test methods and requirements for mechanical properties and durability can be found in BS EN 13492:2004 (E): “Geosynthetic barriers – Characteristics required for use as a fluid barrier in the construction of tunnels and underground structures”.

Where reinforced concrete is to be placed against the sheet waterproofing membrane, a signaling layer, to give a visual indication of any mechanical damage, shall be provided on the exposed surface of the waterproofing membrane. The signaling layer shall be such that it does not adversely affect the seam welds.

13.5.5 Installation

The manufacturer's instructions for installation of felt backing and waterproofing membrane, including procedures for preparation, fixing, welding and splicing, flashing shall be followed solely by the Contractor.

Prior to application of the geotextile fleece layer the primary lining shall be surveyed to confirm that it does not encroach into the designed extrados of the secondary lining. Any proposals to rectify areas of the primary lining shall be agreed with the Employer’s Representative.

The shotcrete lining shall be constructed in a way that all bolts and anchors are fully covered with shotcrete of the primary lining. The surface shall be prepared in accordance with the manufacturer’s instructions. Except where indicated on the drawings, all fixtures shall be removed from the primary lining prior to application of the geotextile fleece layer. All core holes shall be backfilled with mortar to be flush with the surface of the primary lining.

For sheet waterproof membranes, the profile of the substrate (tunnel surface) shall not have any irregularities that exceed a ratio of length to depth of 5:1 and its minimum radius shall be 200 mm. Transitions and intersections of tunnel profiles shall be rounded off with a minimum radius of 500 mm. The substrate surface shall be free from protrusions or sharp edges which may lead to membrane puncture. Crushed aggregates of a grain size greater than 8 mm shall not be used.

Groundwater penetrating through the primary tunnel lining shall be collected and drained by appropriate measures. This drainage shall be maintained throughout the membrane placing process, and shall be so arranged that excess water pressure behind the membrane cannot develop. All shotcrete surface shall finally be smoothened with fine-graded shotcrete (rounded aggregates, grain size 0 - 8 mm), applied in a layer of 30 mm minimum thickness. A layer of protective geotextile shall be attached to the substrate by suitable non-projecting fastenings installed directly through the geotextile fleece. When fixing the geotextile fleece overhead, sufficient fixings shall be installed to ensure the fleece is in close contact with the substrate and is self-supporting. The sheets shall overlap by at least 200 mm. When placing the sheet waterproof membrane, no other Works shall be carried out in the vicinity which may cause personnel or equipment to come into contact with the sheet waterproof membrane before it has been protected. If it is likely that excessive dust may be generated in the vicinity of the Works (vehicle movements etc.), then dust suppression measures shall be put in place. The amount of membrane stored in the tunnel shall not exceed one day's production to minimise the fire load stored underground. The sheet waterproof membrane shall be fixed to the tunnel structure by means of fastening devices which preserve the integrity of the sheet waterproof membrane. Sufficient fixings shall be installed to ensure the fleece is in close contact with the substrate and is self-supporting. No perforation of the membrane shall be allowed for installation purposes. The waterproofing membrane shall be laid with the signal layer towards the inside and with sufficient slack to prevent overstressing during concreting. All sheet waterproof membrane overlaps shall be welded in accordance with the membrane manufacturer's instructions. Where waterproof membrane has been installed in the tunnel invert, it shall be protected from any damage as soon as possible after testing. Radial joints between sheets of sheet waterproof membrane shall be welded using flat-faced fillet welds. Two lines of weld shall be used on each joint forming a double seam of at least 15 mm wide, with the minimum sheet waterproof membrane overlap 80 mm for manual welding and 100 mm for automatic welding. If protrusions through the membrane are required, they shall be fitted with collars to maintain the water tightness of the system. Star or cross joints shall be avoided.The length of material roll shall be procured to enable a complete extrados to be installed as a continuous length. Longitudinal joints shall be avoided. The placing of inner lining concrete sequence and processes shall be such that they do not displace or damage the geotextile fleece or sheet waterproofing membrane.

13.6 Checking

Field Trials

Field trials shall be made to demonstrate the capability of the equipment, workmanship, materials and application methods under field conditions. The testing program shall be started sufficiently early prior to installing the membrane to ensure that the required watertightness can be achieved and allow repetition of the trials should the initial results prove unsatisfactory. All trials and acceptance tests shall be completed satisfactorily by the time installation commences. Prior to construction, trials shall be carried out in order to establish the speed and temperature of joint welding required to achieve welds which are acceptable to the Employer's Representative. If hand-welded joints are proposed at junctions, then this type of weld shall be pre-tested and agreed with the Employer's Representative.

Construction Testing

A visual inspection of the sheet waterproof membrane shall be carried out as specified in Table 20. Areas where the sheet waterproof membrane is damaged shall be marked up; repairs carried out and tested in accordance with the manufacturer's instructions. All welded joints shall be tested in accordance with Table 20. Any joints that fail the test and require repair shall be marked with a permanent marker, at the time of the test. Repairs and hand-welded joints shall be tested by hand-held vacuum chamber in accordance with Table 20.

Table 20: Construction testing for sheet waterproof membrane

Parameter	Test Method	Frequency	Pass Criteria
Coverage	Visual	A visual inspection to be carried out continuously while the membrane is applied	100% coverage
Double welded seam joints	DIN 16726	Every joint	Pressure drop not to be greater than 20% when a 2 bar pressure is applied for 10 minutes
Hand welding and repairs	ASTM D5641-94 (2006)	Every hand-weld and repair	Pressure drop not to be greater than 20% when a 0.3 bar pressure is applied for 10 minutes

A visual inspection of the fleece shall be carried out. Areas in which the substrate is still visible, or where the fleece is damaged, shall be marked up and an additional layer of fleece applied with a minimum lap of 200 mm around the area.

Failure Measures

Where tears, rips or defective joints in the geotextile fleece are noted, these shall be repaired with a minimum overlap of 200 mm.

Where tears, rips or defective joints in the sheet waterproof membrane are noted, these shall be repaired in accordance with manufacturer's recommendations. These shall be tested by hand-held vacuum chamber in accordance with Table 16.

Any sheet waterproof membrane not meeting specified requirements shall be removed and replaced including any associated water management measures or smoothing layer. The cause of the problem shall be rectified before placing any further sheet waterproof membrane.

13.7 ADDENDUMS

All listed Addendums are integral part of the Contract.

Addendum 1 "Guideline for Inner Shell Concrete", Austrian Society for Concrete- and Construction Technology, 2006, Austria.

Addendum 2 "Guideline for Sprayed Concrete", Austrian Society for Concrete- and Construction Technology, 2005, Austria.

-------- End of Main Document --------

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Project:

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Revision History

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INTRODUCTION

This report is prepared under Contract Agreement clause 2.8; "Key Date No: KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)" after incorporation of Client's observations on earlier submitted "KD5: Kucha Draft Detailed Project Report (KDDPR)" vide letter no. NH/PIU-Tunnel/NH-48/KD-3/2015-16/383-386 dated 14.12.2015.

The present submission (10 Hard Bound Sets and 5 Soft Copies of each) is as detailed below:

(i) Volume-I, Main Report:

- *Executive summary*
- *Project Description*
- *Socio Economic Profile*
- *Materials Surveys and Investigation*
- *Traffic Surveys and Analysis*
- *Design Standards and Specifications*
- *Alignment Proposals*
- *Summary of EIA/IEE and Action Plan*
- *Summary of Resettlement Plan*
- *Preliminary Cost Estimates*
- *Preliminary Economic Analysis*
- *Preliminary Financial Analysis*
- *Suggested Methods of procurement and packaging*
- *Conclusions and Recommendations*
- *Acknowledgement*
- *Compliance of the Observations*

The basic data obtained from the field studies and investigations and input data used for the detailed engineering design (if any) shall be submitted in a separate volume as an Appendix to Main Report.

(ii) Volume – II : Design Report

Part- I Traffic Study, Analysis and Forecast :

- *Description of Existing Road in Ghat Section*
- *Road and Bridge Inventory*
- *Traffic Surveys, analysis and forecast*
- *Proposed Pavement Design*

Part-II Design of Tunnels :

- *Proposed Tunnel Design, Standards*
- *Structural Analysis- Primary Lining*

Part-III Design of Bridges and Cross-Drainage Structures :

- *Proposed Bridges and Structures Design Basis and*
- *Bridges Dimensioning*

Part-IV Geological Design and Geotechnical Report :

- *Geological Survey and Analysis*
- *Geotechnical Investigations Report*

(iii) Volume-III Materials Report :

(iv) Volume - IV(a) Environmental Assessment Report including Environmental Management Plan (EMP) &

(v) Volume - IV(b) Resettlement Action Plan (RAP) :

(vi) Volume - V Technical Specifications :

(vii) Volume - VI Rate Analysis :

(viii) Volume - VII Cost Estimates :

(ix) Volume - VIII Bill of Quantities :

(x) Volume - IX Drawings (A3 Size) :

a. *Location map*
b. *Layout plans*
c. *General Drawings*
d. *Plan and Profile of Refined Alignment "A"*
e. *Typical Cross Sections showing Pavement details of Cut & Fill Section*
f. *Typical Cross Sections of Tunnel*
g. *Typical Cross Sections of Bridges*
h. *Tunnels- General Arrangement Plan and L-Sections (L&R)*
i. *Viaducts – General Arrangement Plan and L-Section*
j. *Cut & Fill and Viaducts – General Arrangement Plan and L-Section*
k. *GAD for proposed RoB at Railway km 54+650*
l. *Standard Drawings*
m. *Miscellaneous Drawings*
n. *Indicative Land Acquisition Plans*
o. *Detailed Cross Sections @ 100m interval*

(xi) Volume - X Civil Work Contract Agreement :
(xii) Volume - XI Project Clearances :

Volume – VI: Rate Analysis

1 GENERAL

This Volume - VI: Rate Analysis, a part of KD6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR) is submitted in accordance with the Contract Agreement and as per requirement specified in Terms of Reference (ToR) for preparation of Rate Analysis of "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH-48 in the State of Karnataka".

2 UNIT RATES

The rates of various items of construction work have been analysed as per procedure laid down in the "MORT&H Standard Data Book"-2003 (Fourth Revision, Reprint 2006) and guidelines set there in. Market studies were made to ascertain the rates of various items of construction materials. The market rates of major BoQ items like earthworks and pavement layers collected from similar adjacent packages and the rates worked out from the standard data book are compared with these market rates.

The rates of natural materials like river sand, moorum, gravel and stone aggregate etc. have been collected from the available quarry sources, in the vicinity of the road, by local enquiry and from government departments. Aggregate quarries are used from the excavated muck disposal, nearest quarries available are within one to two km from the construction place. In case if number of local aggregate crushers are not sufficient to meet the requirement, the rates of crushed aggregate, and crusher dust are adopted in the rate analysis by considering own cone crusher by the contractors. Sand is available at the Kempuhole river and nalla beds all along Hassan, Sakleshpur, Heggade, Maranhally, and Gundya., Rates of manufactured / proprietary items have been ascertained from the trade. Unit cost of transportation to site, based on the average lead, has been added to the basic cost.

Cartage rates have been considered as per MORT&H Data Book and guide lines laid there in. Hourly cost of owning and operating various machineries and equipment has been considered as per the Standard Data Book and local market enquiry. Local prevailing hire charges and diesel charges were also considered in arriving at Machinery & Equipment hiring charges. For machinery and equipment not covered by the Data Book, prevailing market rates were considered. Rates of different categories of skilled and unskilled manpower, labor have been taken from the rates as provided in the latest NH-SSR of Karnataka 2014-15.

An escalation as per RBI indices has been taken into account wherever applicable for determining current year 2015-2016 rates. Machinery hire charges have been taken from Standard data book with 60% enhancement (5% per year from year 2003 onwards) MoRTH and Karnataka SOR. A conscious effort has been made to arrive at reasonable and logical rates for various items of work. Unit rates have been checked against rates of similar ongoing project under MoRTH near the project road vicinity and were found reasonable.

3 DETAILED RATE ANALYSIS

This softawre of Rate Analysis is based on “Standard Data book for analysis of Rates for Road and Bridge Works” prepared and published by MoRT&H. This Software runs on Microsoft Excel with Automatic updation & calculation of Item Rate. The Overhead charges (8% for road works and 10% for bridges/ tunnel works) and Contractor profits (10%) are fixed by MoRT&H; and the same is adopted. Items which are not covered in standard data book but used & required for tunneling (including E&M) have been analyzed and/or adopted from similar international projects and practice.

INPUT are based on respective latest “Schedule of Rates” published by the concerned State Public Works Department and applicable to NH Division. Input data includes the usage rates of Plant & Machinery, labour and material as applicable. For this project corridor Schedules of Rates - Karnataka State of year 2014-15 are adopted.

There are a number of spread sheets in the Software Excel files as listed below:

GENERAL
DIR USED ITEMS
SUMMARY
CHAPTER -1 CARRIAGE OF MATERIALS
CHAPTER-2 SITE CLEARANCE
CHAPTER-3 EARTH WORK, EROSION CONTROL AND DRAINAGE
CHAPTER-4 SUB-BASES, BASES (NON- BITUMINOUS) AND SHOULDERS
CHAPTER-5 BASES AND SURFACE COURSES (BITUMINOUS)
CHAPTER-6 CEMENT CONCRETE PAVEMENTS
CHAPTER-7 GEOSYNTHETICS AND REINFORCED EARTH
CHAPTER-8 TRAFFIC SIGNS, MARKINGS & OTHER ROAD APPURTENANCES
CHAPTER-9 PIPE CULVERTS
CHAPTER-10 MAINTENANCE OF ROADS
CHAPTER-11 HORTICULTURE
CHAPTER-12 FOUNDATIONS
CHAPTER-13 SUB-STRUCTURE
CHAPTER-14 SUPER-STRUCTURE
CHAPTER-15 RIVER TRAINING AND PROTECTION WORKS
CHAPTER-16 REPAIR AND REHABILITATION
INPUT

MANUFACTURED MATERIALS
QUARRY
EQUIPMENTS

4 MoRTH Guidelines for Cost Methodology

The “Guidelines for Costing Methodology” to be adopted for framing up Cost Estimates of BOT Projects was issued by NHAI on 8th December 2010. These are adopted for preparation of Rate Analysis, Estimation of Quantities and Cost Estimates for this project.

5 STEPS FOR RATE ANALYSIS

The Rate Analysis is worked out on the basis of guidelines given in the Cost Methodology issued by NHAI on 8th December 2010. These are as listed as below:

The analysis is to be worked out on the basis of following:

Step-1- The basic rates for labour, material and cartage are to be taken from the available SOR for NH works (latest Schedule), if the Schedule is of previous years, an escalation of 5% is adopted for labour / material / cartage per year or for the labour minimum wages for particular State / District is considered, if available.

Compliance - ***T****he estimate is reported to be prepared based on MORTH Standard data book. Basic rates of Labour, material as per Karnataka State SOR 2014-15, Govt. Of Karnataka PWD-NH. The machinery rates ar rived are based on MORTH standard Data book 2003 and escalation applied as per RBI indices related to machinery and the market rates are adopted wherever schedule rates are not available. The rates for bitumen, cement & steel has been considered as per current market rate & petroleum company circulars.*

Step-2- The leads of different construction material are to be worked out based on material investigation for location of borrow area in case of borrowed earth, quarry of Stone Aggregates, Sand etc.

Compliance - *The leads of construction materials are taken from excavated materi als of proposed tunnels and identified borrow areas.*

Step-3- The lead of bitumen, cement and steel is to be fixed based on lo cation of refinery in case of bitumen, location of main city for cement, steel and hume pipe.

Compliance - The leads of Bitumen, Cement and Steel is taken from Mangalore, Hassan, Bangalore, and Vishakhapatnam.

Step-4- The current rates of bitumen, cement, steel & NP pipes are to be adopted from the market / website. On the basic rate of bitumen taken from the nearest Refinery an excise duty @ 14.42% is to be undertaken on which the CST/VAT and Cartage cost is further added to arrive at the current rate of Bitumen.

Compliance - The rates for bitumen, cement & steel has been considered as per current market rate & nearest Refinery petroleum company circu lars. Excise Duty @14.42% is taken. VAT/ CST and Cartage Cost is further added.

Step-5- The format for working out rates for different items of bill of quantities is to be used from The Standard Data Book of MORT&H. If the Ma chinery rates are available in Schedule of Rate (SOR), the rates are taken from SOR only; however, if not available, the machinery rentals of 2001-2002 are considered from Standard Data Book and increased @ 5% per year to bring it to the current date. The same may also be compared with the market rate of hiring charges plus POL, applicable to the project location.

Compliance - Yes same is considered. The estimate is reported to be pre pared based on MORTH Standard data book.

Step-6 - In Granular Sub Base, Mix in place Method is used while analyz ing and putting the rate for Cost Estimation.

Compliance - Yes, Granular Sub-base “Mix in Place Method” is used.

Step-7- The contingency rates for different type of structures as proposed in Standard Data Book of the Ministry are to be continued presently as they are based on different site conditions and sound practical invest tigation done by the Ministry at the time of preparing the SDB, until they are revised.

Compliance - Yes; 3% Contingencies is adopted.

6 RATE ANALYSIS

Detailed estimation of quantities has been worked out for various items of works. The details are given as Annexure -1:

--------End of Main Document----------

7 TABLE OF ANNEXURES

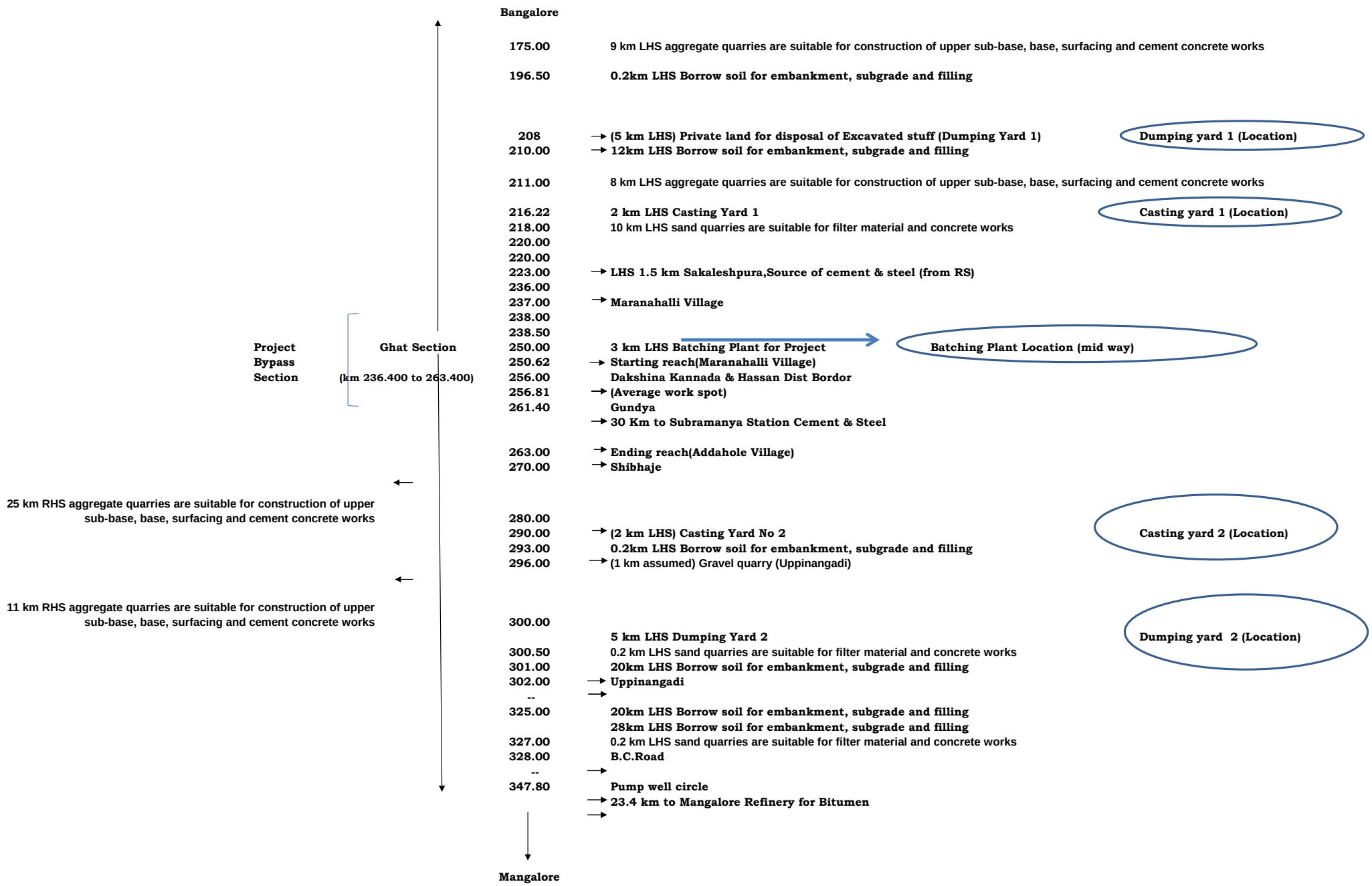
Sr. No.	Topic	Pages
1	Annexure -1 : Rate Analysis	232

ANNEXURE - 1

Rate Analysis

LEAD CHART FOR QUARRY, BORROW AND RAW MATERIALS FOR Shiradi Ghat BY PASS PROJECT Bangalore - Mangalore section.

LEAD CHART



LEADS FOR QUARRY, BORROW AND RAW MATERIALS FOR SHIRADI GHAT BY PASS PROJECT

Lead For Aggregate Quarry @175 Km

Quarry to NH-48 (175 km)	9 km
From 175 km to 250 km	75 km
From 250 km to Batching Plant	3 km
	87.00 km

Lead For Borrow @301 Km

Borrow Area to NH-48 (301 km)	20 km
From 301 km to 250 km	51 km
From 250 km to Batching Plant	3 km
	74.00 km

Lead For Borrow @196.5 Km

Borrow Area to NH-48 (196.5 km)	0.2 km
From 196.5 km to 250 km	53.5 km
From 250 km to Batching Plant	3 km
	56.70 km

Lead For Borrow @325 Km

Borrow Area to NH-48 (325 km)	20 km
From 325 km to 250 km	75 km
From 250 km to Batching Plant	3 km
	98.00 km

Lead For Borrow @210 Km

Borrow Area to NH-48 (210 km)	12 km
From 210 km to 250 km	40 km
From 250 km to Batching Plant	3 km
	55.00 km

Lead For Borrow @325 Km

Borrow Area to NH-48 (325 km)	28 km
From 325 km to 250 km	75 km
From 250 km to Batching Plant	3 km
	106.00 km

Lead For Aggregate Quarry @211 Km

Quarry to NH-48 (211 km)	8 km
From 211 km to 250 km	39 km
From 250 km to Batching Plant	3 km
	50.00 km

Lead For Sand @327 Km

Quarry to NH-48 (327 km)	0.2 km
From 327 km to 250 km	77 km
From 250 km to Batching Plant	3 km
	80.20 km

Lead For Sand @218 Km

Quarry to NH-48 (218 km)	8 km
From 218 km to 250 km	32 km
From 250 km to Batching Plant	3 km
	43.00 km

For Dumping Yard No 1 @208 km

Dumping yard to NH-48 (208 km)	5 km
From 208 km to 250 km	42 km
From 250 km to Batching Plant	3 km
	50.00 km

Lead For Cement & Steel @223 Km

Saklespura Station to NH-48 (223 km)	1.5 km
From 223 km to 250 km	27 km
From 250 km to Batching Plant	3 km
	31.50 km

For Casting Yard No 1 @216 km

Casting yard to NH-48 (216 km)	2 km
From 216 km to 250 km	34 km
From 250 km to Batching Plant	3 km
	39.00 km

Lead For Aggregate Quarry @280 Km

Quarry to NH-48 (280 km)	25 km
From 280 km to 250 km	30 km
From 250 km to Batching Plant	3 km
	58.00 km

For Casting Yard No 2 @290km

Casting yard to NH-48 (290 km)	2 km
From 290 km to 250 km	40 km
From 250 km to Batching Plant	3 km
	45.00 km

Lead For Borrow @293 Km

Borrow Area to NH-48 (293 km)	0.2 km
From 293km to 250 km	43 km
From 250 km to Batching Plant	3 km
	46.20 km

For Dumping Yard No 2 @300 km

Dumping yard to NH-48 (300 km)	5 km
From 300 km to 250 km	50 km
From 250 km to Batching Plant	3 km
	58.00 km

Lead For Gravel Quarry @296 Km

Quarry to NH-48 (296 km)	1 km
From 296 km to 250 km	46 km
From 250 km to Batching Plant	3 km
	50.00 km

Lead For Cement Mangalore City (Subramanya Station)

Subramanya Stn to NH-48 (261.40km)	30 km
From 261.4 km to 250 km	11.4 km
From 250 km to Batching Plant	3 km
	44.40 km

Lead For Aggregate Quarry @300 Km

Quarry to NH-48 (300 km)	11 km
From 300 km to 250 km	50 km
From 250 km to Batching Plant	3 km
	64.00 km

100 km from Project Road Bitumen Mangalore

Mangalore Refinery to NH-48 (347.8 km)	23.4 km
From 347.8 km to 250 km	98 km
From 250 km to Batching Plant	3 km
	124.40 km

Lead For Sand @300.5 Km

Quarry to NH-48 (300.5 km)	0.2 km
From 300.5 km to 250 km	50.5 km
From 250 km to Batching Plant	3 km
	53.70 km

SUMMARY OF LEADS FOR SHIRADI PROJECT (BY PASS NH-48)

GRAVEL / Coarse Aggregate LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source On NH-48	Location of Destination On NH-48	Distance from destination to NH-48	Final Lead	
1	9	175.00	250.00	3.00	87.00	
2	8	211.00	250.00	3.00	50.00	
3	25	280.00	250.00	3.00	58.00	
4	1	296.00	250.00	3.00	50.00	
5	11	300.00	250.00	3.00	64.00	
					309.00	
				Av lead	61.80	

Fine Aggregate LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	8	218.00	250.00	3.00	43.00	
2	0.2	300.50	250.00	3.00	53.70	
3	0.2	327.00	250.00	3.00	80.20	
					176.90	
				Av lead	58.97	

Borrow Material LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	0.2	196.50	250.00	3.00	56.70	
2	12	210.00	250.00	3.00	55.00	
3	0.2	293.00	250.00	3.00	46.20	
4	20	301.00	250.00	3.00	74.00	
5	20	325.00	250.00	3.00	98.00	
6	28	325.00	250.00	3.00	106.00	
					435.90	
				Av lead	72.65	

Bitumen LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	23.4	348.00	250.00	3.00	124.40	
					124.40	
				Av lead	124.40	

Cement and Steel LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	1.5	223.00	250.00	3.00	31.50	
2	30	261.40	250.00	3.00	44.40	
					75.90	
				Av lead	37.95	

Dumping Yard LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	5	208.00	250.00	3.00	50.00	
2	5	300.00	250.00	3.00	58.00	
					108.00	
				Av lead	54.00	

Casting Yard LEAD (Shiradi Ghat By Pass NH-48)						
Sl No	Distance from source to NH-48	Location of Source (NH-48)	Location of Destination (NH-48)	Distance from destination to NH-48	Final Lead	
1	2	216.00	250.00	3.00	39.00	
2	2	290.00	250.00	3.00	45.00	
					84.00	
				Av lead	42.00	

Note: Considering lead from source of material to point at 250 km chainage (about 3 km from here)
All distances are in Kms

Labour and Plant Rates

S.No.	Labour	Rate per day (Rs)	S.No	Plant & Equipment	Rate per hour (Rs.)
1	Mate	275	1	Power Roller 8-10t	386
2	Mazdoor	245	2	Front End Loader(2m^3)	624
3	Ordinary Rod Binder	275	3	Hot Mix Plant 40-60t/h	8580
4	Welder	250	4	Sensor Paver Finisher	2070
5	Helper to Welder	245	5	Truck/Tipper 5t (hour)	240
6	Head Blacksmith	250	6	Truck/Tipper 5t (km)	19
7	Ordinary Blacksmith	245	7	Truck/Tipper 5t (T/Km)	2
8	Blacksmith Helper	245	8	Vibratory Road Roller	1292
9	Fitter & Machine Helper	270	9	Motor Grader	1854
10	Hammer Man	245	10	Plate compactor	250
11	Head Mason	250	11	Motorised Scraper	1700
12	Ordinary Mason	245	12	Dozer D50	1565
13	Mason Helper	245	13	Dozer 1.2m3 D80	2640
14	Bhistee	270	14	Hot Mix Plant,6-10 t/h	1552
15	Khalasi	270	15	Hot Mix Plant,20-30 t/h	4830
16	Carpenter	250	16	Paver Finisher (Mechl.)	786
17	Carpenter ordinary	245	17	Tractor-50 hp	280
18	Sprayer	245	18	Tipper 10t (hour)	225
19	Plumber	275	19	Truck/Tipper 10t (km)	17
20	Electrician	250	20	Truck/Tipper 10t (Tonne)	2
21			21	Wet Mix Macadam Plant 60 tph	1010
22	Tarman	275	22	Bitumen Boiler Oil-Fired	140
23	Painter	250	23	Pneumatic Roller 8-10t	922
24	Skilled mazdoor	245	24	Concrete Mixer 10/7 cft	180
25	Skilled Dresser	275	25	Excavator	1008
26	Dresser	275	26	Excavator JCB	966
27	Driller	245	27	Water Tanker 6000 L	374
28	Blaster	250	28	Transit mixer 4.5 Cum/hr	660
29	Chiseler/ Stone breaker	275	29	Concrete Pump 45/30	173
30	Driver LMV	270	30	Water Tanker (12000 l.)	600
31	Driver HMV	275	31	Needle Vibrator (Poker)	30
32	Operator for Tractor	275	32	Drilling equipment	882
33	Operator for excavator/ crane	275	33	Bitumen Pressure Distubiture	795
34	Operator for Roller	275	34	Hot Mix Plant 120 TPH	16600
35	Operator for Dozer	275	35	Hot Mix Plant 100 TPH	12280
36	Mazdoor pneumatic breaker	250	36	Mech.Broom	276
37	Sinker	279	37	Emulsion Pres.Distrir.	593
38	Sinker Skilled	279	38	GSB Plant	804
39	Diver	250	39	Generator 100Kva	562

S.No.	Labour	Rate per day (Rs)	S.No	Plant & Equipment	Rate per hour (Rs.)
			40	Generator 33Kva	264
			41	Generator 250Kva	1349
			43	Mastic Cooker	50
			44	Tandem Roller	922
			45	Mixer 0.4/0.28 cum	172
			46	Concrete batcher 30cum	1656
			47	Generator 125 Kva	674
			48	Stone crusher 100 TPH	5590
			49	Pugmill	1010
			50	Air compressor	257
			51	Machinewithcutting blades	250
			52	Crane 80 T	866
			53	Crane 35 T	577
			54	Crane 3T	241
			55	Tractor with ripper	302
			56	Tractor with rotavator	293
			57	Excavator with Pneumatic breakers	1200
			58	Hydraulic Chip spreader	1785
			59	Mobile Slurry seal	715
			60	Residual Binder	18000
			61	Crane grab	550
			62	Wooden ballies 8" dia 9m long	360
			63	Wooden ballies 2" dia 1m long	18
			64	Road Marking Machine	60
			64	Kerb Casting Machine	250
			65	Batch Type clod mix plant 75Tonne	8000
			66	Cold milling machine @ 20 cum per hour	800
			67	Road Sweeper at 1250sqm/hr	276
			68	Slip form paver with electronic sensor	1800
			69	Texturing machine	300
			70	Grouting pump with agitator(hr)	800
			71	Stressing jack with pump(hr)	150
			72	Shotcreteing equipment(hr)	100
			73	Hire charges for jack of 40 tonne lifting capacity.	9000

MATERIALS COST

Sl. No.	Description	Unit	Lead (km)	Basic Cost	Carrying Cost (Rs)	Total Cost (Rs)
1	Size Stones	cum	61.00	350.00	449.52	799.52
2	Aggregate, 63 mm	cum	61.00	400.00	449.52	849.52
3	Aggregate, 53 mm	cum	61.00	450.00	449.52	899.52
4	Aggregate, 40 mm	cum	61.00	525.00	449.52	974.52
5	Aggregate, 26.5 mm	cum	61.00	525.00	449.52	974.52
6	Aggregate, 22.4 mm	cum	61.00	525.00	449.52	974.52
7	Aggregate, 20.0 mm	cum	61.00	525.00	449.52	974.52
8	Aggregate, 13.2 mm	cum	61.00	325.00	449.52	774.52
9	Aggregate, 11.2 mm	cum	61.00	325.00	449.52	774.52
10	Aggregate, 10.0 mm	cum	61.00	325.00	449.52	774.52
11	Aggregate, 5.6mm	cum	61.00	325.00	449.52	774.52
12	Aggregate, 2.36mm	cum	61.00	325.00	449.52	774.52
13	Crusher Dust	cum	61.00	150.00	449.52	599.52
14	Bricks 1st Class	1000 Nos	38.00	6500.00	-	6500.00
15	Sand	cum	60.00	775.00	409.68	1184.68
16	Bitumen emulsion(Medium)	mt	137.00	31258.50	274.00	31532.50
17	Bitumen(VG-30)	mt	137.00	42935.95	274.00	43209.95
18	Ordinary Portland Cement	mt	38.00	7400.00	198.00	7598.00
19	Gravel / Muram	m^3	5.00	40.00	72.00	112.00
20	Tor Steel Rod, HYSD / TMT bars FE 500	mt	38.00	49000	198.00	49198.00
21	Structural Steel (angles, tees)	mt	38.00	51000	198.00	51198.00
22	Strands (Steel)	mt	38.00	63700.00	198.00	63898.00
23	High Tensile Steel Wire	mt	38.00	63700.00	198.00	63898.00
24	Rough stone for revetment	cum		227.50	449.52	677.02
25	Mild Steel	mt	38.00	47000.00	198.00	47198.00
26	Shuttering Timber	cum		12000.00	300.00	12300.00
27	Sal ballies	m		25.00	0.50	25.50
28	Neoprene Bearing	cu.cm		0.55	0.02	0.57

Sl. No.	Description	Unit	Lead (km)	Basic Cost	Carrying Cost (Rs)	Total Cost (Rs)
29	110mm dia. PVC. pipe	m		150.00	3.00	153.00
30	150mm dia. PVC. pipe	m		260.00	4.00	264.00
31	2mm thick Copper plate	sqm		6960.00	122.00	7082.00
32(a)	20mm Compress. Fibre Board.	sqm		500.00	8.00	508.00
32(b)	12mm Compress. Fiber Board.	sqm		210.00	5.00	215.00
32 ©	6mm Compress. Fiber Board.	sqm		340.00	3.00	343.00
32(d)	5mm Compress. Fiber Board.	sqm		315.00	3.00	318.00
33	50mm dia. PVC. pipe	m		80.00	1.40	81.40
34	Diesel (ODL)	lit		55.00		55.00
35	Geofabric 500gsm	sqm		100.00	3.00	103.00
36	Bond stone	each		5.60	8.09	13.69
37	Gelatine 80 %	Kg		100.00	2.00	102.00
38	Detonator	Nos		6.00	0.12	6.12
39	Fuse wire	coil		180.00	3.60	183.60
40	Premoulded joint filler 20 mm	sqm		580.00	11.60	591.60
41	Hume pipe NP4 - 600 with Coller	m		2400.00	40.00	2440.00
42	Hume pipe NP4 - 900 with Coller	m		4050.00	40.00	4090.00
43	Hume pipe NP4 - 1000 with coller	m		4500.00	40.00	4540.00
44	Hume pipe NP4 - 1200 with coller	m		5300.00	40.00	5340.00
45	Hume pipe NP3 - 750 with Coller	m		2600.00	40.00	2640.00
46	Hume pipe NP3 - 600 with Coller	m		2400.00	40.00	2440.00
47	Hume pipe NP3 - 450 with Coller	m		2000.00	40.00	2040.00
48	6 mm Compress Fiber Board	sqm		340.00	3.00	343.00
49	CRMB 55	T	137.00	40555.50	274.00	40829.50
50	Bitumen Cutback MC 70	T	137.00	67626.00	274.00	67900.00
51	NP4 300 dia	m		2052.00	40.00	2092.00
52	NP4 450 dia	m		2280.00	40.00	0.00
53	B S Slab 10cms thick	sqm		230.00		230.00
54	Tubular steel railing as per MOST drg. BD/1-88 and Tech.Spec.Cl.1900,	m		1000.00	20.00	1020.00
55	Water	KL		30.00		30.00

Sl. No.	Description	Unit	Lead (km)	Basic Cost	Carrying Cost (Rs)	Total Cost (Rs)
56	Compensation of Earth	Cum		20.00	72.000	92.00
57	Manure	cum		110.00		110.00
58	Lime	T		4000.00	55.00	4055.00
59	Chequered Mosaic Tiles	each		12.00	0.20	12.20
60	Bitumen 80/100	T	137.00	50077.34	274.00	50351.34
61	Fly Ash	cum	0.00	50.00	66.000	116.00
62	Enamel Paint	lit		200.00	4.00	204.00
63	Admixture	Kg		60.00	1.20	61.20
64	Binding wire	Kg		45.00	0.80	45.80
65	Road marking paint	Kg		320.00	6.00	326.00
66	Tar Paper	Sqm		90.00	1.60	91.60
67	Carble Stone	Sqm		290.00	26.00	316.00
68	Solid concrete blocks, size 400x200x150mm	Each		29.9	0.00	29.90
69	M-35 grade RCC facia panels including reinforcement	sqm		5187.7	0.00	5187.72
70	Doob Grass	Kg		30.0		30.00
71	Fine Grass	Kg		7.0		7.00
72	Grass Seeds	Kg		120.0		120.00
73	Jute Netting	Sqm		12.0		12.00
74	Hedge Plant	Each		3.0		3.00
75	Pesticide	kg		200.0		200.00
76	Shrubs	each		2.0		2.00
77	Flowring Plant	each		2.5		2.50
78	Sapling 2m high 25mm dia	each		10.0		10.00
79	MS Sheet	Kg		34.0		34.00
80	Empty Bitumen Drum	each		100.0		100.00
81	Rivets	each		3.0		3.00
82	Steel Wire 3mm dia	kgs		45.0		45.00
83	Sapling 1 to 1.5m high 2cm dia	each		8.0		8.00
84	RCC NP2 200mm dia including collars	m		255.0		255.00
85	Separation Membrane of impermeable plastic sheeting 125	sqm		150.0		150.00

Sl. No.	Description	Unit	Lead (km)	Basic Cost	Carrying Cost (Rs)	Total Cost (Rs)
86	Joint sealant	kg		100.0		100.00
87	Sealant Primer	kg		100.0		100.00
88	Curing Compond	L		80.0		80.00
89	Super plasticizer admixture	kg		100.0		100.00
90	Geonets/Grides	Sqm		300.0		300.00
91	Perforated geosynthetic pipe 150 mm dia	m		250.0		250.00
92	Connectors/ Staples	each		5.0		5.00
93	Polymer braids	m		20.0		20.00
94	Geotextile filter fabric	sqm		75.0		75.00
95	Aluminium alloy plate,2 mm thick, fixed with high intensity grade	sqm		2600.0		2600.00
96	Hot applied thermoplastic compound	L		100.0		100.00
97	Reflectorising glass beads	kg		50.0		50.00
98	Cost of approved type of delineators from ISI certified firm as per the	each		250.0		250.00
99	Welded steel wire fabric 75x50 mm mesh @ 4 kg/sqm,4 x 30 x 1.2 + 5 per	kg		50.0		50.00
	Steel pipe 50 mm external dia as per IS:1239	m		55.0		55.00
100	Medium weight steel channel (ISMC series) 100 mm x 50 mm,10.8 metres	kg		34.0		34.00
101	Corrugated sheet,3 mm thick, "W" beam section railing,4.5 m in length	kg		45.0		45.00
102	Channel post 150 x 75 x 5 mm,1.8 m long,3 Nos @ 16.4 kg per metre	kg		35.0		35.00
103	Spacer 150 x 75 x 5 mm channel 0.33 m long,3 Nos @ 16.4 kg per metre	kg		34.0		34.00
104	Nuts and bolts	kg		37.0		37.00
105	RS Joist 100 x 75 mm - 16.5 m @ 11.5 kg per metre	kg		34.0		34.00
106	Struts - 2 Nos. for terminal posts,2 m long each 2 x 2 x 11.50	kg		34.0		34.00
107	Tie 2 Nos. of 8 mm steel plate,1.5 sqm each for terminal posts @ 62.80	kg		45.0		45.00
108	Steel wire rope 40 mm, including 7.50 per cent extra for fixing at ends 15 x 4	kg		45.0		45.00
109	25 mm steel pipe	m		200.0		200.00
110	MS sheet for 600 x 300 x 3 mm rectangular vane, one number @	kg		34.0		34.00
111	MS sheet for 250 mm dia circular vane 3 mm thick,4 numbers @ 24 kg/sqm	kg		34.0		34.00
112	Steel circular hollow pole of standard specification for street lighting to	each		4500.0		4500.00
113	Sodium vapour lamp	each		1200.0		1200.00
114	Alluminium alloy/galvanised steel including 5 per cent wastage	tonne		46000.0		46000.00

Sl. No.	Description	Unit	Lead (km)	Basic Cost	Carrying Cost (Rs)	Total Cost (Rs)
115	Scrap tyres of size 900 x 20	Nos		200.0		200.00
116	20 mm steel wire rope	kg		38.0		38.00
117	Plastic tubes 50 cm dia,1.2 m high	Nos		25.0		25.00
118	Aluminium studs 100 x 100 mm fitted with lense reflectors	Nos		200.0		200.00
119	Traffic cones with 150 mm reflective sleeve	each		400.0		400.00
120	Angle iron 45 x 45 x 5 mm	kg		45.0		45.00
121	Steel drum 300 mm dia 1.2 m high/empty bitumen drum	Nos		600.0		600.00
122	Flag of red color cloth 600 x 600 mm	each		20.0		20.00
123	Wooden staff for fastening of flag 25 mm dia, one m long	each		5.0		5.00
124	Sand bags	each		50.0		50.00
125	M35 grade RCC corbel provided for supporting of equipment (Dimensions	cum		4200.0		4200.00
126	PTFE sliding plate bearing assembly of 80 tonnes design load capacity duly	Nos		70000.0		70000.00
127	Cast steel rocker bearing assembly of 250 tonne design load capacity duly	Nos		70000.0		70000.00
128	Forged steel roller bearing of 250 tonne design load capacity duly	Nos		3000.0		3000.00
129	Elastomeric bearing assembly consisting of 7 layers of elastomer	Nos		8000.0		8000.00
130	G.I. Pipe 100mm dia	m		540.0		540.00
131	Helical pipes 600mm diameter	m		150.0		150.00
132	Trailor 30tonne capacity	hr		1000.0		1000.00
133	Tie rods 20mm diameter	Nos		50.0		50.00
134	Supply of elastomeric slab seal expansion joint assembly	m		12000.0		12000.00
135	Strip Seal expansion joint	m		11500.0		11500.00
136	Box Seal Joint	m		5400.0		5400.00
137	Box Seal Joint 3modules	m		6500.0		6500.00
138	ISMC 100 = 2.806 x 1.05 = 2.946 MT	tonne		38000.0		38000.00
139	MS Flat = 0.964 x 1.05 = 1.012 MT	tonne		36000.0		36000.00
140	MS bars = 0.17 x 1.05 = 0.180 MT	tonne		40000.0		40000.00
141	MS bolts, nuts and washers	tonne		36000.0		36000.00
142	Copper plate - 12m long x 250 mm wide	kg		400.0		400.00
143	Accelerator compound for guniting	kg		20.0		20.00
144	Nipples	each		10.0		10.00

Sl. No.	Description	Unit	Lead (km)	Basic Cost	Carrying Cost (Rs)	Total Cost (Rs)
145	Pre-packed polymer concrete based on epoxy system complete with	kg		10.0		10.00
146	Quick setting compound	kg		30.0		30.00
147	Acrylic polymer bonding coat	L		1000.0		1000.00
148	pre-packed cement based polymer mortar of strength 45 Mpa at 28 days	kg		200.0		200.00
149	Tube anchorage set complete with bearing plate, permanent wedges etc	Nos		12000.0		12000.00
150	Epoxy resin with pot life not less than 60-90 minutes and satisfying testing	kg		500.0		500.00
151	MS plates for deviator (where deviator blocks are not provided)	tonne		40000.0		40000.00
152	Wire mesh 50mm x 50mm size of 3mm wire	kg		35.0		35.00
	Pond Ash	Cum	0.00	18.1	66.00	84.12

Feasibility cum Geo-Technical Study for the bypass to Shiradi Ghat from km 238.00 to 261.45 on NH-48 in the State of Karnataka

TOTAL LENGTH =23.6 Kms

Sl.No.	Material/Quarry Locations with respect to Road Chinage	Distance from Quarry to Road in KM	Distance on Road to Plant for Aggregate/Stones on Road in KM	Total Distance in KM
	Granite Stones / Aggregate			
	Plant @ Ch 250+000 (Km 0+000)			
1	Granite Stones / Aggregate			
	Quarry Q1 of Road @ Ch: 0+000 (Km 238+000)	60.00	60.00	
	To Plant @ Ch: 12+000 (Km 250+000)		-	
	Total Lead			***60.00***
2	Stone Dust			
	Quarry Q1 of Road @ Ch: 0+000 (Km 238+000)	60.00	60.00	
	To Plant @ Ch: 12+000 (Km 250+000)		-	
	Total Lead			***60.00***
			Average to Plant 1	**60.00**
			Average Lead For Road	**60.50**
			SAY	**61.00**
	Sand To Road			
1	Sand Quarry 1 of Road @ Ch: --------- (Km)	58.00	58.00	
	On Road (Km to Km)		-	
	Average			58.00
			Average Lead For Road	**58.00**
			SAY	**60.00**
	Morrum / Earth to Road			
			Average Lead For Road	**5.00**
	Cement, Steel & Bricks			
			Average Lead For Road	**38.00**
	Bitumen (From Mangalore)			
1	Plant 1 @ Ch 12+000 (Km 250+000)			
	Mangalore to Road @ 150.000	125.00	125.00	
	To Plant 1		12.00	
			Average to Plant 1	**137.00**
			Average Lead For Road	**137.00**
	Fly Ash	N/A		
2	At Km 355+00 to Road	-		
	Average to Road		-	
	On Road		-	
	To Road			-
			Average Lead For Road	**-**

Abstract

Item	Lead (km)
Stone (aggregates)	61.00
Sand	60.00
Earth	5.00
Steel, Brick & Cement	38.00
Bitumen	137.00
Flyash	-

LEAD STATEMENT

Sl. No	Description	Unit	Lead (km)	Royalty Charges	Loading / Unloading	Lead Charges per kms	Lead charges			Total Lead Charges including Loading / Unloading / Royalty
							Distance	Rate per km	Amount	
1	Granite aggr / stone	cum	61.00	120.00	66.00	4.32	61.00	4.32	263.52	**449.52**
2	River sand	cum	60.00	96.00	66.00	4.13	60.00	4.13	247.68	**409.68**
3	Muram / Earth	cum	5.00	35.00	22.00	3.00	5.00	3.00	15.00	**72.00**
4	Cement	T	38.00	0.00	122.00	2.00	38.00	2.00	76.00	**198.00**
5	Steel	T	38.00	0.00	122.00	2.00	38.00	2.00	76.00	**198.00**
6	Bricks	1000 no	38.00	114.00	29.00	9.50	38.00	9.50	361.00	**504.00**
7	Bitumen 60 / 70	T	137.00	0.00	0.00	2.00	137.00	2.00	274.00	**274.00**
8	CRMB, Emulsion from panipat	T	137.00	0.00	0.00	2.00	137.00	2.00	274.00	**274.00**
9	Fly Ash	Cum	0.00	0.00	66.00	3.00	0.00	3.00	0.00	**66.00**
10	Granite aggr / stone for GSB & WMM	Cum	61.00	120.00	66.00	4.32	61.00	4.32	263.52	**449.52**
11	Fly Ash	Cum	0.00	0.00	66.00	3.00	0.00	3.00	0.00	**66.00**

This softawre is based on Standard Data book for analysis of Rates for Road and Bridge Works

This Software runs on Microsoft Excel

INPUT- Input the usage rates of Plant & Machinery, labour and material as applicable

SUMMARY - In this sheet summary of all the rates analysized is presented

ANALYSIS- The analysis has been presented in 16 nos. of spread sheets

Worksheet- 1 : CHAPTER-1 CARRIAGE OF MATERIALS
Worksheet- 2 : CHAPTER-2 SITE CLEARANCE
Worksheet- 3 : CHAPTER-3 EARTH WORK, EROSION CONTROL AND DRAINAGE
Worksheet- 4 : CHAPTER-4 SUB-BASES, BASES (NON- BITUMINOUS) AND SHOULDERS
Worksheet- 5 : CHAPTER-5 BASES AND SURFACE COURSES (BITUMINOUS)
Worksheet- 6 : CHAPTER-6 CEMENT CONCRETE PAVEMENTS
Worksheet- 7 : CHAPTER-7 GEOSYNTHETICS AND REINFORCED EARTH
Worksheet- 8 : CHAPTER-8 TRAFFIC SIGNS, MARKINGS & OTHER ROAD APPURTENANCES
Worksheet- 9 : CHAPTER-9 PIPE CULVERTS
Worksheet- 10 : CHAPTER-10 MAINTENANCE OF ROADS
Worksheet- 11 : CHAPTER-11 HORTICULTURE
Worksheet- 12 : CHAPTER-12 FOUNDATIONS
Worksheet- 13 : CHAPTER-13 SUB-STRUCTURE
Worksheet- 14 : CHAPTER-14 SUPER-STRUCTURE
Worksheet- 15 : CHAPTER-15 RIVER TRAINING AND PROTECTION WORKS
Worksheet- 16 : CHAPTER-16 REPAIR AND REHABILITATION

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
	CHAPTER-1		
	CARRIAGE OF MATERIALS		
1.1	Loading and unloading of stone boulder / stone aggregates / sand / kanker / moorum. (Placing tipper at loading point, loading with front end loader, dumping, turning for return trip, excluding time for haulage and return trip)	cum	66.00
1.2	Loading and Unloading of Boulders by Manual Means	cum	91.00
1.3	Loading and Unloading of Cement or Steel by Manual Means and stacking.	tonne	122.00
1.4	Cost of Haulage Excluding Loading and Unloading		
(i)	Surfaced Road	tonne.km	2.00
(ii)	Unsurfaced Gravelled Road	tonne.km	2.40
(iii)	Katcha Track and Track in river bed / nallah bed and choe bed.	tonne.km	4.50
1.5	Hand Broken Stone Aggregates 63 mm nominal size (Supply of quarried stone, hand breaking into coarse aggregate 63 mm nominal size (passing 80 mm and retained on 50 mm sieve) and stacking as directed)	cum	634.00
1.6	Crushing of stone aggregates 13.2 mm nominal size. (Crushing of stone boulders of 150 mm size in an integrated stone crushing unit of 200 tonnes per hour capacity comprising of primary and secondary crushing units, belt conveyor and vibrating screens to obtain stone aggregates of 13 mm nominal size.)	cum	507.00
1.7	Crushing of stone aggregates 20 mm nominal size (Crushing of stone boulders of 150 mm size in an integrated stone crushing unit of 200 tonnes per hour capacity comprising of primary and secondary crushing units, belt conveyor and vibrating screens to obtain stone aggregates of 20 mm nominal size.)	cum	430.00
1.8	Crushing of stone aggregates 40 mm nominal size (Crushing of stone boulders of 150 mm size in an integrated stone crushing unit of 200 tonnes per hour capacity comprising of primary and secondary crushing units, belt conveyor and vibrating screens to obtain stone aggregates of 40 mm nominal size.)	cum	300.00
	CHAPTER-2		
	SITE CLEARANCE		
2.1	Cutting of Trees, including Cutting of Trunks, Branches and Removal (Cutting of trees, including cutting of trunks, branches and removal of stumps, roots, stacking of serviceable material with all lifts and up to a lead of 1000 mtrs and earth filling in the depression/pit.)		
(i)	Girth from 300 mm to 600 mm	each	218.00
(ii)	Girth from 600 mm to 900 mm	each	382.00
(iii)	Girth from 900 mm to 1800 mm	each	755.00
(iv)	Girth above 1800 mm	each	1442.00
2.2	Clearing Grass and Removal of Rubbish	hectare	15488.00
2.3	Clearing and Grubbing Road Land . (Clearing and grubbing road land including uprooting rank vegetation, grass, bushes, shrubs, saplings and trees girth up to 300 mm, removal of stumps of trees cut earlier and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned up to a lead of 1000 metres including removal and disposal of top organic soil not exceeding 150 mm in thickness.)		
(i)	By Manual Means:-		
A	In area of light jungle	hectare	46803.00
B	In area of thorny jungle	hectare	62630.00
(ii)	By Mechanical Means		
A	In area of light jungle	hectare	20514.00
B	In area of thorny jungle	hectare	25091.00
2.4	Dismantling of Structures (Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts and lead of 1000 metres)		
(i)	Lime /Cement Concrete		
I	By Manual Means		
A	Lime Concrete, cement concrete grade M-10 and below	cum	321.00
B	Cement Concrete Grade M-15 & M-20	cum	383.00
C	Prestressed / Reinforced cement concrete grade M-20 & above	cum	1002.00
II	By Mechanical Means for items No. 202(b) & (c)		
A	Cement Concrete Grade M-15 & M-20	cum	365.00
B	Prestressed / Reinforced cement concrete grade M-20 & above	cum	610.00
(ii)	Dismantling Brick / Tile work		
A	In lime mortar	cum	197.00
B	In cement mortar	cum	259.00
C	In mud mortar	cum	180.00
D	Dry brick pitching or brick soling	cum	160.00

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
(iii)	*Dismantling Stone Masonry*		
A	*Rubble stone masonry in lime mortar*	cum	222.00
B	*Rubble stone masonry in cement mortar.*	cum	259.00
C	*Rubble Stone Masonry in mud mortar.*	cum	197.00
D	*Dry rubble masonry*	cum	185.00
E	*Dismantling stone pitching/ dry stone spalls.*	cum	172.00
F	*Dismantling boulders laid in wire crates including opening of crates and stacking dismantled materials.*	cum	197.00
(iv)	*Wood work wrought framed and fixed in frames of trusses upto a height of 5 m above plinth level*	cum	447.00
(v)	*Steel work in all types of sections upto a height of 5 m above plinth level excluding cutting of rivet.*		
A	*Including dismembering*	tonne	1169.00
B	*Excluding dismembering.*	tonne	892.00
C	*Extra over item No(V) A and(V) B for cutting rivets.*	tonne	8.00
(vi)	*Scraping of bricks dismantled from brick work including stacking.*		
A	*In lime/Cement mortar*	1000 numbers	1084.00
B	*In mud mortar*	1000 numbers	387.00
(vii)	*Scraping of Stone from dismantled stone masonry*		
A	*In cement and lime mortar*	cum	435.00
B	*In Mud mortar*	cum	92.00
(viii)	*Scarping plaster in lime or cement mortar from brick/ stone masonry*	sqm	13.00
(ix)	*Removing all type of hume pipes and stacking within a lead of 1000 metres including earthwork and dismantling of masonry works.*		
A	*Up to 600 mm dia*	metre	161.00
B	*Above 600 mm to 900 mm dia*	metre	217.00
C	*Above 900 mm*	metre	372.00
2.5	*Dismantling of Flexible Pavements (Dismantling of flexible pavements and disposal of dismantled materials up to a lead of 1000 metres, stacking serviceable and unserviceable materials separately)*		
I	*By Manual Means*		
A	*Bituminous courses*	cum	593.00
B	*Granular courses*	cum	422.00
II	*By Mechanical Means*		
A	*Bituminous course*	cum	227.00
2.6	*Dismantling of Cement Concrete Pavement (Dismantling of cement concrete pavement by mechanical means using pneumatic tools, breaking to pieces not exceeding 0.02 cum in volume and stock piling at designated locations and disposal of dismantled materials up to a lead of 1000 metres, stacking serviceable and unserviceable materials separately)*	cum	1058.00
2.7	*Dismantling Guard Rails (Dismantling guard rails by manual means and disposal of dismantled material with all lifts and up to a lead of 1000 metres, stacking serviceable materials and unserviceable materials separately.)*	metre	63.00
2.8	*Dismantling Kerb Stone (Dismantling kerb stone by manual means and disposal of dismantled material with all lifts and up to a lead of 1000 metre)*	metre	12.00
2.9	*Dismantling Kerb Stone channel (Dismantling kerb stone channel by manual means and disposal of dismantled material with all lifts and up to a lead of 1000 metre)*	metre	18.00
2.10	*Dismantling Kilometre Stone (Dismantling of kilometre stone including cutting of earth, foundation and disposal of dismantled material with all lifts and lead upto 1000 m and back filling of pit.)*		
A	*5th KM stone*	each	316.00
B	*Ordinary KM Stone*	each	189.00
C	*Hectometre Stone*	each	38.00
2.11	*Dismantling of Fencing (Dismantling of barbed wire fencing/ wire mesh fencing including posts, foundation concrete, back filling of pit by manual means including disposal of dismantled material with all lifts and up to a lead of 1000 metres, stacking serviceable material and unserviceable material separately.)*	metre	40.00
2.12	*Dismantling of CI Water Pipe Line (Dismantling of CI water pipe line 600 mm dia including disposal with all lifts and lead upto 1000 metres and stacking of serviceable material and unserviceable material separately under supervision of concerned department)*	metre	92.00
2.13	*Removal of Cement Concrete Pipe of Sewer Gutter (Removal of cement concrete pipe of sewer gutter 1500 mm dia under the supervision of concerned department including disposal with all lifts and up to a lead of 1000 metres and stacking of serviceable and unserviceable material separately but excluding earth excavation and dismantling of masonry works.)*	metre	113.00
2.14	*Removal of Telephone / Electric Poles and Lines (Removal of telephone / Electric poles including excavation and dismantling of foundation concrete and lines under the supervision of concerned department, disposal with all lifts and up to a lead of 1000 metres and stacking the serviceable and unserviceable material separately)*	each	141.00
	CHAPTER-3		
	EARTH WORK, EROSION CONTROL AND DRAINAGE		

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
3.1	*Excavation in Soil by Manual Means. (Excavation for roadway in soil using manual means including loading in truck for carrying of cut earth to embankment site with all lifts and lead upto1000 metres.)*	cum	140.00
3.2	*Excavation in ordinary rock by manual means (Excavation in ordinary rock using manual means including loading in a truck and carrying of excavated material to embankment site with in all lifts and leads upto 1000 metres)*	cum	205.00
3.3	*Excavation in Soil with Dozer with lead upto 100 metres (Excavation for road way in soil by mechanical means including cutting and pushing the earth to site of embankment upto a distance of 100 metres (average lead50 metres), including trimming bottom and side slopes in accordance with requirements of lines, grades and cross sections.)*	cum	110.00
3.4	*Excavation in Ordinary Rock with Dozer with lead upto 100 metres (Excavation for roadway in ordinary rock by deploying a dozer, 80 HP including cutting and pushing the cut earth to site of embankment upto a distance of 100 metres (average lead 50 metres), trimming bottom and side slopes in accordance with the requirements of lines, grades and cross sections.)*	cum	186.00
3.5	*Excavation in Hard Rock (requiring blasting) with disposal upto 1000 metres (Excavation for roadway in hard rock (requiring blasting) by drilling, blasting and breaking, trimming of bottom and side slopes in accordance with requirements of lines, grades and cross sections, loading and disposal of cut road with in all lifts and leads upto 1000 metres)*	cum	204.00
3.6	*Excavation in Soil using Hydraulic Excavator CK 90 and Tippers with disposal upto 5000 metres. (Excavation for roadwork in soil with hydraulic excavator of0.9 cum bucket capacity including cutting and loading in tippers, trimming bottom and side slopes, in accordance with requirements of lines, grades and cross sections, and transporting to the embankment location within all lifts and lead upto 1000m)*	cum	50.50
3.7	*Excavation in Ordinary Rockusing Hydraulic ExcavatorCK-90 and Tippers with disposal upto 5000 metres. (Excavation for roadway in ordinary rock with hydraulic excavator of 0.9 cum bucket capacity including cutting and loading in tippers, transporting to embankment site within all lifts and lead upto 1000 m, trimming bottom and side slopes in accordance with requirements of lines, grades and cross sections.)*	cum	61.50
3.8	*Excavation in Hard Rock (blasting prohibited) (Excavation for roadway in hard rock (blasting prohibited) with rock breakers including breaking rock, loading in tippers and disposal within all lifts and lead upto 1000 metres, trimming bottom and side slopes in accordance with requirements of lines, grades and cross sections.)*		
A	*Mechanised*	cum	374.50
B	*Manual Method*	cum	894.50
3.9	*Excavation in Hard Rock (controlled blasting) with disposal upto 1000 metres (Excavation for roadway in hard rock with controlled blasting by drilling, blasting and breaking, trimming of bottom and side slopes in accordance with requirements of lines, grades and cross sections, loading and disposal of cut road with in all lifts and leads upto 1000 metres)*	cum	258.50
3.10	*Excavation in Marshy Soil (Excavation for roadway in marshy soil with hydraulic excavator 0.9 cum bucket capacity including cutting and loading in tippers and disposal with in all lifts and lead upto 1000 metres, trimming of bottom and side slopes in accordance with requirements of lines, grades and cross sections.)*	cum	40.00
3.11	*Removal of Unserviceable Soil with Disposal upto 1000 metres (Removal of unserviceable soil including excavation, loading and disposal upto 1000 metres lead but excluding replacement by suitable soil which shall be paid separately as per clause 305.)*	cum	35.00
3.12	*Pre-splitting of Rock Excavation Slopes (Carrying out excavation in hard rock to achieve a specified slope of the rock face by controlled use of explosives and blasting accessories in properly aligned and spaced drill holes, collection of the excavated rock by a 80 HP dozer, loading in tipper by a front end loader and disposing of the material with all lifts and lead upto 1000 m, all as specified in clause No. 303)*	sqm	101.00
3.13	*Excavation for Structures (Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom, backfilling the excavation earth to the extent required and utilising the remaining earth locally for road work.)*		
(i)	*Ordinary soil*		
A	*Manual Means (Depth upto 3 m)*	cum	248.00
B	*Mechanical Means (Depth upto 3 m)*	cum	33.00
(ii)	*Ordinary rock (not requiring blasting)*		
A	*Manual Means (Depth upto 3 m)*	cum	310.00
B	*Mechanical Means*	cum	42.00
(iii)	*Hard rock (requiring blasting)*		
A	*Manual Means*	cum	485.00
(iv)	*Hard rock (blasting prohibited)*		
A	*Mechanical Means*	cum	466.00
(v)	*Marshy soil*		
A	*Manual means (upto 3 m depth)*	cum	468.00
B	*Mechanical Means*	cum	163.00
3.14	*Scarifying Existing Granular Surface to a Depth of 50 mm by Manual Means (Scarifying the existing granular road surface to a depth of 50 mm and disposal of scarified material within all lifts and leads upto 1000 metres.)*	sqm	21.00
3.15	*Scarifying existing bituminous surface to a depth of 50 mm by mechanical means (Scarifying the existing bituminous road surface to a depth of 50 mm and disposal of scarified material with in all lifts and lead upto 1000 metres.)*	sqm	3.00

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
3.16	*Embankment Construction with Material Obtained from Borrow Pits (Construction of embankment with approved material obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-2)*	cum	244.00
3.16A	*Construction of Embankment with 20% Flyash*	Cum	244.00
3.16B	*Construction of Embankment with 20% Pond ash*	Cum	236.00
~~*3.16C*~~	~~Construction of Embankment with Material obtained from Borrowpits (80% from Private road side land & 20% from Approved Quarry)~~	~~Cum~~	~~250.00~~
3.17	*Construction of Embankment with Material Deposited from Roadway Cutting (Construction of embankment with approved materials deposited at site from roadway cutting and excavation from drain and foundation of other structures graded and compacted to meet requirement of table 300-2)*	cum	82.00
3.18	*Construction of Subgrade and Earthen Shoulders (Construction of subgrade and earthen shoulders with approved material obtained from borrow pits with all lifts & leads, transporting to site, spreading, grading to required slope and compacted to meet requirement of table No. 300-2)*	cum	270.00
3.18A	Construction of Subgrade and Earthen Shoulders with 20% flyash	Cum	270.00
3.18B	Construction of Subgrade and Earthen Shoulders with 20% pond ash	Cum	262.00
~~*3.18C*~~	~~*Construction of subgrade with approved materials deposited at site from roadway cutting and excavation from drain and foundation of other structures graded and compacted to meet requirement of table 300-2.*~~	~~cum~~	~~96.00~~
3.19	*Compacting Original Ground*		
Case-I	*Compacting original ground supporting subgrade (Loosening of the ground upto a level of500 mm below the subgrade level, watered, graded and compacted in layers to meet requirement of table 300-2 for subgrade construction.)*	cum	53.00
Case-II	*:Compacting original ground supporting embankment*	cum	28.00
3.20	*Stripping and Storing Top Soil (Stripping, storing of top soil by road side at 15 m internal and re-application on embankment slopes, cut slopes and other areas in localities where the available embankment material is not conducive to plant growth)*	cum	187.00
3.21	*Stripping, storing and re-laying top soil from borrow areas in agriculture fields. (Stripping of top soil from borrow areas located in agriculture fields, storing at a suitable place, spreading and re-laying after taking the borrow earth to maintain fertility of the agricultural field, finishing it to the required levels and satisfaction of the farmer.)*	cum	66.00
3.22	*Turfing with Sods (Furnishing and laying of the live sods of perennial turf forming grass on embankment slope, verges or other locations shown on the drawing or as directed by the engineer including preparation of ground, fetching of rods and watering)*	sqm	26.00
3.23	*Seeding and Mulching (Preparation of seed bed on previously laid top soil, furnishing and placing of seeds, fertilizer, mulching material, applying bituminous emulsion at the rate of0.23 litres per sqm and laying and fixing jute netting, including watering for 3 months all as per clause 308)*	sqm	83.00
3.24	*Surface Drains in Soil (Construction of unlined surface drains of average cross sectional area 0.40 sqm in soil to specified lines, grades, levels and dimensions to the requirement of clause 301 and 309. Excavated material to be used in embankment within a lead of50 metres (average lead 25 metres))*		
A	*Mechanical means*	metre	48.00
B	*Manual Means*	metre	62.00
3.25	*Surface Drains in Ordinary Rock (Construction of unlined surface drain of average cross sectional area 0.4 sqm in ordinary rock to specified lines, grades, levels and dimensions as per approved design and to the requirement of clause 301 to 309. Excavated material to be used in embankment at site.)*		
A	*Mechanical Means*	metre	97.00
B	*Manual Means*	metre	93.00
3.26	*Surface Drains in Hard Rock (Rate per metre may be worked out based on quantity of hard rock as per design.)*	metre	
3.27	*Sub Surface Drains with Perforated Pipe (Construction of subsurface drain with perforated pipe of 100 mm internal diameter of metal/ asbestos cement/ cement concrete/PVC, closely jointed, perforations ranging from 3 mm to 6 mm depending upon size of material surrounding the pipe, with 150 mm bedding below the pipe and 300 mm cushion above the pipe, cross section of excavation 450 x 550 mm. Excavated material to be utilised in roadway at site)*		432.00
3.28	*Aggregate Sub- Surface Drains (Construction of aggregate sub surface drain 300 mm x 450 mm with aggregates conforming to table 300-4, excavated material to be utilised in roadway)*	metre	130.00
3.29	*Underground Drain at Edge of Pavement (Construction of an underground drain 1 m x 1 m (inside dimensions) lined with RCC-20 cm thick and covered with RCC slab10 cm in thickness on urban roads)*	metre	#NAME?
3.30	*Preparation and Surface Treatment of formation. (Preparation and surface treatment of formation by removing mud and slurry, watering to the extent needed to maintain the desired moisture content, trimming to the required line, grade, profile and rolling with 8-10 tonne smooth wheeled roller, complete as per clause 310.)*	sqm	2.00
3.31	*Construction of Rock fill Embankment (Construction of rock fill embankment with broken hard rock fragments of size not exceeding 300 mm laid in layers not exceeding 500 mm thick including filling of surface voids with stone spalls, blinding top layer with granular material, rolled with vibratory road roller, all complete as per clause 313)*	cum	39.00
3.32	*Excavation in Hill Area in Soil by Mechanical Means (Excavation in soil in hilly area by mechanical means including cutting and trimming of side slopes and disposing of excavated earth with all lifts and lead upto 1000 metres)*	cum	112.00

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
3.33	*Excavation in Hilly Area in Ordinary Rock by Mechanical Means not Requiring Blasting. (Excavation in hilly area in ordinary rock not requiring ballasting by mechanical means including cutting and trimming of slopes and disposal of cut material with all lift and lead upto 1000 metres)*	cum	170.00
3.34	*Excavation in Hilly Areas in Hard Rock Requiring Blasting (Excavation in hilly areas in hard rock requiring blasting, by mechanical means including trimming of slopes and disposal of cut material with all lifts and lead upto 1000 metres.)*	cum	219.00
3.35	*Work in Urban Roads (The cost of earth work in urban roads inhabited area will be comparatively higher due to following reasons:)*		
3.36	*Embankment Construction with Fly ash/Pond ash available from coal or lignite burning Thermal Plants as waste material. (Construction of embankment with fly ash conforming to table 1 of IRC: SP: 58 - 2001 obtained from coal or lignite burning thermal power stations as waste material, spread and compacted in layer of 200mm thickness each at OMC, all as specified in IRC: SP: 58-2001 and as per approved plans.)*	cum	236.00
	CHAPTER-4		
	SUB-BASES, BASES (NON- BITUMINOUS) AND SHOULDERS		
4.1	*Granular Sub-base with Close Graded Material (Table:- 400-1)*		
A	*Plant Mix Method (Construction of granular sub-base by providing close graded Material, mixing in a mechanical mix plant at OMC, carriage of mixed Material to work site, spreading in uniform layers with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per clause 401)*		
(i)	*for grading- I Material*	cum	1540.00
(ii)	*for grading- II Material*	cum	1508.00
(iii)	*for grading-III Material*	cum	1453.00
B	*By Mix in Place Method (Construction of granular sub-base by providing close graded material, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per clause 401)*		
(i)	*for grading- I Material*	cum	1395.00
(ii)	*for grading- II Material*	cum	1363.00
(iii)	*for grading-III Material*	cum	1308.00
4.2	*Granular Sub-Base with Coarse Graded Material (Table:- 400- 2) (Construction of granular sub-base by providing coarse graded material, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per clause 401)*		
(i)	*for grading- I Material*	cum	1413.00
(ii)	*for grading- II Material*	cum	1409.00
(iii)	*for grading-III Material*	cum	1293.00
4.3	*Lime Stabilisation for Improving Subgrade (Laying and spreading available soil in the subgrade on a prepared surface, pulverising, mixing the spread soil in place with rotavator with 3 % slaked lime having minimum content of 70% of CaO, grading with motor grader and compacting with the road roller at OMC to the desired density to form a layer of improved sub grade)*		
A	*By Mechanical Means*	cum	372.00
B	*By Manual Means*	cum	389.00
4.4	*Lime Treated Soil for Sub- Base (Providing, laying and spreading soil on a prepared sub grade, pulverising, mixing the spread soil in place with rotavator with 3 % slaked lime with minimum content of 70% of CaO, grading with motor grader and compacting with the road roller at OMC to achieve at least 98%of the max dry density to form a layer of sub base.)*	cum	433.00
4.5	*Cement Treated Soil Sub Base/ Base (Providing, laying and spreading soil on a prepared sub grade, pulverising, adding the designed quantity of cement to the spread soil, mixing in place with rotavator, grading with the motor grader and compacting with the road roller at OMC to achieve the desired unconfined compressive strength and to form a layer of sub-base/base.)*	cum	820.00
4.6	*Cement Treated Crushed Rock or combination as per clause 403.2 and table 400.4in Sub base/ Base (Providing, laying and spreading Material on a prepared sub grade, adding the designed quantity of cement to the spread Material, mixing in place with rotavator, grading with the motor grader and compacting with the road roller at OMC to achieve the desired unconfined compressive strength and to form a layer of sub-base/base.)*		
(i)	For Sub-Base course	cum	2128.00
(ii)	For Base course	cum	2100.00
4.7	*Making 50 mm x 50 mm Furrows (Making 50 mm x 50 mm furrows, 25mm deep, 450 to the center line of the road and at one metre interval in the existing thin bituminous wearing coarse including sweeping and disposal of excavated material within 1000 metres lead)*	sqm	69.00
4.8	*Inverted Choke (Construction of inverted choke by providing, laying, spreading and compacting screening B type/ coarse sand of specified grade in uniform layer on a prepared surface with motor grader and compacting with power roller etc)*	cum	1790.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
4.9	Water Bound Macadam (Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density.)		
A	By Manual Means		
(i)	Grading- I (Using Screening Crushable type such as Moorum or Gravel)		
(a)	Using Screening Crushable type such as Moorum or Gravel	cum	1657.00
(b)	Using Screening Type-A (13.2mm Agg.)	cum	1823.47
(ii)	Grading- II (Using Screening Crushable type such as Moorum or Gravel)		
(a)	Using Screening Crushable type such as Moorum or Gravel	cum	1732.00
(b)	Using Screening Type-A (13.2mm Agg.)	cum	1858.00
(c)	Using Screening Type-B (11.2mm Agg.)	cum	1937.00
(iii)	Grading- III (Using Screening Crushable type such as Moorum or Gravel)		
(a)	Using Screening Crushable type such as Moorum or Gravel	cum	1811.00
(b)	Using Screening Type-B (11.2mm Agg.)	cum	2016.00
B	By Mechanical Means:		
(i)	Grading- I (Using Screening Crushable type such as Moorum or Gravel)		
(a)	Using Screening Crushable type such as Moorum or Gravel	cum	1549.00
(b)	Using Screening Type-A (13.2mm Agg.)	cum	1782.53
(ii)	Grading- II (Using Screening Crushable type such as Moorum or Gravel)		
(a)	Using Screening Crushable type such as Moorum or Gravel	cum	1548.00
(b)	Using Screening Type-A (13.2mm Agg.)	cum	1675.00
(c)	Using Screening Type-B (11.2mm Agg.)	cum	1753.00
(iii)	Grading- III (Using Screening Crushable type such as Moorum or Gravel)		
(a)	Using Screening Crushable type such as Moorum or Gravel	cum	1622.00
(b)	Using Screening Type-B (11.2mm Agg.)	cum	1826.00
4.10	Crushed Cement Concrete Sub-base / Base (Breaking and crushing of material obtained by breaking damaged cement concrete slabs to size range not exceeding 75 mm as specified in table 400.7 transporting the aggregates obtained from breaking of cement concrete slabs at a lead of L km., laying and compacting the same as sub base/ base course, constructed as WBM to clause 404 except the use of screening or binding Material.)	cum	238.00
4.11	Penetration Coat Over Top Layer of Crushed Cement Concrete Base (Spraying of bitumen over cleaned dry surface of crushed cement concrete base at the rate of 25 kg per 10 sqm by a bitumen pressure distributor, spreading of key aggregates at the rate of 0.13 cum per 10 sqm by a mechanical gritter and rolling the surface as per clause 506.3.8)	sqm	19.00
4.12	Wet Mix Macadam (Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the Material with water at OMC in mechanical mix plant carriage of mixed Material by tipper to site, laying in uniform layers with paver in sub- base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density.)	cum	1729.00
4.13	Construction of Median and Island with Soil Taken from Roadway Cutting (Construction of Median and Island above road level with approved material deposited at site from roadway cutting and excavation for drain and foundation of other structures, spread, graded and compacted as per clause 407)	cum	207.00
4.14	Construction of Median and Island with Soil Taken from Borrow Areas (Construction of median and Island above road level with approved material brought from borrow pits, spread, sloped and compacted as per clause 407)	cum	349.00
4.15	Construction of Shoulders (A. Earthen Shoulders)		
4.16	Footpaths and Separators (Construction of footpath/separator by providing a 150 mm compacted granular sub base as per clause 401 and 25 mm thick cement concrete grade M15, over laid with precast concrete tiles in cement mortar 1:3 including provision of all drainage arrangements but excluding kerb channel..)	sqm	669.00
4.17	Crusher Run Macadam Base (Providing crushed stone aggregate, depositing on a prepared surface by hauling vehicles, spreading and mixing with a motor grader, watering and compacting with a vibratory roller to clause 410 to form a layer of sub-base/Base)		
A	By Mix in Place Method		
(i)	For 53 mm maximum size	cum	1460.00
(ii)	For 45 mm maximum size	cum	1382.00
B	By Mixing Plant :		
(i)	For 53 mm maximum size	cum	1566.00
(ii)	For 45 mm maximum size	cum	956.00
4.18	Lime, Fly ash stabalised soil sub-base (Construction of Sub-base using lime - fly ash admixture with granular soil, free from organic matter/ deleterious material or clayey silts and low plasticity clays having PI between 5 and 20 and liquid limit less than 25 and commercial dry lime, slaked at site or pre-slaked with CaO content not less than 50%, fly ash to conform to gradation as per clause 4.3 of IRC: 88-1984, lime + fly ash content ranging between 10 to 30%, the minimum un-confined compressive strength and CBR value after 28 days curing and 4 days soaking to be 7.5kg/sq, cm and 25% respectively, all as specified in IRC: 88-1984.)	cum	485.00
	CHAPTER-5		
	BASES AND SURFACE COURSES (BITUMINOUS)		

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
5.1	*Prime coat (Providing and applying primer coat with bitumen emulsion on prepared surface of granular Base including clearing of road surface and spraying primer at the rate of 0.60 kg/sqm using mechanical means.)*	sqm	24.00
5.2	*Tack coat*		
	Providing and applying tack coat with bitumen emulsion using emulsion pressure distributor at the rate of 0.20 kg per sqm on the prepared bituminous surface cleaned with mechanical broom.	sqm	9.00
	Providing and applying tack coat with bitumen emulsion using emulsion pressure distributor at the rate of 0.25 kg per sqm on the prepared granular surface cleaned with mechanical broom.	sqm	11.00
5.3	*Bituminous Macadam (Providing and laying bituminous macadam with 100-120 TPH hot mix plant producing an average output of 75 tonnes per hour using crushed aggregates of specified grading premixed with bituminous binder, transported to site, laid over a previously prepared surface with paver finisher to the required grade, level and alignment and rolled as per clauses 501.6 and 501.7 to achieve the desired compaction)*		
(i)	*for Grading I (40 mm nominal size)*	cum	6304.00
(ii)	*for GradingII(19 mm nominal size)*	cum	6244.00
5.4	*Bituminous Penetration Macadam (Construction of penetration macadam over prepared Base by providing a layer of compacted crushed coarse aggregate using chips spreader with alternate applications of bituminous binder and key aggregates and rolling with a smooth wheeled steel roller 8-10 tonne capacity to achieve the desired degree of compaction)*		
A	*50 mm thick*	sqm	348.00
B	*75 mm thick*	sqm	477.00
5.5	*Built-Up-Spray Grout (Providing, laying and rolling of built-up-spray grout layer over prepared base consisting of a two layer composite construction of compacted crushed coarse aggregates using motor grader for aggregates. key stone chips spreader may be used with application of bituminous binder after each layer, and with key aggregates placed on top of the second layer to serve as a Base conforming to the line, grades and cross-section specified, the compacted layer thickness being 75 mm)*	sqm	277.00
5.6	*Dense Graded Bituminous Macadam (Providing and laying dense bituminous macadam with 100-120 TPH batch type HMP producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 4.0 to 4.5% by weight of total mix of mix and filler, transporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MoRTH specification clause No. 507 complete in all respects.)*		
(i)	*for Grading I (40 mm nominal size)*	cum	7946.00
(ii)	*for GradingII(19 mm nominal size)*	cum	7879.00
5.7	*Semi - Dense Bituminous Concrete (Providing and laying semi dense bituminous concrete with 100-120 TPH batch type HMP producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 4.5 to 5 % of mix and filler, transporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MoRTH specification clause No. 508 complete in all respects)*		
(i)	*for Grading I (13 mm nominal size)*	cum	8133.00
(ii)	*for GradingII(10 mm nominal size)*	cum	8730.00
5.8	*Bituminous Concrete (Providing and laying bituminous concrete with 100-120 TPH batch type hot mix plant producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 5.4 to 5.6 % of mix and filler, transporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MORTH specification clause No. 509 complete in all respects)*		
(i)	*for Grading-I (13 mm nominal size)*	cum	9251.50
(ii)	*for Grading-II(10 mm nominal size)*	cum	9220.50
5.9	*Surface Dressing (Providing and laying surface dressing as wearing course in single coat using crushed stone aggregates of specified size on a layer of bituminous binder laid on prepared surface and rolling with 8-10 tonne smooth wheeled steel roller)*		
Case -1	*:-19 mm nominal chipping size*	sqm	81.00
Case - II	*13 mm nominal size chipping*	sqm	66.00
5.10	*Open - Graded Premix Surfacing (Providing, laying and rolling of open - graded premix surfacing of 20 mm thickness composed of 13.2 mm to 5.6 mm aggregates either using penetration grade bitumen or cut-back or emulsion to required line, grade and level to serve as wearing course on a previously prepared base, including mixing in a suitable plant, laying and rolling with a smooth wheeled roller 8-10 tonne capacity, finished to required level and grades.)*		
(i)	*Case - I: Mechanical method using Penetration grade Bitumen and HMP of appropriate capacity not less than 75 tonnes/hour .*	sqm	119.20
(ii)	*Case - II: Open-Graded Premix Surfacing using cationic Bitumen Emulsion*	sqm	124.20

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
5.11	*Close Graded Premix Surfacing/Mixed Seal Surfacing (Mechanical means using HMP of appropriate capacity not less than 75 tonnes/hour. Providing, laying and rolling of close-graded premix surfacing material of 20 mm thickness composed of 11.2 mm to 0.09 mm (Type-a) or 13.2 mm to 0.09 mm (Type-b) aggregates using penetration grade bitumen to the required line, grade and level to serve as wearing course on a previously prepared base, including mixing in a suitable plant, laying and rolling with a Smooth wheeled roller 8-10 tonne capacity, and finishing to required level and grade.)*	sqm	158.00
5.12	*Seal Coat (Providing and laying seal coat sealing the voids in a bituminous surface laid to the specified levels, grade and cross fall using Type A and B seal coats)*		
(i)	*Case - I : Type A*	sqm	62.00
(ii)	*Case - II : Type B (Providing and laying of premix sand seal coat with HMP of appropriate capacity not less than 75 tonnes/ hours using crushed stone chipping 6.7 mm size and penetration bitumen of suitable grade.)*	sqm	47.00
5.13	*Supply of Stone Aggregates for Pavement Courses (Supply of stone aggregates from approved sources confirming to the physical requirement, specified in the respective specified clauses, including royalties, fees rents, collection, transportation, stacking and testing and measured in cum as per clause 514.5 Competitive market rates to be ascertained. Alternatively, rates for stone crushing given in chapter 1may be adopted, if found economical. In case for supply of aggregates at site are not available, nearest crusher site may be ascertained. Loading and un-loading charges and cost of carriage may be added to these rates to arrive at the cost at site.)*	cum	
5.14	*Mastic Asphalt (Providing and laying 25 mm thick mastic asphalt wearing course with paving grade bitumen meeting the requirements given in table 500-29, prepared by using mastic cooker and laid to required level and slope after cleaning the surface, including providing antiskid surface with bitumen precoated fine-grained hard stone chipping of 13.2 mm nominal size at the rate of 0.005cum per 10 sqm and at an approximate spacing of 10 cm center to center in both directions, pressed into surface when the temperature of surfaces not less than 1000C, protruding 1 mm to 4 mm over mastic surface, all complete as per clause 515.)*	sqm	528.00
5.15	*Slurry Seal Providing and laying slurry seal consisting of a mixture of fine aggregates, portland cement filler, bituminous emulsion and water on a road surface including cleaning of surface, mixing of slurry seal in a suitable mobile plant, laying and compacting to provide even riding surface)*		
(i)	*5 mm thickness*	sqm	35.00
(ii)	*3 mm thickness*	sqm	24.00
(iii)	*1.5 mm thickness*	sqm	14.00
5.16	*Recycling of Bituminous Pavement with Central Recycling Plant (Recycling pavement by cold milling of exiting bituminous layers, planning the surface after cold milling, reclaiming excavated material to the extent of 30 % of the required quantity, hauling and stock piling the reclaimed material near the central recycling plant after carrying out necessary checks and evaluation, adding fresh material including rejuvenators as required, mixing in a hot mix plant, transporting and laying at site and compacting to the required grade, level and thickness, all as specified in clause 517.)*	cum	6383.00
5.17	*Fog Spray*	sqm	30.00
added	*1.In case it is decided by the engineer to blind the fog spray, the following may be added*	sqm	4.00
5.18	*Bituminous Cold Mix (Including Gravel Emulsion) (Providing, laying and rolling of bituminous cold mix on prepared base consisting of a mixture of unheated mineral aggregate and emulsified or cutback bitumen, including mixing in a plant of suitable type and capacity, transporting, laying, compacting and finishing to specified grades and levels.)*		
(i)	*Using bitumen emulsion and 9.5 mm or 13.2 mm nominal size aggregate*	cum	8633.00
(ii)	*Using bitumen emulsion and 19 mm or 26.5 mm nominal size aggregate*	cum	8722.00
(iii)	*Using cutback bitumen and 9.5 mm or 13.2 mm nominal size aggregate*	cum	10991.00
(iv)	*Using cutback bitumen and 19 mm or 26.5 mm nominal size aggregate*	cum	11067.00
5.19	*Sand Asphalt Base Course (Providing, laying and rolling sand-asphalt base course composed of sand, mineral filler and bituminous binder on a prepared sub-grade or sub-base to the lines, levels, grades and cross sections as per the drawings including mixing in a plant of suitable type and capacity, transporting, laying, compacting and finishing.)*	cum	8685.00
5.20	*Modified Binder (Supply of modified binder produced by mixing bitumen with modifier such as natural rubber or crumb rubber or any other polymer found compatible with bitumen and which allows properties given in clause 521.3 and IRC: SP: 53 blending of modifier with bitumen to be done either at the refinery or at the site plant capable of producing the modified binder to be delivered in drums which shall be agitated in melted condition using suitable device before use to ensure uniform dispersion.)*	tonne	
5.21	*Crack Prevention Courses*		
(i)	*Stress Absorbing Membrane (SAM) crack width less than 6 mm (Providing and laying of a stress absorbing membrane over a cracked road surface, with crack width below 6 mm after cleaning with a mechanical broom, using modified binder complying with clause 521, sprayed at the rate of 9 kg per 10 sqm and spreading 5.6 mm crushed stone aggregates @ 0.11 cum per 10 sqm with hydraulic chip spreader, sweeping the surface for uniform spread of aggregates and surface finished to conform to clause 902.)*	sqm	31.00
(ii)	*Stress Absorbing Membrane (SAM) with crack width 6 mm to 9 mm (Providing and laying of a stress absorbing membrane over a cracked road surface, with crack width 6 to 9 mm after cleaning with a mechanical broom, using modified binder complying with clause 521, sprayed at the rate of 11 kg per 10 sqm and spreading 11.2 mm crushed stone aggregates @ 0.12 cum per 10 sqm, sweeping the surface for uniform spread of aggregates and surface finished to conform to clause 902.)*	sqm	35.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
(iii)	*Stress Absorbing Membrane (SAM) crack width above 9 mm and cracked area above 50 % (Providing and laying a single coat of a stress absorbing membrane over a cracked road surface, with crack width above 9 mm and cracked area above 50 % after cleaning with a mechanical broom, using modified binder complying with clause 521, sprayed at the rate of 15 kg per 10 sqm and spreading 11.2 mm crushed stone aggregates @ 0.12 cum per 10 sqm, sweeping the surface for uniform spread of aggregates and surface finished to conform to clause 902.)*	sqm	46.00
(iv)	*Case - IV : Bitumen Impregnated Geotextile (Providing and laying a bitumen impregnated geotextile layer after cleaning the road surface, geotextile conforming to requirements of clause 704.3, laid over a tack coat with 1.05 kg per sqm of paving grade bitumen 80 - 100 penetration and constructed to the requirement of clause 704.4.5)*	sqm	204.00
5.22	*Recipe Cold Mix (Providing and laying of premix of crushed stone aggregates and emulsion binder, mixed in a batch type cold mixing plant, laid over prepared surface, by paver finisher, rolled with a pneumatic tyred roller initially and finished with a smooth steel wheel roller, all as per clause 519.3)*		
(i)	*75 mm thickness*	cum	1794.00
(ii)	*40 mm thickness*	cum	7544.00
(iii)	*25 mm thickness*	cum	8778.00
	CHAPTER-6		
	CEMENT CONCRETE PAVEMENTS		
6.1	*Dry Lean Cement Concrete Sub- base (Construction of dry lean cement concrete Sub- base over a prepared sub-grade with coarse and fine aggregate conforming to IS: 383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per table 600-1, cement content not to be less than 150 kg/ cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, laid with a paver with electronic sensor, compacting with 8-10 tonnes vibratory roller, finishing and curing.)*	cum	3296.00
6.2	*Cement Concrete Pavement (Construction of un-reinforced, dowel jointed, plain cement concrete pavement over a prepared sub base with 43 grade cement @ 400 kg per cum, coarse and fine aggregate conforming to IS 383, maximum size of coarse aggregate not exceeding 25 mm, mixed in a batching and mixing plant as per approved mix design, transported to site, laid with a fixed form or slip form paver, spread, compacted and finished in a continuous operation including provision of contraction, expansion, construction and longitudinal joints, joint filler, separation membrane, sealant primer, joint sealant, debonding strip, dowel bar, tie rod, admixtures as approved, curing compound, finishing to lines and grades as per drawing)*	cum	7331.00
6.3	*Rolled Cement Concrete Base (Construction of rolled cement concrete base course with coarse and fine aggregate conforming to IS:383, the size of coarse aggregate not exceeding 25 mm with minimum, aggregate cement ratio15:1 and minimum cement content of 200 kg/cum, aggregate gradation to be as per table 600-4 after blending, mixing in batching plant at optimum moisture content, transporting to site, laying with a paver with electronic sensor, compacting with 8-10 tonnes smooth wheeled vibratory roller to achieve, the designed flexural strength, finishing and curing.)*	cum	3742.00
6.4	*Transition section between rigid and flexible pavement (Due to change in the properties of materials and type of construction, a gradual changeover from rigid pavement to flexible pavement is desirable to avoid any damage at the butting joint. After provision of an expansion joint in the cement concrete slab, the thickness of slab should be tapered to 10 cm over a length of 3 m towards the flexible pavement. The deficiency of thickness caused due to tapering of the slab should be made up by the asphaltic layers.)*		
6.5	*Construction of Base/Sub-base of pavement with lean concrete - fly ash. (Construction of Base/sub-base using cement, sand, fly ash and coarse aggregates proportioned as per table 4 of IRC: 74/1979 and with water content ratio, slump and compressive strength as defined in the said table, mix prepared in a batching and mixing plant and compacted with a vibratory roller 8-10 tonnes capacity within the time limit laid down vide clause 7.6.3 of IRC: 74-1979, construction joints properly formed at the end of day's work, cured for 14 days, all as specified in IRC: 74-1979 and as per approved plans.)*	cum	3012.00
6.6	*Cement - Fly ash concrete pavement. (Construction reinforced-reinforced, dowel jointed, plain cement concrete pavement over a prepared sub base with 43 grade cement, coarse and fine aggregate conforming to IS 383, maximum size of coarse aggregate not exceeding 25 mm, replacing cement by fly ash to the extent of 15% and sand by 10%, mixed in a batching and mixing plant as per approved mix design, transported to site, laid with a fixed form or slip form paver, spread, compacted and finished in a continuous operation including provision of contraction, expansion, construction and longitudinal joints, joint filler, separation membrane, sealant primer, joint sealant, debonding strip, dowel bar, tie rod, admixtures as approved, curing compound, finishing to lines and grades as per drawing)*	cum	6646.00
	CHAPTER-7		
	GEOSYNTHETICS AND REINFORCED EARTH		
7.1	*Sub- Surface Drain with Geotextiles (Construction of sub surface drain 200 mm dia using geotextiles treated with carbon black with physical properties as given in clause 702.2.3 formed in to a stable network and a planar geocomposite structure, joints wrapped with geotextile to prevent ingress of soil, all as per clause 702 and approved drawings including excavation and backfilling)*	metre	1249.00
7.2	*Narrow Filter Sub- Surface Drain (Construction of a narrow filter sub- surface drain consisting of porous or perforated pipe laid in narrow trench surrounded by a geotextile filter fabric, with a minimum of 450 mm overlap of fabric and installed as per clause 702.3 and 309.3.5 including excavation and backfilling)*	metre	660.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
7.3	*Laying Paving Fabric Beneath a Pavement Overlay (Providing and laying paving fabric with physical requirements as per table 704-2 over a tack coat of paving grade Bitumen 80-100 penetration, laid at the rate of 1 kg per sqm over thoroughly cleaned and repaired surface to provide a water resistant membrane and crack retarding layer. Paving fabric to be free of wrinkling and folding and to be laid before cooling of tack coat, brooming and rolling of surface with pneumatic roller to maximise paving fabric contact with pavement surface)*	sqm	195.00
7.4	*Laying Boulder Apron in Crates of Synthetic Geogrids (Providing, preparing and laying of geogrid crated apron 1 m x 5 m, 600 mm thick including excavation and backfilling with baffles at 1 metre interval, made with geogrids having characteristics as per clause 704.2, joining sides with connectors/ring staples, top corners to be tie tensioned, placing of suitable cross interval ties in layers of 300 mm connecting opposite side with lateral braces and tied with polymer braids to avoid bulging, constructed as per clause 704.3. filled with stone with minimum size of 200 mm and specific gravity not less than 2.65, packed with stone spalls, keyed to the foundation recess in case of sloping ground and laid over a layer of geotextile to prevent migration of fines, all as per clause 704 and laid as per clause 2503.3 and approved design.)*	cum	607.00
7.5	*Reinforced Earth Retaining Wall (Reinforced earth retaining walls have four main components as under: a) Excavation for foundation, foundation concrete and cement concrete grooved seating in the foundation for facing elements (facia material). b) Facia material and its placement. c) Assembling, joining with facing elements and laying of the reinforcing elements. d) Earthfill with granular material which is to be retained by the wall.)*		
(i)	*Facing elements of RCC*	sqm	
(ii)	*Assembling, joining and laying of reinforcing elements.*		
A	*With reinforcing element of steel / Aluminium strips / polymeric strips.*		
Type 1	*1.Galvanised carbon steel strips*	metre	
Type 2	*2.Copper Strips*	metre	
Type 3	*3.Aluminium Strips*	metre	
Type 4	*4.Stainless steel strips*	metre	
Type 5	*5.Glass reinforced polymer/fibre reinforced polymer/polymeric strips*	metre	
B	*With reinforcing elements of synthetic geogrids*	sqm	4099.00
	CHAPTER-8		
	TRAFFIC SIGNS, MARKINGS & OTHER ROAD APPURTENANCES		
8.1	*Cast in Situ Cement Concrete M20 kerb (Construction of cement concrete kerb with top and bottom width 115 and 165 mm respectively, 250 mm high in M 20 grade PCC on M-10 grade foundation 150 mm thick, foundation having 50 mm projection beyond kerb stone, kerb stone laid with kerb laying machine, foundation concrete laid manually, all complete as per clause 408)*		
A	*Using Concrete Mixer*	metre	290.00
B	*Using Concrete Batching and Mixing Plant*	metre	284.00
8.2	*Cast in Situ Cement Concrete M 20 Kerb with Channel (Construction of cement concrete kerb with channel with top and bottom width 115 and 165 mm respectively, 250 mm high in M 20 grade PCC on M10 grade foundation 150 mm thick, kerb channel 300 mm wide, 50 mm thick in PCC M20 grade, sloped towards the kerb, kerb stone with channel laid with kerb laying machine, foundation concrete laid manually, all complete as per clause 408)*		
A	*Using Concrete Mixer*	metre	542.00
B	*Using Concrete Batching and Mixing Plant*	metre	539.00
8.3	*Printing new letter and figures of any shade (Printing new letter and figures of any shade with synthetic enamel paint black or any other approved colour to give an even shade)*		
(i)	*Hindi (Matras commas and the like not to be measured and paid for Half letter shall be counted as half)*	cm height per letter	0.70
(ii)	*English and Roman*	cm height per letter	0.40
8.4	*Retro- reflectorised Traffic signs (Providing and fixing of retro- reflectorised cautionary, mandatory and informatory sign as per IRC :67 made of encapsulated lens type reflective sheeting vide clause 801.3, fixed over aluminium sheeting, 1.5 mm thick supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm firmly fixed to the ground by means of properly designed foundation with M15 grade cement concrete 45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing)*		
(i)	90 cm equilateral triangle	each	4394.00
(ii)	60 cm equilateral triangle	each	3182.00
(iii)	60 cm circular	each	4083.00
(iv)	80 mm x 60 mm rectangular	each	5482.00
(v)	60 cm x 45 cm rectangular	each	3991.00
(vi)	60 cm x 60 cm square	each	4630.00
(vii)	90 cm high octagon	each	6844.00
8.5	*Direction and Place Identification signs upto 0.9 sqm size board. (Providing and erecting direction and place identification retro-reflectorised sign asper IRC:67 made of encapsulated lens type reflective sheeting vide clause 801.3, fixed over aluminium sheeting, 2 mm thick with area not exceeding 0.9 sqm supported on a mild steel single angle iron post 75 x 75 x 6 mm firmly fixed to the ground by means of properly designed foundation with M15 grade cement concrete 45 x 45 x 60 cm, 60 cm below ground level as per approved drawing)*	sqm	11910.00

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
8.6	*Direction and Place Identification signs with size more than 0.9 sqm size board. (Providing and erecting direction and place identification retro- reflectorised sign asper IRC :67 made of encapsulated lens type reflective sheeting vide clause 801.3, fixed over aluminium sheeting, 2 mm thick with area exceeding 0.9 sqm supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm, 2 Nos. firmly fixed to the ground by means of properly designed foundation with M 15 grade cement concrete45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing)*	sqm	20539.00
8.7	*Overhead Signs (Providing and erecting overhead signs with a corrosion resistant aluminium alloy sheet reflectorised with high intensity retro-reflective sheeting of encapsulated lense type with vertical and lateral clearance given in clause 802.2 and 802.3 and installed as per clause 802.7 over a designed support system of aluminium alloy or galvanised steel trestles and trusses of sections and type as per structural design requirements and approved plans)*		
A	Truss and Vertical Support	tonne	76654.00
B	Aluminium alloy plate for over head sign	tonne	3228.00
8.8	*Painting Two Coats on New Concrete Surfaces (Painting two coats after filling the surface with synthetic enamel paint in all shades on new plastered concrete surfaces)*	sqm	64.00
8.9	*Painting on Steel Surfaces (Providing and applying two coats of ready mix paint of approved brand on steel surface after through cleaning of surface to give an even shade)*	sqm	56.00
8.10	*Painting on Wood Surfaces (Providing and applying two coats of ready mix paint of approved brand on wood surface after through cleaning of surface to give an even shade)*	sqm	62.00
8.11	*Painting Lines, Dashes, Arrows etc on Roads in Two Coats on New Work (Painting lines, dashes, arrows etc on roads in two coats on new work with ready mixed road marking paint conforming to IS:164 on bituminous surface, including cleaning the surface of all dirt, dust and other foreign matter, demarcation at site and traffic control)*		
(i)	Over 10 cm in width	sqm	124.00
(ii)	Up to 10 cm in width	sqm	111.00
8.12	*Painting Lines, Dashes, Arrows etc on Roads in Two Coats on Old Work (Painting lines, dashes, arrows etc on roads in two coats on old work with ready mixed road marking paint confirming to IS: 164 on bituminous surface, including cleaning the surface of all dirt, dust and other foreign matter, demarcation at site and traffic control)*		
(i)	Over 10 cm in width	sqm	84.00
(ii)	Up to 10 cm in width	sqm	88.00
8.13	*Road Marking with Hot Applied Thermoplastic Compound with Reflectorising Glass Beads on Bituminous Surface (Providing and laying of hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250 gms per sqm area, thickness of 2.5 mm is exclusive of surface applied glass beads as per IRC:35 .The finished surface to be level, uniform and free from streaks and holes.)*	sqm	320.00
8.14	*Kilo Metre Stone (Reinforced cement concrete M15grade kilometre stone of standard design as per IRC:8-1980, fixing in position including painting and printing etc)*		
(i)	5th kilometre stone (precast)	each	3695.00
(ii)	Ordinary Kilometer stone (Precast)	each	2252.00
(iii)	Hectometer stone (Precast)	each	610.00
8.15	*Road Delineators (Supplying and installation of delineators (road way indicators, hazard markers, object markers), 80-100 cm high above ground level, painted black and white in 15 cm wide stripes, fitted with 80 x 100 mm rectangular or 75 mm dia circular reflectorised panels at the top, buried or pressed into the ground and confirming toIRC-79 and the drawings.)*	each	343.00
8.16	*Boundary pillar (Reinforced cement concrete M15 grade boundary pillars of standard design as per IRC:25-1967, fixed in position including finishing and lettering but excluding painting)*	each	648.00
8.17	*G.I Barbed wire Fencing 1.2 metre high (Providing and fixing 1.2 metres high GI barbed wire fencing with 1.8 m angle iron posts 40 mm x 40 mm x 6 mm placed every 3 metres center to center founded in M15 grade cement concrete, 0.6 metre below ground level, every 15th post, last but one end post and corner post shall be strutted on both sides and end post on one side only and provided with 9 horizontal lines and 2 diagonals interwoven with horizontal wires, fixed with GI staples, turn buckles etc complete as per clause 807)*	metre	242.00
8.18	*G.I Barbed wire Fencing 1.8 metre high (Providing and fixing 1.8 metres high GI barbed wire fencing with 2.4 m angle iron posts 50 mm x 50 mm x 6 mm placed every 3 metres center to center founded in M15 grade cement concrete, 0.6 metre below ground level, every 15th post, last but one end post and corner post shall be strutted on both sides and end post on one side only and provided with 12 horizontal lines and 2 diagonals interwoven with horizontal wires, fixed with GI staples, turn buckles etc complete as per clause 807)*	metre	415.00
8.19	*Fencing with welded steel wire Fabric 75 mm x 50 mm (Suggestive) (Providing 1.20 metre high fencing with angle iron posts 50 mm x 50 mm x 6 mm at 3 metre center to center with 0.40 metre embedded in M15 grade cement concrete, corner, end and every 10th post to be strutted, provided with welded steel wire fabric of 75 mm x 50 mm mesh or 75 mm x 25 mm mesh and fixed to iron posts by flat iron 50 x 5 mm and bolts etc. complete in all respects.)*	metre	624.00
8.20	*Tubular Steel Railing on Medium Weight steel channel (ISMC series) 100 mm x 50 mm (Providing, fixing and erecting 50 mm dia steel pipe railing in 3 rows duly painted on medium weight steel channels (ISMC series) 100 mm x 50 mm, 1.2 metres high above ground, 2 m centre to centre, complete as per approved drawings)*	metre	1157.00
8.21	*Tubular Steel Railing on Precast RCC posts, 1.2 m high above ground level (Providing, fencing and erecting 50 mm dia painted steel pipe railing in 3 rows on precast M20 grade RCC vertical posts1.8 metres high (1.2 m above GL) with 3 holes 50 mm dia for pipe, fixed 2 metres centre to, complete as per approved drawing)*	metre	845.00

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
8.22	*Reinforced Cement Concrete Crash Barrier (Provision of an Reinforced cement concrete crash barrier at the edges of the road, approaches to bridge structures and medians, constructed with M-20 grade concrete with HYSD reinforcement conforming to IRC:21 and dowel bars 25 mm dia, 450 mm long at expansion joints filled with pre-moulded asphalt filler board, keyed to the structure on which it is built and installed as per design given in the enclosure to MOST circular No. RW/NH - 33022/1/94-DO III dated 24 June 1994 as per dimensions in the approved drawing and at locations directed by the Engineer, all as specified)*		
(i)	M 20 grade concrete	metre	3832.00
8.22a	M 40 grade concrete	metre	4222.00
8.22b	M 40 grade concrete with friction slab	metre	8565.00
8.23	*Metal Beam Crash Barrier*		
A	*Type - A, "W" : Metal Beam Crash Barrier (Providing and erecting a "W" metal beam crash barrier comprising of 3 mm thick corrugated sheet metal beam rail, 70 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 1.8 m high, 1.1 m below ground/road level, all steel parts and fitments to be galvanised by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a spacer of channel section 150 x 75 x 5 mm, 330 mm long complete as per clause 810)*	metre	2210.00
B	*Type - B, "THRIE" : Metal Beam Crash Barrier (Providing and erecting a "Thrie" metal beam crash barrier comprising of 3 mm thick corrugated sheet metal beam rail, 85 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 2 m high with 1.15 m below ground level, all steel parts and fitments to be galvanised by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a space of channel section 150 x 75 x 5 mm, 546 mm long complete as per clause 810)*	metre	2816.00
8.24	*Road Traffic Signals electrically operated (Since it is a ready made item commercially produced and erected by specialised firm in the electrical and electronic field, rate may be taken based on market enquiry from firms specialised in this field and ISI certified for the approved design and drawing.)*		
8.25	*Flexible Crash Barrier, Wire Rope Safety Barrier (Providing and erecting a wire rope safety barrier with vertical posts of medium weight RS Joist (ISMB series) 100 mm x 75 mm (11.50 kg/m), 1.50 m long 0.85 m above ground and 0.65 m below ground level, split at the bottom for better grip, embedded in M 15 grade cement concrete 450 x 450 x 450 mm, 1.50 m center to center and with 4 horizontal steel wire rope 40 mm dia and anchored at terminal posts 15 m apart. Terminal post to be embedded in M 15 gradecementconcretefoundation2400 x 450 x 900 mm (depth), strengthened by a strut of RS joist 100 x 75 mm, 2 m long at 450 inclination and a tie 100 x 8 mm, 1.50 m long at the bottom, all embedded in foundation concrete as per approved design and drawing, rate excluding excavation and cement concrete.)*	metre	1775.00
8.26	*Anti - Glare Devices in Median*		
A	*Plantation (Plantation of shrubs and plants of approved species in the median. apart from cutting off glare from vehicle coming from opposite direction, these plants provide a pleasant envoirenment and are eco-friendly. The rate for this item is available in the chapter 11 on horticulture.)*		
B	*Anti - Glare Screen with 25 mm steel pipe framework fixed with circular and rectangular vans (Providing and erecting an anti - glare screen with 25 mm dia vertical pipes fabricated and framed in the form of panels of one metre length and 1.75 mtr height fixed with circular vane 250 mm dia at top and rectangular vane 600 x 300 mm at the middle, made out of steel sheet of 3 mm thickness, end vertical pipes of the panel made larger for embedding in foundation concrete, applying 2 coats of paint on all exposed surfaces, all as per approved design and drawings.)*	metre	4593.00
C	*Anti - Glare Screen with Rectangular Vane of MS sheet (Providing and erecting anti - glare screen with rectangular vanes of size 750 x 500 mm made from MS sheet, 3 mm thick and fixed on MS angle 50 x 50 x 6 mm at an angle of 450 to the direction of flow of traffic, 1.5 m center to center, top edge of the screen 1.75 m above ground level, vertical post firmly embedded in cement concrete foundation 0.60 m below ground level, applying 2 coats of paint on exposed faces, all complete as per approved design and drawings)*	metre	639.00
8.27	*Street Lighting (Providing and erecting street light mounted on a steel circular hollow pole of standard specifications for street lighting, 9 m high spaced 40 m apart, 1.8 m overhang on both sides if fixed in the median and on one side if fixed on the footpath, fitted with sodium vapour lamp and fixed firmly in concrete foundation.)*		
(i)	*For Fixing in Median*	each	7953.00
(ii)	*For fixing in Footpath*	each	7927.00
8.28	*Lighting on Bridges (Providing and fixing lighting on bridges, mounted on steel hollow circular poles of standard specifications, 5 m high fixed on parapets with cement concrete, 20 m apart and fitted with sodium vapour lamp)*	each	7543.00
8.29	*Cable Duct Across the Road (Providing and laying of a reinforced cement concrete pipe duct, 300 mm dia, across the road (new construction), extending from drain to drain in cuts and toe of slope to toe of slope in fills, constructing head walls at both ends, providing a minimum fill of granular material over top and sides of RCC pipe as per IRC:98-1997, bedded on a 0.3 m thick layer of granular material free of rock pieces, outer to outer distance of pipe at least half dia of pipe subject to minimum 450 mm in case of double and triple row ducts, joints to be made leak proof, invert level of duct to be above higher than ground level to prevent entry of water and dirt, all as per IRC: 98 - 1997 and approved drawings.)*		
(i)	*Single Row for one utility service*	metre	3327.00
(ii)	*Double Row for two utility services*	metre	2084.00
(iii)	*Triple Row for three utility services*	metre	3080.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
8.30	*Highway Patrolling and Traffic Aid Post (It is proposed to locate one Traffic Aid Post every 50-60 km of the highway.)*		
8.31	*Items related to under pass/ subway/ overhead bridge/ overhead foot bridge (The items involved for underpass/ subway/ overhead bridge/ overhead foot bridge are earthwork, plain cement concrete, plastering, painting, information sign etc. The rates for these items are available in respective chapters which can be adopted for the quantities derived from the approved designs and drawings)*		
8.32	*Traffic Control System and Communication system (Providing a traffic control centre and communication system including telecommunication facilities and related accessories, CCTV, radar, vehicle detection camera, central computer system These are specialised item of telecommunication system and are the commercial products. The designer is required to contact the manufacturers to ascertain market prices. In case of civil works required to be executed for these installations, pricing may be done as per rates in relevant chapters for quantities derived approved design and drawing.)*		
8.33	*Gantry Mounted Variable Message Sign board (Providing and erecting gantry mounted variable message sign board electronically operated capable of flashing the desired message over a designed support system of aluminium alloy or galvanised steel, erected as per approved design and drawings and with lateral clearance as per clause 802.3)*		
(i)	*Gantry Support System*	tonne	72151.00
(ii)	*Message Display (Message display board 6 sqm electronically operated with complete electronic fitments for flashing the pre-determined messages.)*		
8.34	*Traffic Impact Attenuators at Abutments and Piers*		
A	*With Scrap Tyres (Provision and installation of traffic attenuators at abutment/pier of flyovers bridges using scrap tyres of size 100 x 20 retrieved from trucks laid in 2 rows and 4 tiers, one above the other and tied with 20 mm wire rope as per approved design and drawings.)*	sqm	1458.00
B	*Using Plastic/Steel Barrel, Filled with Sand (Provision and installation of traffic impact attenuator at abutment/pier of flyovers bridges using plastic/steel barrels 0.60 m dia and 1.0 m in height, filled with sand in three rows and tied with20 mm steel wire rope as per approved design and drawings)*	sqm	803.00
C	*With HI - DRO cell Sandwich (Patented) ((In this patented HI - DRO cell system, water gets discharged from plastic tubes on impact over a pre-determined time, thus absorbing the energy))*	sqm	904.00
8.35	*Road Markers/Road Stud with Lense Reflector (Providing and fixing of road stud 100x 100 mm, die cast in aluminium, resistant to corrosive effect of salt and grit, fitted with lense reflectors, installed in concrete or asphaltic surface by drilling hole 30 mm upto a depth of 60 mm and bedded in a suitable bituminous grout or epoxy mortar, all as per BS 873 part 4:1973)*	each	285.00
8.36	*Traffic Cone (Provision of red fluorescent with white reflective sleeve traffic cone made of low density polyethylene (LDPE) material with a square base of 390 x 390 x 35 mm and a height of 770 mm, 4 kg in weight, placed at 1.5 m interval, all as per BS 873)*	each	509.00
8.37	*Roadside Amenities*		
A	*Rest Areas (Providing plainly furnished accommodation for rest rooms, dormitories, restaurants, stalls, shops, petrol pump, telephone booth, first aid room, traffic aid post, police assistance booth, including electricity, toilet and sewerage system Pricing may be done based on current plinth area rates approved by PWD/CPWD/MES for a particular zone. Area is required to be assessed for specific location as per actual site conditions)*		
B	*Parking areas and Bus Laybyes for Trucks, Buses and Light vehicles (Pricing of parking areas may be done for the quantities of various items based on the approved dimensions and pavement design for a particular terrain and soil. Rates for items may be from respective chapters.)*		
C	*Lawn (Providing a lawn planted with grass and its maintenance)*		
8.38	*Rumble Strips (Provision of 15 nos rumble strips covered with premix bituminous carpet, 15-20 mm high at center, 250 mm wide placed at 1 m center to center at approved locations to control speed, marked with white strips of road marking paint.)*	sqm	
8.39	*Policeman Umbrella (Provision of a 2 m high (floor to roof) umbrella for traffic policeman at road crossings, where necessary, installed on a raised platform, built on a central support of a steel pipe 100 mm dia, roof made of 25 mm dia steel pipe to provide covered area of 3 sqm, roofed with CGI sheets, all steel parts to be given 2 coats of paint)*	each	
8.40	*High Mast Pole Lighting at Interchanges and Flyovers (Providing and erecting a high mast pole lighting with 30 m high hot dip galvanised mast designed to withstand forces exerted with wind speeds of 180 km per hour with 3 seconds gust, as per IS:875 (Part 3) - 1978, fitted with a base flange, door at the base of mast with heavy duty internal lock, lantern carriage, suitable winching arrangement for safe working load of 750 kg and high powered electrically driven power tools for raising and lowering of lantern carriage, flexible 8 core electric cable, lightening conductor, earthing terminal, and fixing 2 nos aviation obstruction lights on top of the mast, all complete as per approved design and drawings This is a specialised work and is generally done by firms who specialise in such jobs. The detailed designs and estimates are submitted by the firms alongwith their tender for checks by the Department. The cost of this work is required to be worked out based on approved design, drawings and estimate of the lowest tender. A separate contract for this work is concluded as the contractors for road and bridge works generally donot undertake such jobs.)*		
8.41	*Toll Plaza (The construction, operation and maintenance of Toll Plaza can be broken into separate items of work as under based on the approved design and drawings:-)*		

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
8.42	*Safety Devices and signs in Construction Zones (Provision and fixing of traffic signs for limited period at suitable locations in construction zone comprising of warning zone, approach transition zone, working zone and terminal transition zone with a minimum distance of 60 cm from the edge of the kerb in case of kerbed roads and 2 to 3 m from the edge of the carriageway in case of un-kerbed roads, the bottom edge of the lowest sign plate to be not less than 2 m above the road level, fixed on 60 mm x 60 mm x 6 mm angle iron post, founded and installed as per approved design and drawings, removed and disposed of after completion of construction work, all as per IRC:SP:55-2001)*		
8.43	*Portable Barricade in Construction Zone (Installation of a steel portable barricade with horizontal rail 300 mm wide, 2.5 m in length fitted on a 'A' frame made with 45 x 45 x 5 mm angle iron section, 1.5 m in height, horizontal rail painted (2 coats) with yellow and white stripes, 150 mm in width at an angle of 450, 'A' frame painted with 2 coats of yellow paint, complete as per IRC:SP:55-2001)*	each	2479.00
8.44	*Permanent Type Barricade in Construction Zone*		
A	*With Steel Components (Construction of a permanent type barricade made of steel components, 1.5 m high from road level, fitted with 3 horizontal rails 200 mm wide and 4 m long on 50 x 50 x 5 mm angle iron vertical support, painted with yellow and white strips, 150 mm in width at an angle of450, complete as per IRC:SP:55-2001)*	each	3554.00
B	*With Wooden Components (Construction of a permanent type barricade made of wooden components, 1.5 m high from road level, fitted with 3 horizontal planks 200 mm wide and 3.66 m long on 100 x 100mm wooden vertical post, painted with yellow and white striups, 150 mm in width at an angle of450, complete as per IRC:SP:55-2001)*	each	#VALUE!
C	*With Bricks (Construction of a permanent type barricade made with brick work in mud mortar, 1.5 m high, 4 m long, 600 mm thick, plastered with cement mortar 1:6, painted with yellow and white strips)*	each	17215.00
8.45	*Drum Delineator in Construction Zone (Provision of metal drum/empty bitumen drum delineator, 300 mm in diameter, 800 mm high, filled with earth for stability, painted in circumferential strips of alternate black and white 100 mm wide fitted with reflectors 3 Nos of 7.5 cm dia, all as per IRC:SP:55-2001)*	each	970.00
8.46	*Flagman (Positioning of a smart flagman with a yellow vest and a yellow cap and a red flag 600 x 600 mm securely fastened to a staff 1 m in length for guiding the traffic)*	each	355.00
	CHAPTER-9		
	PIPE CULVERTS		
9.1	*PCC 1:3:6 in Foundation (Plain cement concrete 1:3:6 mix with crushed stone aggregate 40 mm nominal size mechanically mixed, placed in foundation and compacted by vibration including curing for 14 days.)*	cum	4442.00
9.2	*Laying Reinforced Cement Concrete Pipe NP4/prestrssed concrete pipe on first class bedding in single row . (Laying Reinforced cement concrete pipe NP4/prestrssed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .)*		
A	*1000 mm dia*	metre	5699.00
B	*1200 mm dia*	metre	6751.00
9.3	*Laying Reinforced Cement Concrete Pipe NP 4 /prestrssed concrete pipe on first class bedding in double row . (Laying Reinforced cement concrete pipe NP4 /prestrssed concrete pipe for culverts on first class bedding of granular material in double row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .)*		
A	*1000 mm dia*	metre	11435.00
B	*1200 mm dia*	metre	13542.00
	CHAPTER-10		
	MAINTENANCE OF ROADS		
10.1	*Restoration of Rain Cuts (Restoration of rain cuts with soil, moorum, gravel or a mixture of these, clearing the loose soil, benching for 300 mm width, laying fresh material in layers not exceeding 250 mm and compacting with plate compactor or power rammers to restore the original alignment, levels and slopes)*	cum	96.00
10.2	*Maintenance of Earthen Shoulder (filling with fresh soil) (Making up loss of material/ irregularities on shoulder to the design level by adding fresh approved soil and compacting it with appropriate equipment.)*	sqm	54.00
10.3	*Maintenance of Earth Shoulder (stripping excess soil) (Stripping excess soil from the shoulder surface to achieve the approved level and compacting with plate compactor)*	sqm	20.00
10.4	*Filling Pot- holes and Patch Repairs with open - graded Premix surfacing, 20mm. (Removal of all failed material, trimming of completed excavation to provide firm vertical faces, cleaning of surface, painting of tack coat on the sides and base of excavation as per clause 503, back filling the pot holes with hot bituminous material as per clause 511, compacting, trimming and finishing the surface to form a smooth continuous surface, all as per clause 3004.2)*	sqm	137.00
10.5	*Filling Pot- holes and Patch Repairs with - Bituminous concrete, 40mm. (Removal of all failed material, trimming of completed excavation to provide firm vertical faces, cleaning of surface, painting of tack coat on the sides and base of excavation as per clause 503, back filling the pot holes with hot bituminous material as per clause 504, compacting, trimming and finishing the surface to form a smooth continuous surface, all as per clause 3004.2)*		
(i)	*for grading I Material*	sqm	372.00
(ii)	*for grading II Material*	sqm	387.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
10.6	Crack Filling (Filling of crack using slow - curing bitumen emulsion and applying crusher dust in case crack are wider than 3mm.)	metre	3.00
10.7	Dusting (Applying crusher dust to areas of road where bleeding of excess bitumen has occurred.)	sqm	1.47
10.8 A	Fog Seal (ref item 5.17)	sqm	18.00
B	Crack Prevention courses. (ref item 5.21)		
(i)	Stress Absorbing Membrane (SAM) crack width less than 6 mm	sqm	33.00
(ii)	Stress Absorbing Membrane (SAM) with crack width 6 mm to 9 mm	sqm	38.00
(iii)	Stress Absorbing Membrane (SAM) crack width above 9 mm and cracked area above 50 %	sqm	50.00
(iv)	Bitumen Impregnated Geotextile	sqm	130.00
C	Slurry Seal (ref item 5.15)		
(i)	5 mm thickness	sqm	30.00
(ii)	3 mm thickness	sqm	20.00
(iii)	1.5 mm thickness	sqm	12.00
D	Surface Dressing for maintance works. (ref item 5.9)		
(i)	19 mm nominal chipping size	sqm	40.00
(ii)	13 mm nominal size chipping	sqm	33.00
10.9	Repair of joint Grooves with Epoxy Mortar Repair of spalled joint grooves of contraction joints, longitudinal joints and expansion joints in concrete pavements using epoxy mortar or epoxy concrete)	metre	564.00
10.10	Repair of old Joints Sealant (Removal of existing sealant and re sealing of contraction, longitudinal or expansion joints in concrete pavement with fresh sealant material)	metre	27.00
10.11	Hill Side Drain Clearance (Removal of earth from the choked hill side drain and disposing it on the valley side manually)	metre	32.00
10.12	Land Slide Clearance in soil (Clearance of land slides in soil and ordinary rock by a bull-dozer D 80 A-12, 180 HP and disposal of the same on the valley side)	cum	56.00
10.13	Land slide Clearance in Hard Rock Requiring Blasting (Clearing of land slide in hard rock requiring blasting for 50% of the boulders and disposal of the same on the valley side.)	cum	95.00
10.14	Snow Clearance on Roads with Dozer (Snow clearance from road surface by a bull- dozer 165 Hp and disposing it on the valley side)	cum	4.00
10.15	Snow Clearance on Roads with Snow Blowers (Snow clearance from road surface by a snow blower and disposing on the valley side.)	cum	0.58
	CHAPTER-11		
	HORTICULTURE		
11.1	Spreading of Sludge Farm Yard Manure or/and good Earth (Spreading of sludge farm yard manure or/ and good earth in required thickness (cost of sludge, farm- yard manure or/and good earth to be paid for separately))	cum	21.00
11.2	Grassing with ' Doobs' Grass (Grassing with 'Doobs' grass including watering and maintenance of the lawn for 30 days or more till the grass forms a thick lawn free from weeds and fit for moving including supplying good earth if needed)		
(i)	In rows 15 cm apart in either direction	sqm	44.00
(ii)	In rows 7.5 cm apart in either direction	sqm	83.00
11.3	Making Lawns including Ploughing and Dragging with 'Swagha' Breaking of Clod (Making lawns including ploughing and breaking of clod, removal of rubbish, dressing and supplying doobs grass roots and planting at 15 cm apart, including supplying and spreading of farm yard manure at rate of 0.18 cum per 100 sqm)	sqm	16.00
11.4	Maintenance of Lawns or Turfing of Slopes (Maintenance of lawns or Turfing of slopes (rough grassing) for a period of one year including watering etc)	sqm	134.00
11.5	Turfing Lawns with Fine Grassing including Ploughing, Dressing (Turfing lawns with fine grassing including ploughing, dressing including breaking of clods, removal of rubbish, dressing and supplying doobs grass roots at 10 cm apart, including supplying and spreading of farm yard manure at rate of0.6 cum per 100 sqm)	sqm	20.00
11.6	Maintenance of Lawns with Fine Grassing for the First Year	sqm	142.00
11.7	a) Planting Permanent Hedges including Digging of Trenches (Planting permanent hedges including digging of trenches, 60 cm wide and 45 cm deep, refilling the excavated earth mixed with farmyard manure, supplied at the rate of 4.65 cum per 100 metres and supplying and planting hedge plants at 30 cm apart)	metre	81.00
(b)	Maintenance of Hedge for one year	metre	139.00
11.8	a) Planting Flowering Plants and Shrubs in Central Verge	km	19111.00
(b)	Maintenance of Flowering Plants and Shrubs in Central Verge for one Year	km	169394.00
11.9	Planting of Trees and their Maintenance for one Year (Planting of trees by the road side (Avenue trees) in 0.60 m dia holes, 1 m deep dug in the ground, mixing the soil with decayed farm yard/sludge mannure, planting the saplings, backfilling the trench, watering, fixing the tree guard and maintaining the plants for one year)	each	731.00
11.10	Renovation Lawns including, Weeding, Forking the Ground, Top Dressing with Forked Soil (Renovation lawns including, weeding, forking the ground, top dressing with forked soil, watering and maintenance the lawns, for 30 days or more, till the grass forms a thick lawn, free from weeds, and fit for moving and disposal of rubbish as directed, including supplying good earth, if needed but excluding the cost of well decayed farm yard manure)	sqm	13.00
11.11	Supply at Site Well Decayed Farm Yard Manure (Supply at site of work well decayed farm yard manure, from any available source, approved by the engineer in charge including screening and stacking)	cum	

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
11.12	**Supply at Site of Work/ Store - Deoiled Neem Cake** (Supply at site of work/ store- deoiled neem cake duly packed in used gunny bags)	quintal	
11.13	**Supplying Sludge** (Supplying sludge duly stacked at site/ store)	cum	
11.14	**Half Brick Circular Tree Guard, in 2nd class Brick, internal diametre 1.25 metres, and height 1.2 metres, above ground and 0.20 metre below ground** (Half brick circular tree guard, in 2nd class brick, internal diametre 1.25 metres, and height 1.2 metres, above ground and 0.20 metre below ground, bottom two courses laid dry, and top three courses in cement mortar 1:6 (1 cement 6 sand) and the intermediate courses being in dry honey comb masonry, as per design complete)	each	2095.00
11.15	**Edging with 2nd class Bricks, laid dry lengthwise (Edging with 2nd class bricks, laid dry lengthwise, including excavation, refilling, consolidation, with a hand packing and spreading nearly surplus earth within a lead of 50 metres)**	metre	42.00
11.16	**Making Tree Guard 53 cm dia and 1.3 m high as per design from empty bitumen drum** (Making tree guard 53 cm dia and 1.3 m high as per design from empty bitumen drum, slit suitably to permit sun and air, (supplied by the department at stock issue rate) including providing and fixing 2 nos MS sheet rings 50 x 0.5 mm with rivets, complete in all respect)	each	299.00
11.17	**Making Tree Guard 53 cm dia and 2 metres high as per design from empty bitumen drums** (Making tree guard 53 cm dia and 2 metres high as per design from empty bitumen drums, slit suitably to permit sun and air, (supplied by the department at stock issue rate) including providing and fixing four legs 40 cm long of 30 x 3 mm MS riveted to tree guard and providing and fixing 2 nos MS sheet rings 50 x 0.5 mm with rivets complete in all respects)	each	575.00
11.18	**Wrought Iron and Mild Steel Welded Work (Wrought iron and mild steel welded work)** (using angles, square bars, tees and channel grills, grating frames, gates and tree guards of any size and design etc. including cost of screens and welding rods or bolts and nuts complete fixed in position but without the cost of excavation and concrete for fixing which will be paid separately)	quintal	7972.00
11.19	**Tree Guard with MS Iron** (Providing and fixing MS iron tree guard 60 cm dia and 2 metre high above ground level formed of 4 Nos (25 x 6 mm) and 8 Nos (25 x 3 mm) vertical MS riveted to 3 Nos (25 x 6 mm) iron rings in two halves, bolted together with 8 mm dia and 30 mm long bolts including painting two coats with paint of approved brand over a coat of priming, complete in all respects.)	each tree guard	2165.00
11.20	**Tree Guard with MS Angle Iron and Steel Wire** (Providing and fixing tree guard 0.60 metre square, 2.00 metre high fabricated with MS angle iron 30 x 30 x 3 mm, MS iron 25 x 3 mm and steel wire3 mm dia welded and fabricated as per design in two halves bolted together)	each tree guard	2886.00
11.21	**Compensatory Afforestation** (Planting trees as compensatory afforestation at the rate of 290 trees per hectare at a spacing of 6 m by grubbing and leveling the ground upto a depth of 150 mm, digging holes 0.9 m dia, 1 m deep, mixing farm yard/sludge manure with soil, planting of sapling 2 m high with 25 cm dia stem, backfilling the hole and watering)	hectare	68948.00
	CHAPTER-12		
	FOUNDATIONS		
12.1	**Excavation for Structures** (Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom and backfilling with approved material.)		
I	Ordinary soil		
A	Manual Means		
(i)	upto 3 m depth	cum	118.00
(ii)	3 m to 6 m depth	cum	152.00
(iii)	Above 6 m depth	cum	203.00
B	Mechanical Means		
(i)	Depth upto 3 m	cum	45.00
(ii)	Depth 3 m to 6 m	cum	51.00
(iii)	Depth above 6m	cum	63.00
II	Ordinary rock (not requiring blasting)		
A	Manual Means		
(i)	Depth upto 3 m	cum	169.00
B	Mechanical Means	cum	56.00
III	Hard rock (requiring blasting)		
A	Manual Means	cum	388.00
IV	Hard rock (blasting prohibited)		
A	Mechanical Means	cum	373.00
V	Marshy soil		
(i)	upto 3 m depth		
A	Manual means	cum	437.00
B	Mechanical Means	cum	104.00
VI	Back Filling in Marshy Foundation Pits	cum	292.00
12.2	**Filling Annular Space Around Footing in Rock** (Lean cement concrete 1:3:6 nominal mix. Rate may be taken as per items 13.4.)		

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
12.3	*Sand Filling in Foundation Trenches as per Drawing & Technical Specification*	cum	1977.00
12.4	*PCC 1:3:6 in Foundation (Plain cement concrete 1:3:6 nominal mix in foundation with crushed stone aggregate 40 mm nominal size mechanically mixed, placed in foundation and compacted by vibration including curing for 14 days.)*	cum	4872.00
12.5	*Brick masonry work in cement mortar 1:3 in foundation complete excluding pointing and plastering, as per drawing and technical specifications*	cum	6796.00
12.6 A	*Cement mortar1:3 (1cement :3 sand)*	cum	5350.00
B	*Cement mortar1:2 (1cement :2 sand)*	cum	6439.00
C	*Cement mortar1:4 (1cement :4 sand)*	cum	4622.00
D	*Cement mortar1:6 (1cement :6 sand)*	cum	4004.00
12.7	*Stone masonry work in cement mortar 1:3 in foundation complete as drawing and Technical Specification*		
(a)	*Square Rubble Coursed rubble masonry(first sort)*	cum	4521.00
(b)	*Random Rubble Masonry*	cum	4492.00
12.8	*Plain/Reinforced cement concrete in open foundation complete as per drawing and technical specifications*		
A	*PCC Grade M15*	cum	5690.00
B	*PCC Grade M20*	cum	6218.00
C	*RCC Grade M20*		
Case I	*Using concrete mixer*	cum	6203.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	5919.00
D	*PCC Grade M25*		
Case I	*Using concrete Mixer*	cum	6779.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6500.00
E	*RCC Grade M25*		
Case I	*Using concrete Mixer*	cum	6771.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6488.00
F	*PCC Grade M30*		
Case I	*Using Concrete Mixer*	cum	6824.00
Case II	*Using Batching Plant, Transit Mixer and Concrete Pump*	cum	6541.00
G	*RCC Grade M30*		
Case I	*Using Concrete Mixer*	cum	6506.00
Case II	*Using Batching Plant, Transit Mixer and Concrete Pump*	cum	6509.00
H	*RCC Grade M35*		
Case I	*Using Concrete Mixer*	cum	6339.00
Case II	*Using Batching Plant, Transit Mixer and Concrete Pump*	cum	6636.00
12.9	*Providing and constructing temporary island 16 m diameter for construction of well foundation for 8m dia. Well.*		
A	*Assuming depth of water 1.0 m and height of island to be 1.25m.*	each	106517.00
B	*Assuming depth of water 4.0 m and height of island 4.5 m.*	each	679536.00
C	*Providing and constructing one span service road to reach island location from one pier location to another pier location*	metre	3982.00
12.10	*Providing and laying cutting edge of mild steel weighing 40 kg per metre for well foundation complete as per drawing and technical specification.*	tonne	90500.00
12.11	*Plain/Reinforced cement concrete, in well foundation complete as per drawing and technical specification*		
A	*Well curb*		
(i)	*RCC M20 Grade*		
Case I	*Using concrete mixer*	cum	6562.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6257.00
(ii)	*RCC M25 Grade*		
Case I	*Using concrete mixer*	cum	7180.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	7493.00
(iii)	*RCC M35 Grade*		
Case I	*Using concrete mixer*	cum	8056.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	7402.00
B	*Well steining*		
(I)	*PCC M15 Grade*	cum	5768.00
(ii)	*PCC M20 Grade*	cum	6303.00
(iii)	*RCC M20 Grade*		
Case I	*Using concrete mixer*	cum	6288.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6000.00
(iv)	*PCC M25 Grade*		
Case I	*Using concrete mixer*	cum	6888.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6603.00
(v)	*RCC M25 Grade*		
Case I	*Using concrete mixer*	cum	6881.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
Case II	With Batching Plant, Transit Mixer and Concrete Pump	cum	6591.00
(vi)	PCC M30 Grade		
Case I	Using concrete mixer	cum	6952.00
Case II	With Batching Plant, Transit Mixer and Concrete Pump	cum	6661.00
(vii)	RCC M30 Grade		
Case I	Using concrete mixer	cum	6916.00
Case II	With Batching Plant, Transit Mixer and Concrete Pump	cum	6629.00
(viii)	RCC M35 Grade		
Case I	Using concrete mixer	cum	7077.00
Case II	With Batching Plant, Transit Mixer and Concrete Pump	cum	6791.00
(ix)	RCC M40 Grade		7254.00
C	Bottom Plug		
(i)	PCC Grade M20		
Case I	Using Concrete Mixer	cum	6773.00
Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump	cum	6305.00
(ii)	PCC Grade M25		
Case I	Using Concrete Mixer	cum	7099.00
Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump	cum	6628.00
(iii)	PCC Grade M30		
Case I	Using Concrete Mixer	cum	7162.00
Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump	cum	6694.00
(iv)	PCC Grade M35		
Case I	Using Concrete Mixer	cum	7310.00
Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump	cum	6838.00
D	Intermediate plug		
(I)	Grade M20 PCC		
Case I	Using Concrete Mixer	cum	6451.00
Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump	cum	6520.00
(ii)	Grade M25 PCC		
Case I	Using Concrete Mixer	cum	6451.00
Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump	cum	6520.00
(iii)	Grade M30 PCC		
Case I	Using Concrete Mixer	cum	6451.00
Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump	cum	6520.00
E	Top plug		
(i)	Grade M15 PCC		
Case I	Using Concrete Mixer	cum	6451.00
(ii)	Grade M20 PCC		
Case I	Using Concrete Mixer	cum	6451.00
(iii)	Grade M25 PCC		
Case I	Using Concrete Mixer	cum	6451.00
Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump	cum	6520.00
(iv)	Grade M30 PCC		
Case I	Using Concrete Mixer	cum	6451.00
Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump	cum	6520.00
F	Well cap		
(i)	RCC Grade M20		
Case I	Using concrete Mixer	cum	6140.00
Case II	Using Batching Plant, Transit Mixer and Concrete Pump	cum	5855.00
(ii)	RCC Grade M25		
Case I	Using concrete Mixer	cum	6771.00
Case II	Using Batching Plant, Transit Mixer and Concrete Pump	cum	6490.00
(iii)	RCC Grade M30		
Case I	Using Concrete Mixer	cum	6789.00
Case II	Using Batching Plant, Transit Mixer and Concrete Pump	cum	6508.00
(iv)	RCC Grade M35		
Case I	Using Concrete Mixer	cum	6915.00
Case II	Using Batching Plant, Transit Mixer and Concrete Pump	cum	6636.00
(v)	RCC M40 Grade	cum	6844.00
12.12	Sinking of 6 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.		
A	Sandy soil		
(i)	Depth below bed level upto 3.0 M	metre	2517.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
(ii)	Beyond 3m upto 10m depth	metre	3831.00
(iii)	Beyond 10m upto 20m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	5061.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	9493.00
b	Add 20% of cost for Kentledge including supports, loading arrangement and Labour .		11391.00
(v)	Beyond 30m upto 40 m	metre	
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter		22555.00
b	Add 20% of cost for Kentledge including supports, loading arrangement and Labour .	metre	27065.00
B	Clayey soil (6m dia. Well)		
(i)	Depth below bed level upto 3.0 M	metre	3512.00
(ii)	Beyond 3m upto 10m depth	metre	7708.00
(iii)	Beyond 10 m upto 20 m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	10179.00
b	Add for dewatering @ 5% of cost, if required.	metre	10688.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	19093.00
b	Add 5% of cost for dewatering of the cost, if required	metre	25059.00
c	Add 25% of cost for Kentledge including supports, loading arrangement and Labour).	metre	23866.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	45360.00
b	Add 5% of cost for dewatering, if required	metre	57153.00
c	Add 20% of cost for Kentledge including supports, loading arrangement and Labour).	metre	54432.00
C	Soft rock (6m dia well)		
(i)	Depth of soft rock strata upto 3m	metre	12965.00
D	Hard rock (6m dia well)		
(i)	Depth of soft rock strata upto 3m	metre	13267.00
12.13	Sinking of 7 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.		
A	Sandy soil		
(i)	Depth below bed level upto 3.0 M	metre	7329.00
(ii)	Beyond 3m upto 10m depth	metre	5095.00
(iii)	Beyond 10m upto 20m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	6730.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	12623.00
b	Add 20% of cost for Kentledge including supports, loading arrangement and Labour) .	metre	15147.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	29991.00
b	Add 20% of cost for Kentledge including supports, loading arrangement, and Labour etc.	metre	35989.00
B	Clayey soil (7m dia. Well)		
(I)	Depth below bed level upto 3.0 M	metre	5316.00
(ii)	Beyond 3m upto 10m depth	metre	7575.00
(iii)	Beyond 10 m upto 20 m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	10005.00
b	Add for dewatering @ 5% of cost, if required.	metre	10506.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	18770.00
b	Add 5% of cost for dewatering on the cost, if required	metre	24635.00
c	Add 25% of cost for Kentledge including supports, loading arrangement and Labour).	metre	23462.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	44596.00
b	Add 5% of cost for dewatering, if required	metre	56191.00
c	Add 20% of cost for Kentledge including supports, loading arrangement and Labour).		53515.00
C	Soft rock (7m dia well)		
(i)	Depth of soft rock strata upto 3m	metre	11115.00
D	Hard rock (7m dia well)		
(i)	Depth upto 3 m	metre	16062.00
12.14	Sinking of 8 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.		
A	Sandy soil		
(i)	Depth below bed level upto 3.0 M	metre	4917.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
(ii)	Beyond 3m upto 10m depth	metre	6017.00
(iii)	Beyond 10m upto 20m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	7947.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	14907.00
b	Add 20% of cost for Kentledge including supports, loading arrangement and Labour .	metre	17888.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	5240.00
b	Add 20% of cost for Kentledge including supports, loading arrangement, and Labour etc.	metre	6288.00
B	Clayey soil (8m dia. Well)		
(i)	Depth upto 3.0 M	metre	6498.00
(ii)	Beyond 3m upto 10m depth	metre	8792.00
(iii)	Beyond 10 m upto 20 m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	11612.00
b	Add for dewatering @ 5% of cost, if required.	metre	12192.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	21780.00
b	Add 5% of cost for dewatering on the cost, if required	metre	28587.00
c	Add 25% of cost for Kentledge including supports, loading arrangement and Labour).	metre	27226.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	51748.00
b	Add 5% of cost for dewatering, if required	metre	65202.00
c	Add 20% of cost for Kentledge including supports, loading arrangement and Labour).	metre	62098.00
C	Soft rock (8m dia well)		
(i)	Depth in soft rock strata upto 3m	metre	12455.00
D	Hard rock (8m dia well)		
(i)	Depth in hard rock strata upto 3 m	metre	16841.00
12.15	Sinking of 9 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.		
A	Sandy soil		
(i)	Depth below bed level upto 3.0 M	metre	5013.00
(ii)	Beyond 3m upto 10m depth	metre	6608.00
(iii)	Beyond 10m upto 20m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	8727.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	16370.00
b	Add 20% of cost for Kentledge including supports, loading arrangement and Labour .	metre	19644.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	38893.00
b	Add 20% of cost for Kentledge including supports, loading arrangement, and Labour etc.	metre	46671.00
B	Clayey soil (9m dia. Well)		
(i)	Depth below bed level upto 3.0 M	metre	6889.00
(ii)	Beyond 3m upto 10m depth	metre	9081.00
(iii)	Beyond 10 m upto 20 m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	11995.00
b	Add for dewatering @ 5% of cost, if required.	metre	12595.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	22501.00
b	Add 5% of cost for dewatering on the cost, if required	metre	29533.00
c	Add 25% of cost for Kentledge including supports, loading arrangement and Labour).	metre	28127.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	53463.00
b	Add 5% of cost for dewatering, if required	metre	67364.00
c	Add 20% of cost for Kentledge including supports, loading arrangement and Labour).	metre	64156.00
C	Soft rock (9m dia well)		
(i)	Depth upto 3m	metre	15383.00
D	Hard rock (9m dia well)		
(i)	Depth of hard rock strata upto 3 m	metre	19272.00
12.16	Sinking of 10 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.		
A	Sandy soil		
(i)	Depth below bed level upto 3.0 M	metre	5907.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
(ii)	Beyond 3m upto 10m depth	metre	7006.00
(iii)	Beyond 10m upto 20m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	9254.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	17359.00
b	Add 20% of cost for Kentledge including supports, loading arrangement and Labour .	metre	20831.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	41243.00
b	Add 20% of cost for Kentledge including supports, loading arrangement, and Labour etc.	metre	49492.00
B	Clayey soil (10m dia. Well)		
(i)	Depth below bed level upto 3.0 M	metre	7829.00
(ii)	Beyond 3m upto 10m depth	metre	9560.00
(iii)	Beyond 10 m upto 20 m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	12626.00
b	Add for dewatering @ 5% of cost, if required.	metre	13257.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	23685.00
'b	Add 5% of cost for dewatering on the cost, if required	metre	31086.00
c	Add 25% of cost for Kentledge including supports, loading arrangement and Labour).	metre	29606.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	56273.00
b	Add 5% of cost for dewatering, if required	metre	70904.00
c	Add 20% of cost for Kentledge including supports, loading arrangement and Labour).		67528.00
C	Soft rock (10m dia well)		
(i)	Depth of soft rock strata upto 3m	metre	15675.00
D	Hard rock (10m dia well)		
(i)	Depth of hard rock strata upto 3 m	metre	21410.00
12.17	Sinking of 11 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.		
A	Sandy soil		
(i)	Depth from bed level upto 3.0 M	metre	13271.00
(ii)	Beyond 3m upto 10m depth	metre	11409.00
(iii)	Beyond 10m upto 20m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	15067.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	28261.00
b	Add 20% of cost for Kentledge including supports, loading arrangement and Labour .	metre	33913.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	67145.00
b	Add 20% of cost for Kentledge including supports, loading arrangement, and Labour etc.	metre	80574.00
B	Clayey soil (11 m dia. Well)		
(i)	Depth from bed level upto 3.0 M	metre	12962.00
(ii)	Beyond 3m upto 10m depth	metre	19880.00
(iii)	Beyond 10 m upto 20 m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	26256.00
b	Add for dewatering @ 5% of cost, if required.	metre	27569.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	49251.00
b	Add 5% of cost for dewatering on the cost, if required	metre	64642.00
c	Add 25% of cost for Kentledge including supports, loading arrangement and Labour).	metre	61563.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	117014.00
b	Add 5% of cost for dewatering, if required	metre	147438.00
c	Add 20% of cost for Kentledge including supports, loading arrangement and Labour).	metre	140417.00
C	Soft rock (11m dia well)		
(i)	Depth of soft rock strata upto 3m	metre	35011.00
D	Hard rock (11m dia well)		
(i)	Depth of hard rock upto 3 m	metre	47463.00
12.18	Sinking of 12 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.		
A	Sandy soil		
(i)	I) Depth below bed level upto 3.0 M	metre	27956.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
(ii)	Beyond 3m upto 10m depth	metre	31046.00
(iii)	Beyond 10m upto 20m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	41002.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	76907.00
b	Add 20% of cost for Kentledge including supports, loading arrangement and Labour .	metre	92289.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	182721.00
b	Add 20% of cost for Kentledge including supports, loading arrangement, and Labour etc.	metre	219266.00
B	Clayey soil (12 m dia. Well)		
(i)	Depth below bed level upto 3.0 M	metre	31449.00
(ii)	Beyond 3m upto 10m depth	metre	48386.00
(iii)	Beyond 10 m upto 20 m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	63902.00
b	Add for dewatering @ 5% of cost, if required.	metre	67097.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	119862.00
b	Add 5% of cost for dewatering on the cost, if required	metre	157319.00
c	Add 25% of cost for Kentledge including supports, loading arrangement and Labour).	metre	149828.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	284775.00
b	Add 5% of cost for dewatering, if required	metre	358816.00
c	Add 20% of cost for Kentledge including supports, loading arrangement and Labour).	metre	341730.00
C	Soft rock (12m dia well)		
(i)	Depth of soft rock strata upto 3m	metre	80926.00
D	Hard rock (12m dia well)		
(i)	Depth of hard rock strata upto 3 m	metre	104595.00
12.19	Sinking of Twin D Type well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.		
A	Sandy soil		
(i)	Depth from bed level upto 3.0 M	metre	6306.00
(ii)	Beyond 3m upto 10m depth	metre	6830.00
(iii)	Beyond 10m upto 20m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	9022.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	16925.00
b	Add 20% of cost for Kentledge including supports, loading arrangement and Labour .	metre	20310.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	40211.00
b	Add 20% of cost for Kentledge including supports, loading arrangement, and Labour etc.	metre	48253.00
B	Clayey soil (Twin D Type Well)		
(i)	Depth below bed level upto 3.0 M	metre	7479.00
(ii)	Beyond 3m upto 10m depth	metre	10576.00
(iii)	Beyond 10 m upto 20 m		
a	Add 5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	13968.00
b	Add for dewatering @ 5% of cost, if required.	metre	14666.00
(iv)	Beyond 20m upto 30 m		
a	Add 7.5% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	26199.00
b	Add 5% of cost for dewatering on the cost, if required	metre	34386.00
c	Add 25% of cost for Kentledge including supports, loading arrangement and Labour).	metre	32749.00
(v)	Beyond 30m upto 40 m		
a	Add 10% for every additional meter depth of sinking over the rate of sinking for the previous meter	metre	62245.00
b	Add 5% of cost for dewatering, if required	metre	78429.00
c	Add 20% of cost for Kentledge including supports, loading arrangement and Labour).	metre	74694.00
C	Soft rock (Twin D Type well)		
(i)	Depth of soft rock strata upto 3m	metre	17325.00
D	Hard rock (Twin D Type well)		
(i)	Depth of hard rock strata upto 3 m	metre	22493.00

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
12.20	*Pneumatic sinking of wells with equipment of approved design, drawing and specifications worked by competent and trained personnel and comprising of compression and decompression chambers, reducers, two air locks separately for men and plant & materials, arrangement for supply of fresh air to working chambers, check valves, exhaust valves, shafts made from steel plates of riveted construction not less than 6 mm thick to withstand an air pressure of 0.50 MPa, controlled blasting of hard rock where required, staircases and 1 m wide landing plate forms with railing, arrangement for compression and decompression, electric lighting of 50 V maximum, proper rooms for rest and medical examinations and compliance with safety precautions as per IS:4138, all as per clause1207.6 of MoRTH Specifications.*		
12.21	*Sand filling in wells complete as per drawing and technical specifications*	cum	610.00
12.22	*Providing steel liner 10 mm thick for curbs and 6mm thick for steining of wells including fabricating and setting out as per detailed drawing*	tonne	80115.00
12.23	*Bored cast-in-situ M35 grade R.C.C. pile excluding reinforcement complete as per drawing and technical specifications and removal of excavated earth with all lifts and lead upto 1000 m. (Pile diameter-750 mm)*	metre	5322.00
12.24	*Bored cast-in-situ M35 grade R.C.C. pile excluding reinforcement complete as per drawing and technical specifications and removal of excavated earth with all lifts and lead upto 1000 m. (Pile diameter-1000 mm)*	metre	8892.00
12.25	*Bored cast-in-situ M35 grade R.C.C. pile excluding reinforcement complete as per drawing and technical specifications and removal of excavated earth with all lifts and lead upto 1000 m. (Pile diameter-1200 mm)*	metre	11695.00
12.26	*Driven cast-in-place vertical M35 grade R.C.C. pile excluding reinforcement complete as per drawing and & Technical Specification (Pile diameter - 750 mm)*	metre	#VALUE!
12.27	*Driven cast-in-place vertical M35 grade R.C.C. piles excluding reinforcement complete as per drawing and & Technical Specification (Pile diameter - 1000 mm)*	metre	#VALUE!
12.28	*Driven cast-in-place vertical M35 grade R.C.C. piles excluding reinforcement complete as per drawing and & Technical Specification (Pile diameter - 1200 mm)*	metre	#VALUE!
12.29	*Driven precast vertical M35 grade R.C.C. piles excluding reinforcement complete as per drawing and & Technical Specification (Pile Diameter=500 mm)*	metre	#VALUE!
12.30	*Driven precast vertical M35 grade R.C.C. piles excluding reinforcement complete as per drawing and & Technical Specification (Pile Diameter=750 mm)*	metre	#VALUE!
12.31	*Driven precast vertical M35 grade R.C.C. piles excluding reinforcement complete as per drawing and & Technical Specification (Pile Diameter=1000 mm)*	metre	#VALUE!
12.32	*Driven precast vertical M35 grade R.C.C. piles excluding reinforcement complete as per drawing and & Technical Specification (Size of pile - 300 mm x 300 mm)*	metre	#VALUE!
12.33	*Driven precast vertical M35 grade R.C.C. piles excluding reinforcement complete as per drawing and & Technical Specification (Size of pile - 500 mm x 500 mm)*	metre	#VALUE!
12.34	*Driven precast vertical M35 grade R.C.C. piles excluding reinforcement complete as per drawing and & Technical Specification (Size of pile - 750 mm x 750 mm)*	metre	#VALUE!
12.35	*Driven vertical steel piles complete as per drawing and & Technical Specification (Section of the pile - H Section steel column 400 x 250 mm (ISHB Series))*	metre	#VALUE!
12.36	*Driven vertical steel piles complete as per drawing and & Technical Specification (Section of the pile - H Section steel column 450 x 250 mm (ISHB Series))*	metre	#VALUE!
12.37	*Pile load test on single vertical pile in accordance with IS:2911(Part-IV)*		
12.38	*Cement concrete for reinforced concrete in pile cap complete as per drawing and Technical Specification*		
A	*RCC Grade M20*		
(i)	*Using Concrete Mixer*	cum	6064.00
(ii)	*Using Batching Plant, Transit Mixer and Concrete Pump*	cum	5762.00
B	*RCC Grade M25*		
(i)	*Using concrete mixer.*	cum	6487.00
(ii)	*Using Batching Plant, Transit Mixer and Concrete Pump*	cum	6252.00
C	*RCC Grade M30*		
(i)	*Using concrete mixer.*	cum	6560.00
(ii)	*Using Batching Plant, Transit Mixer and Concrete Pump*	cum	6318.00
D	*RCC Grade M35*		
(i)	*Using concrete mixer.*	cum	6713.00
(ii)	*Using Batching Plant, Transit Mixer and Concrete Pump*	cum	6576.00
12.39	*Levelling course for Pile cap*	cum	5092.00
12.40	*Supplying, fitting and placing un-coated HYSD bar reinforcement in foundation complete as per drawing and technical specifications*	tonne	71284.00
12.41	*Supplying, fitting and placing un-coated Mild steel reinforcement complete in foundation as per drawing and technical specification*	tonne	74613.00
	CHAPTER-13		
	SUB-STRUCTURE		
13.1	*Brick masonry work in 1:3 in sub-structure complete excluding pointing and plastering, as per drawing and technical specifications*	cum	6850.00
13.2	*Pointing with cement mortar (1:3) on brick work in substructure as per Technical specifications*	sqm	55.00
13.3	*Plastering with cement mortar (1:3) on brick work in sub-structure as per Technical specifications*	sqm	124.00

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
13.4	*Stone masonry work in cement mortar 1:3 for substructure complete as per drawing and Technical Specifications*		
A	*Random Rubble Masonry*	cum	4541.00
B	*Coursed rubble masonry (first sort)*	cum	4641.00
C	*Ashlar masonry (first sort)*	cum	5584.00
13.5	*Plain/Reinforced cement concrete in sub-structure complete as per drawing and technical specifications*		
A	*PCC Grade M15*		
(p)	*Height upto 5m*	cum	5517.00
B	*PCC Grade M20*		
(p)	*Height upto 5m*	cum	6578.00
C	*PCC Grade M25*		
(p)	*Height upto 5m*		
Case I	*Using concrete Mixer*	cum	7187.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6319.00
(q)	*Height 5m to 10m*		
Case I	*Using concrete Mixer*	cum	7449.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6547.00
(r)	*Height above 10m*		
Case I	*Using concrete Mixer*	cum	7775.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	7445.00
D	*PCC Grade M30*		
(p)	*Height upto 5m*		
Case I	*Using concrete Mixer*	cum	7254.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6947.00
(q)	*Height 5m to 10m*		
Case I	*Using concrete Mixer*	cum	6891.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	7197.00
(r)	*Height above 10m*		
Case I	*Using concrete Mixer*	cum	7848.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	7510.00
E	*RCC Grade M20*		
(p)	*Height upto 5m*		
Case I	*Using concrete Mixer*	cum	6562.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6257.00
(q)	*Height 5m to 10m*		
Case I	*Using concrete Mixer*	cum	6800.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6482.00
(r)	*Height above 10m*		
Case I	*Using concrete Mixer*	cum	6507.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6764.00
F	*RCC Grade M25*		
(p)	*Height upto 5m*		
Case I	*Using concrete Mixer*	cum	7180.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6875.00
(q)	*Height 5m to 10m*		
Case I	*Using concrete Mixer*	cum	7415.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	7097.00
(r)	*Height above 10m*		
Case I	*Using concrete Mixer*	cum	7768.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	7431.00
G	*RCC Grade M30*		
(p)	*Height upto 5m*		
Case I	*Using concrete Mixer*	cum	6916.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	6629.00
(q)	*Height 5m to 10m*		
Case I	*Using concrete Mixer*	cum	7111.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	7107.00
(r)	*Height above 10m*		
Case I	*Using concrete Mixer*	cum	7387.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	7380.00
H	*RCC Grade M35*		
(p)	*Height upto 5m*		
Case I	*Using concrete Mixer*	cum	7385.00
Case II	*With Batching Plant, Transit Mixer and Concrete Pump*	cum	7084.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
(q)	Height 5m to 10m		
Case I	Using concrete Mixer	cum	7546.00
Case II	With Batching Plant, Transit Mixer and Concrete Pump	cum	7237.00
(r)	Height above 10m		
Case I	Using concrete Mixer	cum	7788.00
Case II	With Batching Plant, Transit Mixer and Concrete Pump	cum	7466.00
13.6	Supplying, fitting and placing HYSD bar reinforcement in sub-structure complete as per drawing and technical specifications	tonne	71423.00
13.7	Supplying, fitting and placing Mild steel reinforcement complete in sub-structure as per drawing and technical specification	tonne	68145.00
13.8	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical specifications	each	256.00
13.9	Back filling behind abutment, wing wall and return wall complete as per drawing and Technical specification		
A	Granular material	cum	466.30
B	Sandy material	cum	2199.00
13.10	Providing and laying of Filter media with granular materials/stone crushed aggregates satisfying the requirements laid down in clause 2504.2.2. of MoRTH specifications to a thickness of not less than 600 mm with smaller size towards the soil and bigger size towards the wall and provided over the entire surface behind abutment, wing wall and return wall to the full height compacted to a firm condition complete as per drawing and technical specification.	cum	1010.00
13.11	Supplying, fitting and fixing in position true to line and level cast steel rocker bearing conforming to IRC: 83(Pt.-1) section IX and clause 2003 of MoRTH specifications complete including all accessories as per drawing and Technical Specifications.	tonne capacity	344.00
13.12	Supplying, fitting and fixing in position true to line and level forged steel roller bearing conforming to IRC: 83(Pt.-1) section IX and clause 2003 of MoRTH specifications complete including all accessories as per drawing and Technical Specifications.	tonne capacity	17.00
13.13	Supplying, fitting and fixing in position true to line and level sliding plate bearing with PTFE surface sliding on stainless steel complete including all accessories as per drawing and Technical Specifications and BS: 5400, section 9.1 & 9.2 (for PTFE) and clause 2004 of MoRTH Specifications.	tonne capacity	1075.00
13.14	Supplying, fitting and fixing in position true to line and level elastomeric bearing conforming to IRC: 83 (Part-II) section IX and clause 2005 of MoRTH specifications complete including all accessories as per drawing and Technical Specifications.	cubic centimetre	0.53
13.15	Supplying, fitting and fixing in position true to line and level sliding plate bearing with stainless steel plate sliding on stainless steel plate with mild steel matrix complete including all accessories as per drawing and Technical Specifications.	tonne capacity	1074.00
13.16	Supplying, fitting and fixing in position true to line and level POT-PTFE bearing consisting of a metal piston supported by a disc or unreinforced elastomer confined within a metal cylinder, sealing rings, dust seals, PTFE surface sliding against stainless steel mating surface, completre assembly to be of cast steel/fabricated structural steel, metal and elastomer elements to be as per IRC: 83 part-I & II respectively and other parts conforming to BS: 5400, section 9.1 & 9.2 and clause 2006 of MoRTH Specifications complete asper drawing and approved technical specifications.	tonne capacity	345.00
	CHAPTER-14		
	SUPER-STRUCTURE		
14.1	Furnishing and Placing Reinforced/Prestressed cement concrete in super-structure as per drawing and Technical Specification		
A	RCC Grade M20		
Case I	Using Concrete Mixer		
(i)	For solid slab super-structure, 20-30% of (a+b+c)		
(p)	Height upto 5m	cum	7085.00
(q)	Height 5m to 10m	cum	7380.00
(r)	Height above 10m	cum	7676.00
(ii)	For T-beam & slab, 25-35% of (a+b+c)		
(p)	Height upto 5m	cum	7380.00
(q)	Height 5m to 10m	cum	7676.00
(r)	Height above 10m	cum	7971.00
Case II	Using Batching Plant, Transit Mixer and Concrete Pump		
(i)	For solid slab super-structure, 20-30% of (a+b+c)		
(p)	Height upto 5m	cum	6783.00
(q)	Height 5m to 10m	cum	7066.00
(r)	Height above 10m	cum	7348.00
(ii)	For T-beam & slab, 25-35% of (a+b+c)		
(p)	Height upto 5m	cum	7066.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
(q)	Height 5m to 10m	cum	7348.00
(r)	Height above 10m	cum	7631.00
B	RCC Grade M25		
Case I	Using Concrete Mixer		
(i)	For solid slab super-structure, 20-30% of (a+b+c)		
(p)	Height upto 5m	cum	7783.00
(q)	Height 5m to 10m	cum	8108.00
(r)	Height above 10m	cum	8432.00
(ii)	For T-beam & slab, 25-35% of (a+b+c)		
(p)	Height upto 5m	cum	8108.00
(q)	Height 5m to 10m	cum	8432.00
(r)	Height above 10m	cum	8756.00
Case II	Using Batching Plant, Transit Mixer and Concrete Pump		
(i)	For solid slab super-structure, 20-30% of (a+b+c)		
(p)	Height upto 5m	cum	7463.00
(q)	Height 5m to 10m	cum	7772.00
(r)	Height above 10m	cum	8080.00
(ii)	For T-beam & slab, 25-35% of (a+b+c)		
(p)	Height upto 5m	cum	7772.00
(q)	Height 5m to 10m	cum	8080.00
(r)	Height above 10m	cum	8388.00
C	RCC Grade M 30		
Case I	Using Concrete Mixer		
(i)	For solid slab super-structure, 20-30% of (a+b+c)		
(p)	Height upto 5m	cum	7899.00
(q)	Height 5m to 10m	cum	8228.00
(r)	Height above 10m	cum	8557.00
(ii)	For T-beam & slab, 25-35% of (a+b+c)		
(p)	Height upto 5m	cum	7542.00
(q)	Height 5m to 10m	cum	8557.00
(r)	Height above 10m	cum	8886.00
Case II	Using Batching Plant, Transit Mixer and Concrete Pump.		
(i)	For solid slab super-structure, 20-30% of (a+b+c)		
(p)	Height upto 5m	cum	7022.00
(q)	Height 5m to 10m	cum	7970.00
(r)	Height above 10m	cum	8286.00
(ii)	For T-beam & slab, 25-35% of (a+b+c)		
(p)	Height upto 5m	cum	7970.00
(q)	Height 5m to 10m	cum	8286.00
(r)	Height above 10m	cum	8602.00
D	RCC/PSC Grade M35		
Case 1	Using concrete mixer.		
(i)	For solid slab super-structure, 18-28% of (a+b+c)		
(p)	Height upto 5m	cum	7948.00
(q)	Height 5m to 10m	cum	8285.00
(r)	Height above 10m	cum	8622.00
(ii)	For T-beam & slab, 23-33% of (a+b+c)		
(p)	Height upto 5m	cum	8285.00
(q)	Height 5m to 10m	cum	8622.00
(r)	Height above 10m	cum	8959.00
(iii)	For box girder and balanced cantilever, 38-58% of cost of concrete.		
(p)	Height upto 5m	cum	9296.00
(q)	Height 5m to 10m	cum	9969.00
(r)	Height above 10m	cum	10643.00
Case II	Using Batching Plant, Transit Mixer and Concrete Pump		
(i)	For solid slab super-structure, 18-28% of (a+b+c)		
(p)	Height upto 5m	cum	7701.00
(q)	Height 5m to 10m	cum	8024.00
(r)	Height above 10m	cum	8348.00
(ii)	For T-beam & slab, 23-33% of (a+b+c)		
(p)	Height upto 5m	cum	8024.00
(q)	Height 5m to 10m	cum	8348.00
(r)	Height above 10m	cum	8671.00
(iii)	For box girder and balanced cantilever, 38-58% of cost of concrete.		

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
(p)	Height upto 5m	cum	8994.00
(q)	Height 5m to 10m	cum	9641.00
(r)	Height above 10m	cum	10288.00
E	PSC Grade M-40		
Case 1	Using concrete mixer.		
(i)	For solid slab super-structure, 20-30% of (a+b+c)		
(p)	Height upto 5m	cum	8387.00
(q)	Height 5m to 10m	cum	8736.00
(r)	Height above 10m	cum	9086.00
(ii)	For T-beam & slab, 25-35% of (a+b+c)		
(p)	Height upto 5m	cum	8736.00
(q)	Height 5m to 10m	cum	9086.00
(r)	Height above 10m	cum	9435.00
Case II	Using Batching Plant, Transit Mixer and Concrete Pump		
(i)	For solid slab super-structure, 18-28% of (a+b+c)		
(p)	Height upto 5m	cum	7964.00
(q)	Height 5m to 10m	cum	8299.00
(r)	Height above 10m	cum	8634.00
(ii)	For T-beam & slab, 23-33% of (a+b+c)		
(p)	Height upto 5m	cum	8299.00
(q)	Height 5m to 10m	cum	8634.00
(r)	Height above 10m	cum	8968.00
(iii)	For box girder and balanced cantilever, 38-58% of cost of concrete.		
(p)	Height upto 5m	cum	9303.00
(q)	Height 5m to 10m	cum	9972.00
(r)	Height above 10m	cum	10641.00
F	PSC Grade M-45		
(i)	For solid slab/voided slab super-structure, 16-26% of cost of concrete (a+b+c)		
(p)	Height upto 5m	cum	8182.00
(q)	Height 5m to 10m	cum	8535.00
(r)	Height above 10m	cum	8887.00
(ii)	For I-beam & slab including launching of precast girders by launching truss upto 40 m span, 21-31% of cost of concrete.		
(p)	Height upto 5m	cum	8535.00
(q)	Height 5m to 10m	cum	8887.00
(r)	Height above 10m	cum	9240.00
(iii)	For cast-in-situ box girder, segmental construction and balanced cantilever, 36-56% of cost of concrete.		
(p)	Height upto 5m	cum	9593.00
(q)	Height 5m to 10m	cum	10298.00
(r)	Height above 10m	cum	11003.00
G	PSC Grade M-50		
(i)	For cast-in-situ box girder, segmental construction and balanced cantilever, 35-55% of cost of concrete		
(p)	Height upto 5m	cum	9871.00
(q)	Height 5m to 10m	cum	10603.00
(r)	Height above 10m	cum	11334.00
H	PSC Grade M- 55		
(i)	For cast-in-situ box girder, segmental construction and balanced cantilever, 35-55% of cost of concrete		
(p)	Height upto 5m	cum	10419.00
(q)	Height 5m to 10m	cum	11191.00
(r)	Height above 10m	cum	11962.37
14.2	a) Supplying, fitting and placing HYSD bar reinforcement in super-structure complete as per drawing and technical specifications	tonne	72389.00
14.3	High tensile steel wires/strands including all accessories for stressing, stressing operations and grouting complete as per drawing and Technical Specifications	tonne	162900.00
14.4	Providing and laying Cement concrete wearing coat M-30 grade including reinforcement complete as per drawing and Technical Specifications	cum	17642.00
14.5	Mastic Asphalt (Providing and laying 12 mm thick mastic asphalt wearing course on top of deck slab excluding prime coat with paving grade bitumen meeting the requirements given in table 500-29, prepared by using mastic cooker and laid to required level and slope after cleaning the surface, including providing antiskid surface with bitumen precoated fine grained hard stone chipping of 9.5 mm nominal size at the rate of 0.005cum per 10 sqm and at an approximate spacing of 10 cm center to center in both directions, pressed into surface when the temperature of surfaces not less than 100 deg. C, protruding 1 mm to 4 mm over mastic surface, all complete as per clause 515.)	sqm	284.00

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
14.6	*Construction of precast RCC railing of M30 Grade, aggregate size not exceeding 12 mm, true to line and grade, tolurence of vertical RCC post not to exceed 1 in 500, centre to centre spacing between vertical post not to exceed 2000 mm, leaving adequate space between vertical post for expansion, complete as per approved drawings and technical specifications.*	metre	1964.00
14.7	*Construction of RCC railing of M30 Grade in-situ with 20 mm nominal size aggregate, true to line and grade, tolurence of vertical RCC post not to exceed 1 in 500, centre to centre spacing between vertical post not to exceed 2000 mm, leaving adequate space between vertical post for expansion, complete as per approved drawings and technical specifications.*	metre	1908.00
14.8	*Providing, fitting and fixing mild steel railing complete as per drawing and Technical Specification*	metre	2510.00
14.9	*Drainage Spouts complete as per drawing and Technical specification*	each	915.00
14.10	*PCC M15 Grade leveling course below approach slab complete as per drawing and Technical specification*	cum	5690.00
14.11	*Reinforced cement concrete approach slab including reinforcement and formwork complete as per drawing and Technical specification*	cum	9939.00
14.12	*Providing anti-corrosive treatment to HYSD reinforcement with Fusion Bonded Epoxy Coating (FBEC) (To be taken as per the prevailing market rates.)*	tonne	
14.13	*Precast - pretensioned Girders (Providing, precasting, transportation and placing in position precast pretensioned concrete girders as per drawing and technical specifications)*	cum	58423.00
14.14	*Providing and fixing Helical pipes in voided concrete slabs*	metre	363.00
14.15	*Crash Barriers (The rate analysis for rigid crash barrier in reinforced cement concrete, semi-rigid crash barrier with metal beam and flexible crash barrier with wire ropes have been made and included in chapter-8 on Traffic and Transportation.)*		
14.16	*Painting on concrete surface (Providing and applying 2 coats of water based cement paint to unplastered concrete surface after cleaning the surface of dirt, dust, oil, grease, efflorescence and applying paint @ of 1 litre for 2 Sq.m.)*	sqm	60.00
14.17	*Burried Joint (Providing and laying a burried expansion joint, expansion gap being 20 mm, covered with 12 mm thick, 200 mm wide galvanised wieldable structural steel plate as per IS: 2062, placed symmetrical to centre line of the joint, resting freely over the top surface of the deck concrete, welding of 8 mm dia. 100 mm long galvanised nails spaced 300 mm c/c along the centre line of the plate, all as specified in clause 2604.)*	metre	1231.00
14.18	*Filler joint*		
(i)	*Providing & fixing 2 mm thick corrugated copper plate in expansion joint complete as per drawing & Technical Specification.*	metre	2448.00
(ii)	*Providing & fixing 20 mm thick compressible fibre board in expansion joint complete as per drawing & Technical Specification.*	metre	207.00
(iii)	*Providing and fixing in position 20 mm thick premoulded joint filler in expansion joint for fixed ends of simply supported spans not exceeding 10 m to cater for a horizontal movement upto 20 mm, covered with sealant complete as per drawing and technical specifications.*	metre	243.00
(iv)	*Providing and filling joint sealing compound as per drawings and technical specifications with coarse sand and 6% bitumen by weight*	metre	23.00
14.19	*Asphaltic Plug joint (Providing and laying of asphaltic plug joint to provide for horizontal movement of 25 mm and vertical movement of 2 mm, depth of joint varying from 75 mm to 100 mm, width varying from 500 mm to 750 mm (in traffic direction), covered with a closure plate of 200mm x 6mm of wieldable structural steel conforming to IS: 2062, asphaltic plug to consist of polymer modified bitumen binder, carefully selected single size aggregate of 12.5 mm nominal size and a heat resistant foam caulking/backer rod, all as per approved drawings and specifications.)*	metre	965.00
14.20	*Elastomeric Slab Steel Expansion Joint (Providing and laying of an elastomeric slab steel expansion joint, catering to right or skew (less than 20 deg., moderately curved with maximum horizontal movement upto 50 mm, complete as per approved drawings and standard specifications to be installed by the manufacturer/supplier or their authorised representative ensuring compliance to the manufacturer's instructions for installation and clause 2606 of MoRTH specifications for road & bridge works.)*	metre	16674.00
14.21	*Compression Seal Joint (Providing and laying of compression seal joint consisting of steel armoured nosing at two edges of the joint gap suitably anchored to the deck concrete and a preformed chloroprene elastomer or closed cell foam joint sealer compressed and fixed into the joint gap with special adhesive binder to cater for a horizontal movement upto 40 mm and vertical movement of 3 mm.)*	metre	19676.00
14.22	*Strip Seal Expansion Joint (Providing and laying of a strip seal expansion joint catering to maximum horizontal movement upto 70 mm, complete as per approved drawings and standard specifications to be installed by the manufacturer/supplier or their authorised representative ensuring compliance to the manufacturer's instructions for installation.)*	metre	15976.00
14.23	*Modular Strip / Box Seal Joint (Providing and laying of a modular strip Box steel expansion joint including anchorage catering to a horizontal movement beyond 70 mm and upto 140mm, complete as per approved drawings and standard specifications to be installed by the manufacturer/supplier or their authorised representative ensuring compliance to the manufacturer's instructions for installation.)*	metre	7167.00
14.24	*Modular Strip / Box Seal Joint (Providing and laying of a modular strip box seal expansion joint catering to a horizontal movement beyond 140mm and upto 210mm, complete as per approved drawings and standard specifications to be installed by the manufacturer/supplier or their authorised representative ensuring compliance to the manufacturer's instructions for installation.)*	metre	8629.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
	CHAPTER-15		
	RIVER TRAINING AND PROTECTION WORKS		
15.1	*Providing and laying boulders apron on river bed for protection against scour with stone boulders weighing not less than 40 kg each complete as per drawing and Technical specification.*		
A	*Boulder laid dry without wire crates.*	cum	1394.00
15.2	*Boulder apron laid in wire crates (Providing and laying of boulder apron laid in wire crates made with 4mm dia GI wire conforming to IS: 280 & IS:4826 in 100mm x 100mm mesh (weaved diagonally) including 10% extra for laps and joints laid with stone boulders weighing not less than 40 kg each.)*	cum	2161.00
15.3	*Cement concrete blocks (size 0.5 x 0.5 x 0.5 m) (Providing and laying of apron with cement concrete blocks of size 0.5x0.5x0.5 m cast in-situ and made with nominal mix of M-15 grade cement concrete with a minimum cement content of 250 kg/cum as per IRC: 21-2000.)*	cum	5804.00
15.4	*Providing and laying Pitching on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per drawing and Technical specifications*		
A	*Stone/Boulder*	cum	1394.00
B	*Cement Concrete blocks of size 0.3x0.3 x0.3 m cast in cement concrete of Grade M15*	cum	5804.00
15.5	*Providing and laying Filter material underneath pitching in slopes complete as per drawing and Technical specification*	cum	1802.00
15.6	*Geotextile Filter (Laying of a geotextile filter between pitching and embankment slopes on which pitching is laid to prevent escape of the embankment material through the voids of the stone pitching/cement concrete blocks as well as to allow free movement of water without creating any uplift head on the pitching.)*	sqm	150.00
15.7	*Toe protection (A toe wall for toe protection can either be in dry rubble masonry in case of dry rubble pitching or pitching with stones in wire crates or it can be in PCC M15 nominal mix if cement concrete block have been used for pitching . Rates for toe wall can be adopted from respective clauses depending upon approved design. The rate for excavation for foundation, dry rubble masonry and PCC M15 have been analysed and given in respective chapters.)*		
15.8	*Providing and laying Flooring complete as per drawing and Technical specifications laid over cement concrete bedding.*		
A	*Rubble stone laid in cement mortar 1:3*	cum	5873.00
B	*Cement Concrete blocks Grade M15*	cum	7643.00
15.9	*Dry rubble Flooring*	cum	1836.00
15.10	*Curtain wall complete as per drawing and Technical specification*		
A	*Stone masonry in cement mortar (1:3)*	cum	4521.00
B	*Cement concrete Grade M15*	cum	5690.00
15.11	*Flexible Apron :Construction of flexible apron 1 m thick comprising of loose stone boulders weighing not less than 40 kg beyond curtain wall.*	cum	1606.00
15.12	*Gabian Structure for Retaining Earth (Providing and construction of a gabain structure for retaining earth with segments of wire crates of size 7 m x 3 m x 0.6 m each divided into 1.5 m compartments by cross netting, made from 4 mm galvanised steel wire @ 32 kg per 10 sqm having minimum tensile strength of 300 Mpa conforming to IS:280 and galvanizing coating conforming to IS:4826, woven into mesh with double twist, mesh size not exceeding 100 x 100 mm, filled with boulders with least dimension of 200 mm, all loose ends to be tied with 4 mm galvanised steel wire)*	cum	1668.00
15.13	*Gabian Structure for Erosion Control, River Training Works and Protection works (Providing and constructing gabain structures for erosion control, river training works and protection works with wire crates of size 2 m x 1 m x 0.3 m each divided into 1m compartments by cross netting, made from 4 mm galvanised steel wire @ 32 kg per 10 sqm having minimum tensile strength of 300 Mpa conforming to IS:280 and galvanizing coating conforming to IS:4826, woven into mesh with double twist, mesh size not exceeding 100 mm x 100 mm, filled with boulders with least dimension of 200 mm, all loose ends to be securely tied with 4 mm galvanised steel wire.)*	cum	1974.00
	CHAPTER-16		
	REPAIR AND REHABILITATION		
16.1	*Removal of existing cement concrete wearing coat including its disposal complete as per Technical specification without causing any detrimental effect to any part of the bridge structure and removal of dismantled material with all lifts and lead upto 1000m (Thickness 75 mm)*	sqm	80.00
16.2	*Removal of existing asphaltic wearing coat comprising of 50 mm thick asphaltic concrete laid over 12 mm thick mastic asphalt including disposal with all lift and lead upto 1000m.*	sqm	60.00
16.3	*Guniting concrete surface with cement mortar applied with compressor after cleaning surface and spraying with epoxy complete as per Technical specification*	sqm	812.00
16.4	*Providing and inserting nipples with approved fixing compound after drilling holes for grouting as per Technical specifications including subsequent cutting/removal and sealing of the hole as necessary of nipples after completion of grouting with Cement/Epoxy*	each	83.00
16.5	*Sealing of cracks/porous concrete by injection process through nipples/Grouting complete as per Technical specification.*		
A	*Cement Grout*	kg	114.00
B	*Cement mortar (1:1) Grouting*	kg	189.00

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
16.6	*Patching of damaged concrete surface with polymer concrete and curing compounds, initiator and promoter, available in present formulations, to be applied as per instructions of manufacturer and as approved by the Engineer.*	sqm	621.00
16.7	*Sealing of crack / porous concrete with Epoxy Grout by injection through nipples complete as per clause 2803.1.*	kg	770.00
16.8	*Applying epoxy mortar over leached, honey combed and spalled concrete surface and exposed steel reinforcement complete as per Technical specification*	sqm	380.00
16.9	*Removal of defective concrete, cleaning the surface thoroughly, applying the shotcrete mixture mechanically with compressed air under pressure, comprising of cement, sand, coarse aggregates, water and quick setting compound in the proportion as per clause 2807.1., sand and coarse aggregates conforming to IS: 383 and table 1 of IS: 9012 respectively, water cement ratio ranging from 0.35 to 0.50, density of gunite not less than 2000 kg/cum, strength not less than 25 Mpa and workmanship conforming to clause 2807.6.*	sqm	230.00
16.10	*Applying pre-packed cement based polymer mortar of strength 45 Mpa at 28 days for replacement of spalled concrete*	sqm	505.00
16.11	*Eproxy bonding of new concrete to old concrete*	sqm	529.00
16.12	*Providing external prestressing with high tensile steel wires/strands including drilling for passage of prestessing steel, all accessories for stressing and stressing operation and grouting complete as per drawing and Technical specification*	tonne	401822.00
16.13	*Providing external prestressing with high tensile steel wires/strands including drilling for passage of prestessing steel, all accessories for stressing and stressing operation and grouting complete as per drawing and Technical specification*	tonne	298124.00
16.14	*Providing external prestressing with high tensile steel wires/strands including drilling for passage of prestessing steel, all accessories for stressing and stressing operation and grouting complete as per drawing and Technical specification*	tonne	254141.00
16.15	*Replacement of bearings complete as per Technical specification*	each	12421.00
16.16	*Rectification of bearings as per Technical specifications*	each	7024.00
16.17	*Replacement of Expansion Joints complete as per drawings*	metre	3519.00
16.18	*Replacement of damaged concrete railing.*	metre	189.00
16.19	*Replacement of crash barrier.*	metre	344.00
16.20	*Replacement of damaged mild steel railing*	metre	158.00
16.21	*Repair of crash barrier (Repair of concrete crash barrier with cement concrete of M-30 grade by cutting and trimming the damaged portion to a regular shape, cleaning the area to be repaired thoroughly, applying cement concrete after erection of proper form work.)*	metre	268.00
16.22	*Repair of RCC Railing (Carrying out repair of RCC M30 railing to bring it to the original shape.)*	metre	180.00
16.23	*Repair of steel Railing (Repair of steel railing to bring it to the original shape)*	metre	256.00
17.1	*Provide Concrete Kerb-Type I for median and directional island in accordance with drawings and Technical Specification Clause 408*	metre	268.64
17.2	*Provide Concrete Kerb-Type II for Carriage Way in accordance with drawings and Technical Specification Clause 408*	metre	198.16
17.3	*RCC Marker posts for Burried Culverts as per tech Spec cl. 800*	each	1510.19
17.4	*RCC Guard Posts (precast) as per Drg No U/T/6/10*	each	1044.19
17.5	*Un-Coursed Rubble stone masonry in cement morter 1:6 in foundations and sub structures as per Tech. Spec.*	cum	3181.82
17.6	*Provide and lay 150mm dia PVC pipe under footpath as service pipe as per Tech spec.*	metre	327.15
17.7	*Provide and fix Tar paper bearing after smoothening the surface with grinding stone as per Drawings and Tech Spec.*	sqm	194.24
17.8	*Bus bay and Truck Lay Bys as per Drawing No_____ and _____*	no	53458.43
17.9	*Provide Temporary diversion as per Tech spec (with pipes) at C/D Locations as per Tech Spec Cl 112*	metre	7130.09
17.1	*Geotextile and filter media under Gabion matteresses as per tech Spec*	sqm	684.26
17.11	*Road Humps with BC as per Tech.Spec.Cl.509*	each	2655.50
17.12	*Rumble Strips with MSS as per Tech.Spec.Cl.512*	each	5258.00
17.13	*Diagonal/Chevron Marking as per Tech.Spec.Cl.800*	each	2080.00
17.14	*a) Stop line in intersections as per Tech.Spec.Cl.800*	each	896.00
	a) stop lettering in intersections as per Tech.Spec.Cl.800		1120.00
17.15	*Directional Arrows as per Tech.Spec.Cl.800*	each	576.00
17.16	*Rigid Concrete Delineators*	each	854.05
17.17	*Traffic Sign Boards as per Tech.Spec.Cl.801 and drawings*		
a	*Mandatory/Regulatory traffic signs Type IX*		
(i)	*Octagonal 900 x 900*	each	7737.96
(ii)	*Circular 600 dia. Type IV*	each	4439.50
b	*Informatory road traffic signs Type IV*		
(i)	*Rectangular 1200 x 900*	each	12052.17
(ii)	*Rectangular 900 x 450 Type IV*	each	4477.00

Summary of Rate Analysis

Item No.	Descriptions	Unit	Rate
(iii)	Rectangular 600 x 800 Type IV	each	5630.14
(iv)	State Route Marker (450 x 650) Type IV	each	3974.86
c	Cautionary / Warning Signs (Triangular 900 side) Type IX	each	4512.10
d	Chevron direction sign boards (400 x 550) Type IX	each	3623.96
e	Object markers Type IX	each	2456.31
f	advanced direction/destination / reaaurance / place identification sign boards with aluminimum alloy sheet, sheeting type IV	each	13417.90
17.18	Raised reflective pavement markers as per drawing No._____	each	229.90
17.19	Barricades (tubular steel railing) as per Tech.Spec.Cl.808 and drawing No._____		
a	Footpath barricades	metre	1577.25
b	Median Barricades	metre	2557.85
17.2	Mastic Asphalt Wearing Coat, 25mm th over existing C Ds and Bridges slabs as per Tech.Spec.Cl.2702, and 515	sqm	668.37
17.21	Truck Lay By as per Drawing No _____	no	4665467.95
17.22	Laying Reinforced cement concrete pipe 900mm dia NP4/prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .	metre	5308.34
17.23	Laying Reinforced cement concrete pipe 750mm dia NP3/prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .	metre	3860.30
17.24	Laying Reinforced cement concrete pipe 600mm dia NP3/prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .	metre	3296.61
17.25	Laying Reinforced cement concrete pipe 450mm dia NP3/prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .	metre	2812.61
17.26	Filling foundations with boulders and sand and compacting.	cum	1609.33
17.27	Providing and fixing grating in cover slabs with 25 x 8 mm Galvanised iron flats.	no	201.42
17.28	Gabion walls as per Tech. Spec. 2503 & 2504.	sqm	2011.05
17.29	Gabion matresses 170 mm high as per Tech. Spec. Cl. 2503 & 2504	sqm	1172.28
17.3	Gabion matresses 230 mm high as per Tech. Spec. Cl. 2503 & 2504	sqm	1258.24
17.31	Painting of details on Culverts/Bridges as per Tech. Spec. Cl.	sqm	88.00
17.32	Filling and Patching of Potholes as per Technical Specification Clause.		
a	100mm Deep and less	sqm	281.22
b	>100mm Deep and less	sqm	406.84
17.33	Rain water Harvesting structure	no	14512.71
17.34	Providing New Jersey Barrier with RCC M30 including reinforcement	rmt	5445.18
17.35	Construction of reinforced earth retaining structures together with construction of earthwork in layers, assembling and erection of reinforcing elements and placing of facia panels and all associated components as per Additional Technical Specification A-16, approved design and drawing of specialised firm		
a	Providing and laying M-35 grade RCC facia panels including reinforcement and reinforcing elements with all fixtures and accesories complete	Sqm	5913.00
b	Providing levelling pad in cement concrete M-20 grade below facia panels, including earthwork in excavation, backfilling and profiling of fore slope complete as per approved design, drawing and Technical Specifications Sections 300, 1500, 1700 and 2100.	Cum	6207.45
17.36	Providing and laying heavy duty cobble stones 75mm thick interlock pavers, using cement and course sand for manufacture of blocks of approved size, shape and colour with a minimum compressive strength of 281 kg per sqm over 50mm thick sand bed (average thickness) and compacting with plate vibrator having 3 tons compaction force thereby forcing part of sand underneath to come up in between joints, final compaction of paver surface joints into its final level, including cost of materials, labour and HOM of machineries complete as per specifications.	Sqm	803.00
	M 40 RC Crash Barrier EXCLUDING REINFORCEMENT	Lm	1850.00
17.38	Ston Matrix Asphalt (19mm SMA)		
	Grading - I	Cum	9087.00
	Grading - II	Cum	9055.00
17.39	Chute Drain	Rmtr	785.00

Summary of Rate Analysis

Item No.	*Descriptions*	Unit	Rate
17.4	*Energy Dissipation Basin*	Each	4063.00
17.41	*Cement Concrete M-20 Kerb with Channel*	Rmtr	476.00

CHAPTER-1
CARRIAGE OF MATERIALS

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
1.1			Loading and Unloading of Stone Boulder/Stone aggregates/Sand/Kanker/Moorum.	cum				
			Placing tipper at loading point, loading with front end loader, dumping, turning for return trip, excluding time for haulage and return trip					
			Unit = cum					
			Taking output = 5.5 cum					
			Time required for					
			i) Positioning of tipper at loading point		1 Min			
			ii) Loading by front end loader 1 cum bucket capacity @ 25 cum per hour		13 Min			
			iii) Maneuvering, reversing, dumping and turning for return		2 Min			
			iv) Waiting time, unforeseen contingencies etc		4 Min			
			Total		20 Min			
			a) Machinery					
			Tipper 5.5 tonnes capacity	hour	0.330	240.00	79.20	P&M-048
			Front end-loader 1 cum bucket capacity @ 25 cum/hour	hour	0.330	624.00	205.92	P&M-017
			b) Overhead charges @ 0.15 on (a)				42.77	
			c) Contractor's profit @ 0.1 on (a+b)				32.79	
			Cost for 5.5 cum = a+b+c				360.68	
			Rate per cum = (a+b+c)/ 5.5				65.58	
		Note	Unloading will be by tipping.			*say*	*66.00*	
1.2			Loading and Unloading of Boulders by Manual Means					
			Unit = cum					
			Taking output = 5.5 cum					
			a) Labour					
			Mate	day	0.110	275.00	30.25	L-12
			Mazdoor for loading and unloading	day	0.750	245.00	183.75	L-13
			b) Machinery					
			Tipper 5.5 tonne capacity	hour	0.750	240.00	180.00	P&M-048
			c) Overhead charges @ 0.15 on (a+b)				59.10	
			d) Contractor's profit @ 0.1 on (a+b+c)				45.31	
			Cost for5.5 cum = a+b+c+d				498.41	
			Rate per cum = (a+b+c+d)/5.5				90.62	
		Note	Unloading will be by tipping.			*say*	*91.00*	
1.3			Loading and Unloading of Cement or Steel by Manual Means and Stacking.					
			Unit = tonne					
			Taking output = 10 tonnes					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor for loading and unloading	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Truck 10 tonne capacity	hour	2.000	225.00	450.00	P&M-057
			c) Overhead charges @ 0.15 on (a+b)				144.30	
			d) Contractor's profit @ 0.1 on (a+b+c)				110.63	
			Cost for10 tonnes = a+b+c+d				1216.93	
			Rate per tonnes = (a+b+c+d)/10				121.69	
						say	*122.00*	
1.4			Cost of Haulage Excluding Loading and Unloading					
			Haulage of materials by tipper excluding cost of loading, unloading and stacking.					
			Unit = t.km					
			Taking output 10 tonnes load and lead 10 km = 100 t.km					
		(i)	Surfaced Road					
			Speed with load : 25 km / hour.					
			Speed while Returning empty :35 km / hour.					
			a) Machinery.					
			Tipper 10 tonne capacity					
			Time taken for onward haulage with load	hour	0.400	225.00	90.00	P&M-048
			Time taken for empty return trip.	hour	0.290	225.00	65.25	P&M-048
			b) Overhead charges @ 0.15 on (a)				23.29	
			c) Contractor's profit @ 0.1 on (a+b)				17.85	
			cost for 100 t km = a+b+c				196.39	
			Rate per t.km = (a+b+c)/100				1.96	
						say	*2.00*	
1.4		(ii)	Unsurfaced Graveled Road					
			Speed with load: 20 km / hour					
			Speed for empty return trip :30 km / hour					
			a) Machinery					
			Tipper 10 tonnes capacity					
			Time taken for onward haulage with load	hour	0.500	225.00	112.50	P&M-048
			Time taken for empty return trip	hour	0.330	225.00	74.25	P&M-048
			b) Overhead charges @ 0.15 on (a)				28.01	
			c) Contractor's profit @ 0.1 on (a+b)				21.48	
			Cost for 100 t .km = a+b+c				236.24	
			Rate per t.Km = (a+b+c)/100				2.36	
						say	*2.40*	
1.4		(iii)	Katcha Track and Track in River Bed/Nallah Bed and Choe Bed.					
			Speed with load :10 km / hour					
			Speed while returning empty:15 km / hour					
			a) Machinery					
			Tipper 10 tonnes capacity					
			Time taken for onward haulage	hour	1.000	225.00	225.00	P&M-048
			Time taken for empty return trip	hour	0.670	225.00	150.75	P&M-048
			b) Overhead charges @10%				37.58	
			c) Contractor's profit @ 10%				41.33	
			Cost for 100 t .km = a+b+c				454.66	
			Rate per t.Km				4.55	
						say	*4.50*	
1.5			Hand Broken Stone Aggregates 63 mm Nominal Size					
			Supply of quarried stone, hand breaking into coarse aggregate 63 mm nominal size (passing 80 mm and retained on 50 mm sieve) and stacking as directed					
			Unit = cum					
			Taking output = 1 cum					
			a) Labour					
			Mate	day	0.060	275.00	16.50	L-12

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mazdoor	day	1.500	245.00	367.50	L-13
			b) Material					
			Supply of quarried stone 150 - 200 mm size	cum	1.100	227.50	250.25	M-002
			c) Overhead charges @ 0.15 on (a+b)					
			d) Contractor's profit @ 0.1 on (a+b+c)					
			Rate per cum = a+b+c+d				634.25	
						say	*634.00*	
1.6			Crushing of Stone Aggregates 13.2 mm Nominal Size.					
			Crushing of stone boulders of 150 mm size in an integrated stone crushing unit of 200 tonnes per hour capacity comprising of primary and secondary crushing units, belt conveyor and vibrating screens to obtain stone aggregates of 13.2 mm nominal size.					
			Unit = cum					
			Taking Output = 600 cum at crusher location.					
			a) Labour					
			Mate	day	0.760	275.00	209.00	L-12
			Mazdoor Skilled	day	2.000	245.00	490.00	L-14
			Mazdoor including breaking of any oversize boulder.	day	17.000	245.00	4165.00	L-13
			b) Material					
			Stone Boulder of size 150 mm and below	cum	800.000	227.50	182000.00	M-001
			c) Machinery					
			Integrated stone crusher of 200 TPH including belt conveyor and vibrating screens	Hour	6.000	10062.00	60372.00	P&M-028
			Front end loader 1 cum bucket capacity	Hour	20.000	624.00	12480.00	P&M-017
			Tipper 5.5 cum capacity	Hour	20.000	240.00	4800.00	P&M-048
			d) Overhead charges @ 0.15 on (a+b+c)				26451.60	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				29096.76	
			Cost for 600 cum = a+b+c+d+e				320064.36	
			Rate per cum = (a+b+c+d+e)*0.95/600				506.77	
						say	*507.00*	
		Note	1. 800 cum of stone boulders are needed to get 600 cum of stone chips of size 13.2 mm.					
			2. 95 per cent of above cost will be attributed to the production of 600 cum of stone chips of 13.2 mm size and balance 5 per cent to the production of stone dust which comes out as a by-product.					
			3. The integrated stone crusher includes primary and secondary crushing units.					
1.7			Crushing of Stone Aggregates 20 mm Nominal Size					
			Crushing of stone boulders of 150 mm size in an integrated stone crushing unit of 200 tonnes per hour capacity comprising of primary and secondary crushing units, belt conveyor and vibrating screens to obtain stone aggregates of 20 mm nominal size.					
			Unit = cum					
			Taking Output = 670 cum at crusher location.					
			a) Labour					
			Mate	day	0.760	275.00	209.00	L-12
			Mazdoor Skilled	day	2.000	245.00	490.00	L-14
			Mazdoor including breaking of any size boulder.	day	17.000	245.00	4165.00	L-13
			b) Material					
			Stone Boulder of size 150 mm and below	cum	800.000	227.50	182000.00	M-001
			c) Machinery					
			Integrated stone crusher of 200 TPH including belt conveyor and vibrating screens	Hour	6.000	10062.00	60372.00	P&M-028
			Front end loader 1 cum bucket capacity	Hour	20.000	624.00	12480.00	P&M-017
			Tipper 5.5 cum capacity	Hour	20.000	240.00	4800.00	P&M-048
			d) Overhead charges @ 0.15 on (a+b+c)				26451.60	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				29096.76	
			Cost for 670 cum = a+b+c+d+e				320064.36	
			Rate per cum = (a+b+c+d+e)*0.90/670				429.94	
						say	*430.00*	
		Note	1. 800 cum of stone boulders are needed to get 600 cum of stone chips of size 20 and 40 mm.					
			2. 90 per cent of above cost will be attributed to the production of 670 cum of stone aggregates of 20mm size and balance 10 per cent will be for smaller size aggregates and stone dust which comes out as a by-product.					
			3. The integrated stone crusher includes primary and secondary crushing units.					
1.8			Crushing of Stone Aggregates 40 mm Nominal Size					
			Crushing of stone boulders of 150 mm size in an integrated stone crushing unit of 200 tonnes per hour capacity comprising of primary and secondary crushing units, belt conveyor and vibrating screens to obtain stone aggregates of 40 mm nominal size.					
			Unit = cum					
			Taking Output = 750 cum at crusher location.					
			a) Labour					
			Mate	day	0.760	275.00	209.00	L-12
			Mazdoor Skilled	day	2.000	245.00	490.00	L-14
			Mazdoor	day	17.000	245.00	4165.00	L-13
			b) Material					
			Stone Boulder of size 150 mm and below	cum	800.000	227.50	182000.00	M-001
			c) Machinery					
			Integrated stone crusher of 200 TPH including belt conveyor and vibrating screens	Hour	6.000	10062.00	60372.00	P&M-028
			Front end loader 1 cum bucket capacity	Hour	20.000	624.00	12480.00	P&M-017
			Tipper 5.5 cum capacity	Hour	20.000	240.00	4800.00	P&M-048
			d) Overhead charges @ 0.15 on (a+b+c)					
			e) Contractor's profit @ 0.1 on (a+b+c+d)					
			Cost for 750 cum = (a+b+c+d+e)x0.85				224838.60	
			Rate per cum = (a+b+c+d+e)x0.85/750				299.78	
						say	*300.00*	
		Note	1. 800 cum of stone boulders are needed to get 600 cum of stone chips of size 13.2 mm.					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			2. 85 per cent of above cost will be attributed to the production of 750 cum of stone aggregates of 40mm size and balance 15 per cent will be for smaller size aggregates and stone dust which comes out as a by-product.					
			3. The integrated stone crusher includes primary and secondary crushing units.					

CHAPTER-2
SITE CLEARANCE

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
2.1	201		Cutting of Trees, including cutting of Trunks, Branches and Removal					
			Cutting of trees, including cutting of trunks, branches and removal of stumps, roots, stacking of serviceable material with all lifts and up to a lead of 1000 metres and earth filling in the depression/pit.					
			Unit = Each					
		(i)	Girth from 300 mm to 600 mm					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoors for cutting trees including cutting, refilling, compaction of backfilling and stacking of serviceable materials within 1000 metres lead by manual means.	day	0.600	245.00	147.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.100	280.00	28.00	P&M-053
			c) Overhead charges @ 10%				18.05	
			d) Contractor's profit @ 10%				19.86	
			Rate for each tree				218.41	
						say	*218.00*	
2.1		(ii)	Girth from 600 mm to 900 mm					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoors for cutting trees including cutting, refilling, compaction of backfilling, and stacking of serviceable materials within 1000 metres lead by	day	0.900	245.00	220.50	L-13
			b) Machinery					
			Tractor-trolley	hour	0.300	280.00	84.00	P&M-053
			c) Overhead charges @ 10%				31.55	
			d) Contractor's profit @ 10%				34.71	
			Rate for each tree				381.76	
						say	*382.00*	
2.1		(iii)	Girth from 900 mm to 1800 mm					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoors for cutting trees including cutting, refilling, compaction of backfilling and stacking of serviceable materials within 1000 metres	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.400	280.00	112.00	P&M-053
			c) Overhead charges @ 10%				62.40	
			d) Contractor's profit @ 10%				68.64	
			Rate for each tree				755.04	
						say	*755.00*	
2.1		(iv)	Girth above 1800 mm					
			a) Labour					
			Mate	day	0.160	275.00	44.00	L-12
			Mazdoors for cutting trees including cutting, refilling, compaction of backfilling and stacking of serviceable materials within 1000 metres	day	4.000	245.00	980.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.600	280.00	168.00	P&M-053
			c) Overhead charges @ 10%				119.20	
			d) Contractor's profit @ 10%				131.12	
			Rate for each tree				1442.32	
						say	*1442.00*	
2.2	201		Clearing Grass and Removal of Rubbish					
			Clearing grass and removal of rubbish up to a distance of 50 metres outside the periphery of the area .					
			By Manual Means					
			Unit = Hectare					
			Taking output = 1 Hectare					
			a) Labour					
			Mate	day	2.000	275.00	550.00	L-12
			Mazdoor	day	50.000	245.00	12250.00	L-13
			c) Overhead charges @ 10%				1280.00	
			d) Contractor's profit @ 10%				1408.00	
			Rate per Hectare				15488.00	
						say	*15488.00*	
2.3	201		Clearing and Grubbing Road Land .					
			Clearing and grubbing road land including uprooting rank vegetation, grass, bushes, shrubs, saplings and trees girth up to 300 mm, removal of stumps of trees cut earlier and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned, up to a lead of 1000 metres including removal and disposal of top organic soil not exceeding 150 mm in thickness.					
			Unit = Hectare					
			Taking output = 1 Hectare					
		(i)	By Manual Means:-					
		A	In area of light jungle					
			a) Labour					
			Mate	day	6.000	275.00	1650.00	L-12
			Mazdoor	day	150.000	245.00	36750.00	L-13
			b) Machinery					
			Tractor-trolley	hour	1.000	280.00	280.00	P&M-053
			c) Overhead charges @ 10%				3868.00	
			d) Contractor's profit @ 10%				4254.80	
			Rate per Hectare				46802.80	
						say	*46803.00*	
2.3 (i)		B	In area of thorny jungle					
			a) Labour					
			Mate	day	8.000	275.00	2200.00	L-12
			Mazdoor	day	200.000	245.00	49000.00	L-13
			b) Machinery					
			Tractor-trolley	hour	2.000	280.00	560.00	P&M-053
			c) Overhead charges @ 10%				5176.00	
			d) Contractor's profit @ 10%				5693.60	
			Rate per Hectare				62629.60	
						say	*62630.00*	
2.3		(ii)	By Mechanical Means					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		A	In area of light jungle					
			a) Labour					
			Mate	day	0.160	275.00	44.00	L-12
			Mazdoor	day	4.000	245.00	980.00	L-13
			b) Machinery					
			Dozer 80 HP with attachment for removal of trees & stumps	hour	10.000	1565.00	15650.00	P&M-014
			Tractor-trolley	hour	1.000	280.00	280.00	P&M-053
			c) Overhead charges @ 10%				1695.40	
			d) Contractor's profit @ 10%				1864.94	
			Rate per Hectare				20514.34	
						say	*20514.00*	
2.3 (ii)		B	In area of thorny jungle					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			b) Machinery					
			Dozer 80 HP with attachment for removal of trees & stumps	hour	12.000	1565.00	18780.00	P&M-014
			Tractor-trolley	hour	1.500	280.00	420.00	P&M-053
			c) Overhead charges @ 10%				2073.60	
			d) Contractor's profit @ 10%				2280.96	
			Rate per Hectare				25090.56	
						say	*25091.00*	
2.4	202		Dismantling of Structures					
			Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts and lead of 1000 metres					
			Unit = cum					
			Taking output = 1.25 cum					
		(i)	Lime /Cement Concrete					
		I	By Manual Means					
		A	Lime Concrete, cement concrete grade M-10 and below					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor for dismantling and loading	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				33.16	
			d) Contractor's profit @ 10%				36.48	
			Cost for 1.25 cum				401.24	
			Rate per cum				320.99	
						say	*321.00*	
2.4 (i)		B	Cement Concrete Grade M-15 & M-20					
			a) Labour					
			Mate	day	0.050	275.00	13.75	L-12
			Mazdoor for dismantling and loading	day	1.250	245.00	306.25	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				39.56	
			d) Contractor's profit @ 10%				43.52	
			Cost for 1.25 cum				478.68	
			Rate per cum				382.94	
						say	*383.00*	
2.4 (i)		C	Prestressed / Reinforced cement concrete grade M-20 & above					
			a) Labour					
			Mate	day	0.150	275.00	41.25	L-12
			Blacksmith	day	0.250	245.00	61.25	L-02
			Mazdoor for dismantling, loading and unloading	day	3.500	245.00	857.50	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				103.56	
			d) Contractor's profit @ 10%				113.92	
			Cost for 1.25 cum				1253.08	
			Rate per cum				1002.46	
						say	*1002.00*	
2.4		II	By Mechanical Means for items No. 202(b)& (c)					
		A	Cement Concrete Grade M-15 & M-20					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor for loading and unloading	day	0.250	245.00	61.25	L-13
			Mazdoor with Pneumatic breaker	day	0.250	250.00	62.50	L-14
			b) Machinery					
			Air Compressor 250 cfm with 2 leads of pneumatic breaker @ 1.5 cum per hour	hour	0.670	257.00	172.19	P&M-001
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				37.70	
			d) Contractor's profit @ 10%				41.47	
			Cost for 1.25 cum				456.22	
			Rate per cum				364.97	
						say	*365.00*	
2.4 II		B	Prestressed / reinforced cement concrete grade M-20 & above					
			a) Labour					
			Mate	day	0.050	275.00	13.75	L-12
			Mazdoor with Pneumatic breaker	day	0.660	245.00	161.70	L-14
			Blacksmith	day	0.250	245.00	61.25	L-02
			Mazdoor for loading and unloading	day	0.250	245.00	61.25	L-13
			b) Machinery					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Air Compressor 250 cfm with 2 leads of pneumatic breaker @ 1.00 cum per hour	hour	1.000	257.00	257.00	P&M-001
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				63.06	
			d) Contractor's profit @ 10%				69.36	
			Cost for 1.25 cum				762.97	
			Rate per cum				610.37	
						say	610.00	
2.4		(ii)	Dismantling Brick / Tile work					
		A	In lime mortar					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor for dismantling, loading and unloading	day	0.500	245.00	122.50	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				20.36	
			d) Contractor's profit @ 10%				22.40	
			Cost for 1.25 cum				246.36	
			Rate per cum				197.08	
						say	197.00	
2.4 (ii)		B	In cement mortar					
			a) Labour					
			Mate	day	0.030	275.00	8.25	L-12
			Mazdoor for dismantling, loading and unloading	day	0.750	245.00	183.75	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				26.76	
			d) Contractor's profit @ 10%				29.44	
			Cost for 1.25 cum				323.80	
			Rate per cum				259.04	
						say	259.00	
2.4 (ii)		C	In mud mortar					
			a) Labour					
			Mate	day	0.016	275.00	4.40	L-12
			Mazdoor for dismantling and loading	day	0.400	245.00	98.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				26.70	
			d) Contractor's profit @ 10%				20.47	
			Cost for 1.25 cum				225.17	
			Rate per cum				180.14	
						say	180.00	
2.4 (ii)		D	Dry brick pitching or brick soling					
			a) Labour					
			Mate	day	0.014	275.00	3.85	L-12
			Mazdoor for Dismantling, loading and unloading	day	0.350	245.00	85.75	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				16.52	
			d) Contractor's profit @ 10%				18.17	
			Cost for 1.25 cum				199.89	
			Rate per cum				159.91	
						say	160.00	
2.4		(iii)	Dismantling Stone Masonry					
		A	Rubble stone masonry in lime mortar					
			a) Labour					
			Mate	day	0.024	275.00	6.60	L-12
			Mazdoor for dismantling, loading and unloading.	day	0.600	245.00	147.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				22.92	
			d) Contractor's profit @ 10%				25.21	
			Cost for 1.25 cum				277.33	
			Rate per cum				221.87	
						say	222.00	
2.4 (iii)		B	Rubble stone masonry in cement mortar.					
			a) Labour					
			Mate	day	0.030	275.00	8.25	L-12
			Mazdoor for dismantling, loading and unloading.	day	0.750	245.00	183.75	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				26.76	
			d) Contractor's profit @ 10%				29.44	
			Cost for 1.25 cum				323.80	
			Rate per cum				259.04	
						say	259.00	
2.4 (iii)		C	Rubble Stone Masonry in mud mortar.					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor for dismantling, loading and unloading.	day	0.500	245.00	122.50	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				20.36	
			d) Contractor's profit @ 10%				22.40	
			Cost for 1.25 cum				246.36	
			Rate per cum				197.08	
						say	197.00	
2.4 (iii)		D	Dry rubble masonry					
			a) Labour					
			Mate	day	0.018	275.00	4.95	L-12
			Mazdoor for dismantling, loading and unloading.	day	0.450	245.00	110.25	L-13
			b) Machinery					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				19.08	
			d) Contractor's profit @ 10%				20.99	
			Cost for 1.25 cum				230.87	
			Rate per cum				184.69	
						say	*185.00*	
2.4 (iii)		E	Dismantling stone pitching/ dry stone spalls.					
			a) Labour					
			Mate	day	0.016	275.00	4.40	L-12
			Mazdoor for dismantling, loading and unloading.	day	0.400	245.00	98.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				17.80	
			d) Contractor's profit @ 10%				19.58	
			Cost for 1.25 cum				215.38	
			Rate per cum				172.30	
						say	*172.00*	
2.4 (iii)		F	Dismantling boulders laid in wire crates including opening of crates and stacking dismantled materials.					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor for dismantling, loading and unloading	day	0.500	245.00	122.50	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				20.36	
			d) Contractor's profit @ 10%				22.40	
			Cost for 1.25 cum				246.36	
			Rate per cum				197.08	
						say	*197.00*	
2.4		(iv)	Wood Work wrought framed and fixed in frames of trusses upto a height of 5 m above plinth level					
			a) Labour					
			Mate	day	0.060	275.00	16.50	L-12
			Carpenter	day	0.500	250.00	125.00	L-04
			Mazdoor for dismantling, loading and unloading.	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.270	280.00	75.60	P&M-053
			c) Overhead charges @ 10%				46.21	
			d) Contractor's profit @ 10%				50.83	
			Cost for 1.25 cum				559.14	
			Rate per cum				447.31	
						say	*447.00*	
2.4		(v)	Steel Work in all types of sections upto a height of 5 m above plinth level excluding cutting of rivet.					
			Unit = tonne					
			Taking output = 1 tonne					
		A	Including dismembering					
			a) Labour					
			Mate	day	0.140	275.00	38.50	L-12
			Blacksmith	day	1.000	245.00	245.00	L-02
			Mazdoor for dismantling, loading and unloading	day	2.500	245.00	612.50	L-13
			Add 2.5 per cent of cost of labour for gas cutting, ropes, pulleys etc.				22.40	
			b) Machinery					
			Tractor-trolley	hour	0.170	280.00	47.60	P&M-053
			c) Overhead charges @ 10%				96.60	
			d) Contractor's profit @ 10%				106.26	
			Rate per tonne				1168.86	
						say	*1169.00*	
2.4 (v)		B	Excluding dismembering.					
			a) Labour					
			Mate	day	0.220	275.00	60.50	L-12
			Mazdoor for dismantling, loading and unloading	day	2.000	245.00	490.00	L-13
			Blacksmith	day	0.500	245.00	122.50	L-02
			Add 2.5 per cent of cost of labour for gas cutting, ropes, pulleys etc.				16.83	
			b) Machinery					
			Tractor-trolley	hour	0.170	280.00	47.60	P&M-053
			c) Overhead charges @ 10%				73.74	
			d) Contractor's profit @ 10%				81.12	
			Rate per tonne				892.28	
						say	*892.00*	
2.4 (v)		C	Extra over item No(v) A and(v) B for cutting rivets.					
			Unit = each					
			Taking output = 10 rivets					
			a) Labour					
			Mate	day	0.010	275.00	2.75	L-12
			Blacksmith	day	0.130	245.00	31.85	L-02
			Mazdoor	day	0.130	245.00	31.85	L-13
			b) Overhead charges @ 10%				6.65	
			c) Contractor's profit @ 10%				7.31	
			Cost for 10 rivets				80.40	
			Rate for each rivet				8.04	
						say	*8.00*	
2.4		(vi)	Scraping of Bricks Dismantled from Brick Work including Stacking.					
			Unit = numbers					
			Taking output = 1000 numbers					
		A	In lime/Cement mortar					
			a) Labour					
			Mate	day	0.140	275.00	38.50	L-12
			Mazdoor	day	3.500	245.00	857.50	L-13
			b) Overhead charges @ 10%				89.60	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			c) Contractor's profit @ 10%				98.56	
			Rate per1000 Nos				1084.16	
						say	*1084.00*	
2.4 (iv)		B	In mud mortar					
			a) Labour					
			Mate	day	0.050	275.00	13.75	L-12
			Mazdoor	day	1.250	245.00	306.25	L-13
			b) Overhead charges @ 10%				32.00	
			c) Contractor's profit @ 10%				35.20	
			Rate per1000 Nos				387.20	
						say	*387.00*	
2.4		(vii)	Scraping of Stone from Dismantled Stone Masonry					
			Unit = cum					
			Taking output = 1 cum					
		A	In cement and lime mortar					
			a) Labour					
			Mate	day	0.060	275.00	16.50	L-12
			Mazdoor	day	1.400	245.00	343.00	L-13
			b) Overhead charges @ 10%				35.95	
			c) Contractor's profit @ 10%				39.55	
			Rate per cum				435.00	
						say	*435.00*	
2.4 (vii)		B	In Mud mortar					
			a) Labour					
			Mate	day	0.010	275.00	2.75	L-12
			Mazdoor	day	0.300	245.00	73.50	L-13
			b) Overhead charges @ 10%				7.63	
			c) Contractor's profit @ 10%				8.39	
			Rate per cum				92.26	
						say	*92.00*	
2.4		(viii)	Scarping Plaster in Lime or Cement Mortar from Brick/ Stone Masonry					
			Unit = sqm					
			Taking output = 100 sqm					
			a) Labour					
			Mate	day	0.160	275.00	44.00	L-12
			Mazdoor for scarping and loading	day	4.000	245.00	980.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.320	280.00	89.60	P&M-053
			c) Overhead charges @ 10%				111.36	
			d) Contractor's profit @ 10%				122.50	
			Cost for 100 sqm				1347.46	
			Rate per sqm				13.47	
						say	*13.00*	
2.4		(ix)	Removing all type of Hume Pipes and Stacking within a lead of 1000 metres including Earthwork and Dismantling of Masonry Works.					
			Unit = metre					
			Taking output = 1 metre					
		A	Up to 600 mm dia					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor	day	0.520	245.00	127.40	L-13
			c) Overhead charges @ 10%				13.29	
			d) Contractor's profit @ 10%				14.62	
			Rate per metre				160.81	
						say	*161.00*	
2.4 (ix)		B	Above 600 mm to 900 mm dia					
			a) Labour					
			Mate	day	0.030	275.00	8.25	L-12
			Mazdoor	day	0.700	245.00	171.50	L-13
			c) Overhead charges @ 10%				17.98	
			d) Contractor's profit @ 10%				19.77	
			Rate per metre				217.50	
						say	*217.00*	
2.4 (ix)		C	Above 900 mm					
			a) Labour					
			Mate	day	0.050	275.00	13.75	L-12
			Mazdoor	day	1.200	245.00	294.00	L-13
			b) Overhead charges @ 10%				30.78	
			c) Contractor's profit @ 10%				33.85	
			Rate per metre				372.38	
						say	*372.00*	
		Note	1. The excavation of earth, dismantling of stone masonry work in head walls and protection works is not included which is to be measured and paid separately.					
			2. Credit for retrieved stone from masonry work may be taken as per actual availability.					
2.5	202		Dismantling of Flexible Pavements					
			Dismantling of flexible pavements and disposal of dismantled materials up to a lead of 1000 metres, stacking serviceable and unserviceable materials separately					
			Unit = cum					
			Taking output = 1 cum					
		I	By Manual Means					
		A	Bituminous courses					
			a) Labour					
			Mate	day	0.060	275.00	16.50	L-12
			Mazdoor for dismantling, loading and unloading	day	1.500	245.00	367.50	L-13
			b) Machinery					
			Tractor-trolley	hour	0.380	280.00	106.40	P&M-053
			c) Overhead charges @ 10%				49.04	
			d) Contractor's profit @ 10%				53.94	
			Rate per cum				593.38	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
						say	*593.00*	
2.5 I		B	Granular courses					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor for dismantling, loading and unloading.	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.330	280.00	92.40	P&M-053
			c) Overhead charges @ 10%				34.84	
			d) Contractor's profit @ 10%				38.32	
			Rate per cum				421.56	
						say	*422.00*	
2.5		II	By Mechanical Means					
		A	Bituminous course					
			a) Labour					
			Mate	day	0.010	275.00	2.75	L-12
			Mazdoor	day	0.300	245.00	73.50	L-13
			b) Machinery					
			Tractor-trolley	hour	0.380	280.00	106.40	P&M-053
			Farm tractor with ripper @ 60 cum per hour	hour	0.017	280.00	4.76	P&M-055
			c) Overhead charges @ 10%				18.74	
			d) Contractor's profit @ 10%				20.62	
			Rate per cum				226.77	
						say	*227.00*	
2.6	202		Dismantling of Cement Concrete Pavement					
			Dismantling of cement concrete pavement by mechanical means using pneumatic tools, breaking to pieces not exceeding 0.02 cum in volume and stock piling at designated locations and disposal of dismantled materials up to a lead of 1000 metres, stacking serviceable and unserviceable materials separately					
			Unit = cum					
			Taking output = 1 cum					
			a) Labour					
			Mate	day	0.030	275.00	8.25	L-12
			Semi skilled mazdoor for operating pneumatic tools	day	0.500	250.00	125.00	L-14
			Mazdoors as helpers including loading and unloading	day	0.500	245.00	122.50	L-13
			b) Machinery					
			Air compressor 250 cfm with two leads for pneumatic cutters/ hammers @ 1 cum per hour	hour	1.000	257.00	257.00	P&M-001
			Tractor-trolley	hour	0.400	280.00	112.00	P&M-053
			Joint Cutting Machine with 2-3 blades	hour	1.000	250.00	250.00	P&M-083
			c) Overhead charges @ 10%				87.48	
			d) Contractor's profit @ 10%				96.22	
			Rate per cum = a+b+c+d				1058.45	
						say	*1058.00*	
		Note	The above analysis is for removal of complete pavement. In case full depth repair work is required to be done after dismantling, provision of a concrete cutting and sawing machine may be added for 0.25 hours.					
2.7	202		Dismantling of Guard Rails					
			Dismantling guard rails by manual means and disposal of dismantled material with all lifts and up to a lead of 1000 metres, stacking serviceable materials and unserviceable materials separately.					
			Unit = running metre					
			Taking output = 1 metre					
			a) Labour					
			Mate	day	0.006	275.00	1.65	L-12
			Mazdoor including loading and unloading	day	0.150	245.00	36.75	L-13
			b) Machinery					
			Tractor-trolley	hour	0.050	280.00	14.00	P&M-053
			c) Overhead charges @ 10%				5.24	
			d) Contractor's profit @ 10%				5.76	
			Rate per metre				63.40	
						say	*63.00*	
2.8	202		Dismantling of Kerb Stone					
			Dismantling kerb stone by manual means and disposal of dismantled material with all lifts and up to a lead of 1000 metre					
			Unit = running metre					
			Taking output = 10 metre					
			a) Labour					
			Mate	day	0.010	275.00	2.75	L-12
			Mazdoor including loading and unloading	day	0.150	245.00	36.75	L-13
			b) Machinery					
			Tractor-trolley	hour	0.200	280.00	56.00	P&M-053
			c) Overhead charges @ 10%				9.55	
			d) Contractor's profit @ 10%				10.51	
			Cost for 10 m				115.56	
			Rate per metre				11.56	
						say	*12.00*	
2.9	202		Dismantling of Kerb Stone Channel					
			Dismantling kerb stone channel by manual means and disposal of dismantled material with all lifts and up to a lead of 1000 metre					
			Unit = running metre					
			Taking output = 10 metre					
			a) Labour					
			Mate	day	0.015	275.00	4.13	L-12
			Mazdoor including loading and unloading	day	0.225	245.00	55.13	L-13
			b) Machinery					
			Tractor-trolley	hour	0.300	280.00	84.00	P&M-053
			c) Overhead charges @ 10%				21.49	
			d) Contractor's profit @ 10%				16.47	
			Cost for 10 m = a+b+c+d				181.21	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Rate per metre = (a+b+c+d)/10				18.12	
						say	*18.00*	
2.10	202		Dismantling of Kilometre Stone					
			Dismantling of kilometre stone including cutting of earth, foundation and disposal of dismantled material with all lifts and lead upto 1000 m and back filling of pit.					
			Unit = Each					
			Taking output = one KM stone					
	A		5th KM stone					
			Quantity of cement concrete = 0.392 cum					
			a) Labour					
			Mate	day	0.130	275.00	35.75	L-12
			Mazdoor	day	0.750	245.00	183.75	L-13
			b) Machinery					
			Tractor-trolley	hour	0.150	280.00	42.00	P&M-053
			c) Overhead charges @ 10%				26.15	
			d) Contractor's profit @ 10%				28.77	
			Rate for one 5th KM stone				316.42	
						say	*316.00*	
	B		Ordinary KM Stone					
			Quantity of cement concrete = 0.269 cum					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor	day	0.500	245.00	122.50	L-13
			b) Machinery					
			Tractor-trolley	hour	0.100	280.00	28.00	P&M-053
			c) Overhead charges @ 10%				15.60	
			d) Contractor's profit @ 10%				17.16	
			Rate for one ordinary KM stone				188.76	
						say	*189.00*	
	C		Hectometre Stone					
			Quantity of cement concrete = 0.048 cum					
			a) Labour					
			Mate	day	0.004	275.00	1.10	L-12
			Mazdoor	day	0.100	245.00	24.50	L-13
			b) Machinery					
			Tractor-trolley	hour	0.020	280.00	5.60	P&M-053
			c) Overhead charges @ 10%				3.12	
			d) Contractor's profit @ 10%				3.43	
			Rate for one Hectometre stone				37.75	
						say	*38.00*	
2.11	202		Dismantling of Fencing					
			Dismantling of barbed wire fencing/ wire mesh fencing including posts, foundation concrete, back filling of pit by manual means including disposal of dismantled material with all lifts and up to a lead of 1000 metres, stacking serviceable material and unserviceable material separately.					
			Unit = running metre					
			Taking output = 30 metres					
			a) Labour					
			Mate	day	0.150	275.00	41.25	L-12
			Mazdoor including loading and unloading	day	3.000	245.00	735.00	L-13
			Blacksmith	day	0.750	245.00	183.75	L-02
			b) Machinery					
			Tractor-trolley	hour	0.150	280.00	42.00	P&M-053
			c) Overhead charges @ 10%				100.20	
			d) Contractor's profit @ 10%				110.22	
			Cost for 30 metres				1212.42	
			Rate per metre				40.41	
						say	*40.00*	
2.12	202		Dismantling of CI Water Pipe Line					
			Dismantling of CI water pipe line 600 mm dia including disposal with all lifts and lead upto 1000 metres and stacking of serviceable material and unserviceable material separately under supervision of concerned department					
			Unit = running metre					
			Taking output = 10 metres					
			a) Labour					
			Mate	day	0.090	275.00	24.75	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			Plumber	day	0.250	275.00	68.75	L-02
			b) Machinery					
			Truck 10 tonne capacity	hour	0.250	225.00	56.25	P&M-057
			Light Crane 3 tonne capacity	hour	0.500	241.00	120.50	P&M-013
			c) Overhead charges @ 10%				76.03	
			d) Contractor's profit @ 10%				83.63	
			Cost for 10 metres				919.90	
			Rate per metre				91.99	
						say	*92.00*	
		Note	The rate analysis does not include any excavation in earth or dismantling of masonry works which are to be measured and paid separately.					
2.13	202		Removal of Cement Concrete Pipe of Sewer Gutter					
			Removal of cement concrete pipe of sewer gutter 1500 mm dia under the supervision of concerned department including disposal with all lifts and up to a lead of 1000 metres and stacking of serviceable and unserviceable material separately but excluding earth excavation and dismantling of masonry works.					
			Unit = running metre					
			Taking output = 10 metres					
			a) Labour					
			Mate	day	0.100	275.00	27.50	L-12
			Mazdoor	day	2.500	245.00	612.50	L-13

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			b) Machinery					
			Crane 5 tonne capacity	hour	0.300	241.00	72.30	P&M-070
			Truck flat body 10 tonne	hour	1.000	225.00	225.00	P&M-057
			c) Overhead charges @ 10%				93.73	
			d) Contractor's profit @ 10%				103.10	
			Cost for 10 metres				1134.13	
			Rate per metre				113.41	
						say	*113.00*	
		Note	The rate analysis does not include any excavation in earth or dismantling of masonry works which are to be measured and paid separately.					
2.14	202		Removal of Telephone / Electric Poles and Lines					
			Removal of telephone / Electric poles including excavation and dismantling of foundation concrete and lines under the supervision of concerned department, disposal with all lifts and up to a lead of 1000 metres and stacking the serviceable and unserviceable material separately					
			Unit = each					
			Taking output = 30 Nos					
			a) Labour					
			Mate	day	0.480	275.00	132.00	L-12
			Mazdoor	day	10.000	245.00	2450.00	L-13
			Electrician/Lineman	day	2.000	250.00	500.00	L-02
			b) Machinery					
			Tractor-trolley	hour	1.500	280.00	420.00	P&M-053
			c) Overhead charges @ 10%				350.20	
			d) Contractor's profit @ 10%				385.22	
			Cost for 30 poles				4237.42	
			Rate per pole				141.25	
						say	*141.00*	

CHAPTER - 3
EARTH WORK, EROSION CONTROL AND DRAINAGE

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
3.1	301		Excavation in Soil by Manual Means .					
			Excavation for roadway in soil using manual means including loading in truck for carrying of cut earth to embankment site with all lifts and lead upto1000 metres.					
			Unit = cum					
			Taking output = 120 cum					
			a) Labour					
			Mate	day	1.800	275.00	495.00	L-12
			Mazdoor	day	45.000	245.00	11025.00	L-13
			b) Machinery					
			Truck 5.5 cum capacity	hour	10.000	240.00	2400.00	P&M-057
			c) Overhead charges @ 10%				1392.00	
			d) Contractor's profit @ 10%				1531.20	
			Cost of 120 cum				16843.20	
			Rate per cum				140.36	
						say	*140.00*	
		Note	In case there is a situation where the cross-section is of cut and fill and cut earth is required to be used in embankment in the immediate vicinity, the item of carriage in the truck shall be omitted.					
3.2	301		Excavation in Ordinary Rock by Manual Means					
			Excavation in ordinary rock using manual means including loading in a truck and carrying of excavated material to embankment site with in all lifts and leads upto 1000 metres					
			Unit = cum					
			Taking output = 120 cum					
			a) Labour					
			Mate	day	2.800	275.00	770.00	L-12
			Mazdoor	day	70.000	245.00	17150.00	L-13
			b) Machinery					
			Truck 5.5 cum capacity	hour	10.000	240.00	2400.00	P&M-057
			c) Overhead charges @ 10%				2032.00	
			d) Contractor's profit @ 10%				2235.20	
			Cost for 120 cum				24587.20	
			Rate per cum				204.89	
						say	*205.00*	
		Note	In case there is a situation where the cross-section is of cut and fill and cut earth is required to be used in embankment in the immediate vicinity, the item of carriage in the truck shall be omitted.					
3.3	301		Excavation in Soil with Dozer with lead upto 100 metres					
			Excavation for road way in soil by mechanical means including cutting and pushing the earth to site of embankment upto a distance of 100 metres (average lead50 metres), including trimming bottom and side slopes in accordance with requirements of lines, grades and cross sections.					
			Unit = cum					
			Taking output = 180 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Dozer, 80 HP @ 30 cum per hour	hour	6.000	2640.00	15840.00	P&M-014
			c) Overhead charges @ 10%				1635.20	
			d) Contractor's profit @ 10%				1798.72	
			Cost for 180 cum				19785.92	
			Rate per cum				109.92	
						say	*110.00*	
3.4	301		Excavation in Ordinary Rock with Dozer with lead upto 100 metres					
			Excavation for roadway in ordinary rock by deploying a dozer, 80 HP including cutting and pushing the cut earth to site of embankment upto a distance of 100 metres (average lead 50 metres), trimming bottom and side slopes in accordance with the requirements of lines, grades and cross sections.					
			Unit = cum					
			Taking output = 108 cum					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Mazdoor	day	3.000	245.00	735.00	L-13
			b) Machinery					
			Dozer, 80 HP @ 20 cum per hour	hour	6.000	2640.00	15840.00	P&M-014
			c) Overhead charges @ 10%				1660.80	
			d) Contractor's profit @ 10%				1826.88	
			Cost for 108 cum				20095.68	
			Rate per cum				186.07	
						say	*186.00*	
3.5	301		Excavation in Hard Rock (requiring blasting) with disposal upto 1000 metres					
			Excavation for roadway in hard rock (requiring blasting) by drilling, blasting and breaking, trimming of bottom and side slopes in accordance with requirements of lines, grades and cross sections, loading and disposal of cut road with in all lifts and leads upto 1000 metres					
			Unit = cum					
			Taking 0utput = 180 cum					
			a) Labour					
			Mate	day	0.220	275.00	60.50	L-12
			Mazdoor	day	3.000	245.00	735.00	L-13
			Driller	day	2.000	245.00	490.00	L-06
			Blaster	day	0.250	250.00	62.50	L-03
			b) Machinery					
			Dozer, 80 HP @ 30 cum per hour	hour	6.000	2640.00	15840.00	P&M-014
			Air compressor, 250 cfm with 2 jack hammer	hour	6.000	257.00	1542.00	P&M-001
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper10 tonne capacity	hour	11.250	225.00	2531.25	P&M-048
			c) Materials					
			Gelatin 80 per cent	kg	63.000	102.00	6426.00	M-104
			Electric Detonators @ 1 detonator for 2 gelatin sticks of 125 gms each	each	252.000	6.12	1542.24	M-094 /100
			Credit for excavated rock found suitable for use @ 50 per cent quantity blasted	cum	90.000	(30.00)	(2700.00)	M-089
			c) Overhead charges @ 10%				3027.35	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			d) Contractor's profit @ 10%				3330.08	
			Cost for 180 cum				36630.92	
			Rate per cum				203.51	
						say	*204.00*	
		Note	1. The quality and availability of rock shall be checked before affording credit.					
			2. In case some rock is issued to the contractor at site, the item of carriage shall be reduced/restricted to that extent.					
3.6	301		Excavation in Soil using Hydraulic Excavator CK 90 and Tippers with Disposal upto 5000 metres.					
			Excavation for roadwork in soil with hydraulic excavator of 0.9 cum bucket capacity including cutting and loading in tippers, trimming bottom and side slopes, in accordance with requirements of lines, grades and cross sections, and transporting to the embankment location within all lifts and lead upto 1000m					
			Unit = cum					
			Taking output = 360 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Hydraulic excavator 0.9 cum bucket capacity @ 60 cum per hour	hour	6.000	1008.00	6048.00	P&M-026
			Tipper 5.5 cum capacity, 4 trips per hour.	hour	16.000	240.00	3840.00	P&M-048
			c) Overhead charges @ 10%				1040.00	
			d) Contractor's profit @ 10%				1144.00	
			Cost for 360 cum				12584.00	
			Rate per cum				34.96	
						say	*35.00*	
3.7	301		Excavation in Ordinary Rock using Hydraulic Excavator CK-90 and Tippers with Disposal upto 5000 metres.					
			Excavation for roadway in ordinary rock with hydraulic excavator of 0.9 cum bucket capacity including cutting and loading in tippers, transporting to embankment site within all lifts and lead upto 1000 m, trimming bottom and side slopes in accordance with requirements of lines, grades and cross sections.					
			Unit = cum					
			Taking output = 240 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Hydraulic Excavator 0.90 cum bucket capacity @ 36 cum per hour	hour	6.000	1008.00	6048.00	P&M-026
			Tipper 5.5 cum capacity, 4 trips per hour.	hour	11.000	225.00	2475.00	P&M-048
			c) Overhead charges @ 10%				903.50	
			d) Contractor's profit @ 10%				993.85	
			Cost for 240 cum				10932.35	
			Rate per cum				45.55	
						say	*46.00*	
3.8	301		Excavation in Hard Rock (blasting prohibited)					
			Excavation for roadway in hard rock (blasting prohibited) with rock breakers including breaking rock, loading in tippers and disposal within all lifts and lead upto 1000 metres, trimming bottom and side slopes in accordance with requirements of lines, grades and cross sections.					
		A	Mechanised					
			Unit = cum					
			Taking output = 36 cum					
			a) Labour					
			Mate	day	0.400	275.00	110.00	L-12
			Mazdoor for trimming slopes including mannul loading in truck	day	10.000	245.00	2450.00	L-13
			b) Machinery					
			Hydraulic excavator with rock breaker attachment @ 6 cum per hour	hour	6.000	1200.00	7200.00	P&M-026
			Tipper 5.5 cum capacity, 1 trip per hour.	hour	6.500	225.00	1462.50	P&M-048
			Credit for excavated rock found suitable for use @ 50 per cent of excavated quantity	cum	18.000	(30.00)	(540.00)	M-089
			c) Overhead charges @ 10%				1068.25	
			d) Contractor's profit @ 10%				1175.08	
			Cost for 36 cum				12925.83	
			Rate per cum				359.05	
						say	*359.00*	
		Note	1. The quality and availability of rock shall be checked before affording credit.					
			2. In case some rock is issued to the contractor at site, the item of carriage shall be restricted/reduced to that extent.					
			3.Being small quantity, manual loading will be economical in this case and has been provided accordingly.					
3.8		B	Manual Method					
			Unit = cum					
			Taking output = 16 cum					
			a) Labour					
			Mate	day	1.640	275.00	451.00	L-12
			Mazdoor including loading in truck	day	16.000	245.00	3920.00	L-13
			Chiseller	day	24.000	275.00	6600.00	L-05
			Blacksmith	day	1.000	245.00	245.00	L-02
			b) Machinery					
			Tipper 5.5 cum capacity, 1 trip per hour.	hour	2.900	225.00	652.50	P&M-048
			Credit for excavated rock found suitable for use @ 50 per cent of excavated	cum	8.000	(30.00)	(240.00)	M-089
			c) Overhead charges @ 10%				1162.85	
			d) Contractor's profit @ 10%				1279.14	
			Cost for 16 cum				14070.49	
			Rate per cum				879.41	
						say	*879.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		Note	1. Credit is considered for 50 per cent of quantity of work.					
			2. Loading for disposal will be done manually, being small quantity.					
			3. In case some rock is issued to contractor at site, the item of carriage shall be omitted to the extent of quantity issued to the contractor.					
3.9	301		Excavation in Hard Rock (controlled blasting) with disposal upto 1000 metres					
			Excavation for roadway in hard rock with controlled blasting by drilling, blasting and breaking, trimming of bottom and side slopes in accordance with requirements of lines, grades and cross sections, loading and disposal of cut road with in all lifts and leads upto 1000 metres					
			Unit = cum					
			Taking output = 180 cum					
			a) Labour					
			Mate	day	0.220	275.00	60.50	L-12
			Mazdoor	day	3.000	245.00	735.00	L-13
			Driller	day	2.000	245.00	490.00	L-06
			Blaster	day	0.500	250.00	125.00	L-03
			b) Machinery					
			Dozer 80 HP @ 30 cum per hour	hour	6.000	2640.00	15840.00	P&M-014
			Air compressor, 250 cfm with 2 jack hammers	hour	6.000	257.00	1542.00	P&M-001
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 5.5 cum capacity, 4 trips per hour.	hour	8.200	225.00	1845.00	P&M-048
			c) Materials					
			Gelatin 80 per cent	kg	63.000	102.00	6426.00	M-104
			Electric Detonators @ 1 detonator for1/2 gelatin stick of 125 gms each	each	1008.000	6.12	6168.96	M-094 /100
			Credit for excavated rock found suitable for use @ 50 per cent quantity blasted	cum	90.000	(30.00)	(2700.00)	M-089
			Add 5 per cent of cost of a+b+c towards muffling arrangements to guard against any rock fly off during blasting				1848.82	
			d) Overhead charges @ 10%				3612.53	
			e) Contractor's profit @ 10%				3973.78	
			Cost for 180 cum				43711.59	
			Rate per cum				242.84	
						say	*243.00*	
		Note	1. Credit is considered for 50 per cent of quantity of blastered rock, if found suitable for construction..					
			2. In case some rock is issued to the contractor at site, the item of carriage shall be reduced to that extent.					
3.10	301		Excavation in Marshy Soil					
			Excavation for roadway in marshy soil with hydraulic excavator 0.9 cum bucket capacity including cutting and loading in tippers and disposal with in all lifts and lead upto 1000 metres, trimming of bottom and side slopes in accordance with requirements of lines, grades and cross sections.					
			Unit = cum					
			Taking output = 300 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Hydraulic excavator 0.90 cum bucket capacity @ 50 cum per hour	hour	6.000	1008.00	6048.00	P&M-026
			Tipper 5.5 cum capacity, 4 trips per hour.	hour	13.640	240.00	3273.60	P&M-048
			d) Overhead charges @ 10%				983.36	
			e) Contractor's profit @ 10%				1081.70	
			Cost for 300 cum				11898.66	
			Rate per cum				39.66	
						say	*40.00*	
3.11	301		Removal of Unserviceable Soil with Disposal upto 1000 metres					
			Removal of unserviceable soil including excavation, loading and disposal upto 1000 metres lead but excluding replacement by suitable soil which shall be paid separately as per clause 305.					
			Unit = cum					
			Taking output = 360 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Excavator0.90 cum bucket capacity @ 60 cum per hour	hour	6.000	1008.00	6048.00	P&M-026
			Tipper 5.5 cum capacity, 4 trips per hour.	hour	16.360	240.00	3926.40	P&M-048
			c) Overhead charges @ 10%				1048.64	
			d) Contractor's profit @ 10%				1153.50	
			Cost for 360 cum				12688.54	
			Rate per cum				35.25	
						say	*35.00*	
		Note	This item does not include replacement of unsuitable soil by suitable soil. Replacement, where required, is to be provided and paid separately under clause 305.					
3.12	303		Presplitting of Rock Excavation Slopes					
			Carrying out excavation in hard rock to achieve a specified slope of the rock face by controlled use of explosives and blasting accessories in properly aligned and spaced drill holes, collection of the excavated rock by a 80 HP dozer, loading in tipper by a front end loader and disposing of the material with all lifts and lead upto 1000 m, all as specified in clause No. 303					
			Unit = sqm					
			Taking output = 400 sqm(120 cum considering 300mm average depth of excavation over the existing rock face)					
			a) Labour					
			Mate	day	0.600	275.00	165.00	L-12
			Mazdoor	day	15.000	245.00	3675.00	L-13

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			b) Machinery					
			Air compressor 250 cfm with 2 leads @ 20 cum per hour	hour	6.000	257.00	1542.00	P&M-001
			Dozer, 80 HP	hour	6.000	2640.00	15840.00	P&M-014
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			c) Materials					
			Gelatin 80 per cent	kg	42.000	102.00	4284.00	M-104
			Electric Detonators @ 1 detonator for 1/2 gelatin stick of 125 gms each	each	672.000	6.12	4112.64	M-094 /100
			d) Overhead charges @ 10%				3336.26	
			e) Contractor's profit @ 10%				3669.89	
			Cost for 400 sqm				40368.79	
			Rate per sqm				100.92	
						say	*101.00*	
		Note	In case blasted rock is used to the contractor against payment for constructed work, the cost of carriage shall be reduced to that extent.					
3.13	304		Excavation for Structures					
			Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom, backfilling the excavation earth to the extent required and utilising the remaining earth locally for road work.					
		(i)	Ordinary soil					
			Unit = cum					
			Taking output = 10 cum					
		A	Manual Means (Depth upto 3 m)					
			a) Labour					
			Mate	day	0.320	275.00	88.00	L-12
			Mazdoor	day	8.000	245.00	1960.00	L-13
			b) Overhead charges @ 10%				204.80	
			c) Contractor's profit @ 10%				225.28	
			Cost for 10 cum				2478.08	
			Rate per cum				247.81	
						say	*248.00*	
		Note	Cost of dewatering may be added where required upto 10 per cent of labour cost Assessment for dewatering shall be made as per site conditions..					
3.13 (i)		B	Mechanical Means (Depth upto 3 m)					
			Unit = cum					
			Taking output = 300 cum					
			a) Labour					
			Mate	day	0.320	275.00	88.00	L-12
			Mazdoor	day	8.000	245.00	1960.00	L-13
			b) Machinery					
			Hydraulic excavator 1.0 cum bucket capacity	hour	6.000	1008.00	6048.00	P&M-026
			c) Overhead charges @ 10%				809.60	
			d) Contractor's profit @ 10%				890.56	
			Cost for 300 cum				9796.16	
			Rate per cum				32.65	
						say	*33.00*	
		Note	Cost of dewatering upto 5 per cent of (a+b) may be added, where required. Assessment for dewatering shall be made as per site conditions..					
3.13		(ii)	Ordinary Rock (not requiring blasting)					
		A	Manual Means (Depth upto 3 m)					
			Unit = cum					
			Taking output = 10 cum					
			a) Labour					
			Mate	day	0.400	275.00	110.00	L-12
			Mazdoor	day	10.000	245.00	2450.00	L-13
			b) Overhead charges @ 10%				256.00	
			c) Contractor's profit @ 10%				281.60	
			Cost for 10 cum				3097.60	
			Rate per cum				309.76	
						say	*310.00*	
		Note	Cost of dewatering upto 10 per cent of labour cost may be added, where required. Assessment for dewatering shall be made as per site conditions..					
3.13 (ii)		B	Mechanical Means					
			Unit = cum					
			Taking output = 216 cum					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			b) Machinery					
			Hydraulic excavator 1.0 cum bucket capacity	hour	6.000	1008.00	6048.00	P&M-026
			c) Overhead charges @ 10%				758.40	
			d) Contractor's profit @ 10%				834.24	
			Cost for 216 cum				9176.64	
			Rate per cum				42.48	
						say	*42.00*	
		Note	1.Cost of dewatering upto 5 per cent of (a+b), may be added, where required Assessment for dewatering shall be made as per site conditions.					
			2.In case of rock, foundation beyond3 m is not dug and hence not included.					
3.13		(iii)	Hard Rock (requiring blasting)					
		A	Manual Means					
			Unit = cum					
			Taking output = 10 cum					
			a) Labour					
			i) Mate	day	0.530	275.00	145.75	L-12
			ii) Driller	day	0.840	245.00	205.80	L-06
			iii) Blaster	day	0.400	250.00	100.00	L-03

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			iv) Mazdoor	day	12.000	245.00	2940.00	L-13
			b) Machinery					
			Air Compressor 250 cfm with 2 jack hammer @ 15 cum per hour	hour	0.667	257.00	171.33	P&M-001
			c) Material					
			Blasting Material	kg	3.500	102.00	357.00	M-104
			Detonator electric	each	14.000	6.12	85.68	M-094 /100
			d) Overhead charges @ 10%				400.56	
			e) Contractor's profit @ 10%				440.61	
			Cost for 10 cum				4846.73	
			Rate per cum				484.67	
						say	485.00	
		Note	Cost of dewatering @ 10 per cent of labour cost may be added, where required Assessment for dewatering shall be made as per site conditions.					
3.13		(iv)	Hard Rock (blasting prohibited)					
			Unit = cum					
			Taking output = 10 cum					
		A	Mechanical Means					
			a) Labour					
			Mate	day	0.200	275.00	55.00	L-12
			Mazdoor	day	5.000	245.00	1225.00	L-13
			b) Machinery					
			Air Compressor 250 cfm with 2 leads of pneumatic breaker @ 1 cum per hour	hour	10.000	257.00	2570.00	P&M-001
			c) Overhead charges @ 10%				385.00	
			d) Contractor's profit @ 10%				423.50	
			Cost for 10 cum				4658.50	
			Rate per cum				465.85	
						say	466.00	
		Note	1. Cost of dewatering upto 5 per cent of (a+b), may be added, where required Assessment for dewatering shall be made as per site conditions.					
			2.In case of rock, foundation beyond 3 m is not dug and hence not included.					
3.13		(v)	Marshy soil					
			Unit = cum					
			Taking output = 10 cum					
		A	Manual means (upto 3 m depth)					
			a) Labour					
			Mate/Supervisor	day	0.400	275.00	110.00	L-12
			Mazdoor	day	10.000	245.00	2450.00	L-13
			b) Machinery					
			Tractor-trolley	hour	2.670	280.00	747.60	P&M-053
			c) Material					
			Selected earth for refilling	cum	5.000	112.00	560.00	M-163
			d) Overhead charges @ 10%				386.76	
			e) Contractor's profit @ 10%				425.44	
			Cost for 10 cum				4679.80	
			Rate per cum				467.98	
						say	468.00	
		Note	1. Cost of dewatering @ 30 per cent of (a), may be added, where required Assessment for dewatering shall be made as per site conditions.					
			2. Shoring & strutting 20 per cent of (a), where required may be added					
			3. It is assumed that Marshy Soil will be available upto 3 m depth only. For deeper excavation below 3 m depth, refer analysis in item (i) to (iv) for ordinary soil					
3.13 (v)		B	Mechanical Means					
			a) Labour					
			i) Mate	day	0.080	275.00	22.00	L-12
			ii) Mazdoor for dressing sides, bottom and backfilling	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Hydraulic excavator 1.0 cum bucket capacity @ 60 cum per hour	hour	0.170	1008.00	171.36	P&M-026
			Tipper 5.5 cum capacity, 4 trips per hour.	hour	0.450	225.00	101.25	P&M-048
			c) Material					
			Selected earth for refilling	cum	5.000	112.00	560.00	M-163
			d) Overhead charges @ 10%				134.46	
			e) Contractor's profit @ 10%				147.91	
			Cost for 10 cum				1626.98	
			Rate per cum				162.70	
						say	163.00	
		Note	1. Cost of dewatering @ 20 per cent of (a+b) may be added, where required					
			2. Shoring & strutting @ 10 per cent of (a+b), where required may be added					
			3. It is assumed that Marshy Soil will be available upto 3 m depth only. For deeper excavation below 3 m depth, refer analysis in item (i) to (iv) for ordinary soil					
3.14	305.4.3		Scarifying Existing Granular Surface to a Depth of 50 mm by Manual Means					
			Scarifying the existing granular road surface to a depth of 50 mm and disposal of scarified material within all lifts and leads upto 1000 metres.					
			Unit = sqm					
			Taking output = 100 sqm					
			a) Labour					
			Mate	day	0.200	275.00	55.00	L-12
			Mazdoor including loading and unloading	day	5.000	245.00	1225.00	L-13
			b) Machinery					
			Tractor-trolley	hour	1.670	280.00	467.60	P&M-053
			d) Overhead charges @ 10%				174.76	
			e) Contractor's profit @ 10%				192.24	
			Cost for 100 sqm				2114.60	
			Rate per sqm				21.15	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
						say	*21.00*	
		Note	In case material is to be reused at site, transportation cost catered above for disposal shall be deleted.					
3.15	305.4.3		Scarifying Existing Bituminous Surface to a depth of 50 mm by Mechanical Means					
			Scarifying the existing bituminous road surface to a depth of 50 mm and disposal of scarified material with in all lifts and lead upto 1000 metres.					
			Unit = sqm					
			Taking output = 100 sqm					
			a) Labour					
			Mate	day	0.010	275.00	2.75	L-12
			Mazdoor	day	0.250	245.00	61.25	L-13
			b) Machinery					
			Tractor with ripper attachment @ 60 cum per hour	hour	0.080	280.00	22.40	P&M-055
			Front end loader 1 cum bucket capacity @ 25 cum per hour	hour	0.200	624.00	124.80	P&M-017
			Tipper 5.5 cum capacity, 4 trips per hour.	hour	0.230	240.00	55.20	P&M-048
			c) Overhead charges @ 10%				26.64	
			d) Contractor's profit @ 10%				29.30	
			Cost for 100 sqm				322.34	
			Rate per sqm				3.22	
						say	*3.00*	
3.16	305		Construction of Embankment with Material obtained from Borrowpits					
			Construction of embankment with approved material obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-2.					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Hydraulic Excavator1 cum bucket capacity @ 60 cum per hour	hour	1.670	1008.00	1683.36	P&M-026
			Tipper 10 tonne capacity	tonne.km	160.000	1.90	304.00	
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				0.00	
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Motor grader for grading @ 100 cum per hour	hour	1.000	1854.00	1854.00	P&M-032
			Water tanker6 KL capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8 -10 tonnes @ 100 cum per hour	hour	1.000	1292.00	1292.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			Compensation for earth with royalty and extra lead	cum	100.000	112.00	11200.00	M-092
			d) Overhead charges @ 10%				2012.54	
			e) Contractor's profit @ 10%				2213.79	
			Cost for 100 cum				24351.69	
			Rate per cum				243.52	
						say	*244.00*	
		Note	Compensation for earth will vary from place to place and will have to be assessed realistically as per particular ground situation. In case earth is available from Govt. land, compensation for earth will not be required. The position is required to be clearly stated in the cost estimate.					
3.16A	305		Construction of Embankment with 20% Flyash					
			Construction of embankment with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-2.					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Hydraulic Excavator1 cum bucket capacity @ 60 cum per hour	hour	1.670	1008.00	1683.36	P&M-026
			Tipper 10 tonne capacity	tonne.km	128.000	1.90	243.20	
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				14.59	
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Motor grader for grading @ 100 cum per hour	hour	1.000	1854.00	1854.00	P&M-032
			Water tanker6 KL capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8 -10 tonnes @ 100 cum per hour	hour	1.000	1292.00	1292.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			Cost of earth from Private land	Cum	80.000	112.00	8960.00	
			Flyash Cost with lead	Cum	20.000	116.00	2320.00	
			d) Overhead charges @ 10%				2015.92	
			e) Contractor's profit @ 10%				2217.51	
			Cost for 100 cum				24392.57	
			Rate per cum				243.93	
						say	*244.00*	
		Note	Compensation for earth will vary from place to place and will have to be assessed realistically as per particular ground situation. In case earth is available from Govt. land, compensation for earth will not be required. The position is required to be clearly stated in the cost estimate.					
3.16B	305		Construction of Embankment with 20% Pond ash					
			Construction of embankment with approved material obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-2.					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Hydraulic Excavator1 cum bucket capacity @ 60 cum per hour	hour	1.670	1008.00	1683.36	P&M-026
			Tipper 10 tonne capacity	tonne.km	128.000	1.90	243.20	
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				24.32	
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Motor grader for grading @ 100 cum per hour	hour	1.000	1854.00	1854.00	P&M-032
			Water tanker6 KL capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8 -10 tonnes @ 100 cum per hour	hour	1.000	1292.00	1292.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			Compensation for earth taken from private land	cum	80.000	112.00	8960.00	M-092
			Pond ash	cum	20.000	84.12	1682.44	M-092
			d) Overhead charges @ 10%				1953.13	
			e) Contractor's profit @ 10%				2148.45	
			Cost for 100 cum				23632.90	
			Rate per cum				236.33	
						say	236.00	
		Note	Compensation for earth will vary from place to place and will have to be assessed realistically as per particular ground situation. In case earth is available from Govt. land, compensation for earth will not be required. The position is required to be clearly stated in the cost estimate.					
3.16C	305		Construction of Embankment with Material obtained from Borrowpits (80% from Private road side land & 20% from Approved Quarry)					
			Construction of embankment with approved material obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-2.					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Hydraulic Excavator1 cum bucket capacity @ 60 cum per hour	hour	1.670	1008.00	1683.36	P&M-026
			Tipper 10 tonne capacity	tonne.km	1760.000	1.90	3344.00	55km Lead
			Tipper 10 tonne capacity	tonne.km	640.000	1.90	1216.00	5km Lead
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				121.60	
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Motor grader for grading @ 100 cum per hour	hour	1.000	1854.00	1854.00	P&M-032
			Water tanker6 KL capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8 -10 tonnes @ 100 cum per hour	hour	1.000	1292.00	1292.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			Compensation for earth taken from private land	cum	80.000	92.00	7360.00	M-092
			d) Overhead charges @ 10%				2066.30	
			e) Contractor's profit @ 10%				2272.93	
			Cost for 100 cum				25002.18	
			Rate per cum				250.02	
						say	250.00	
		Note	Compensation for earth will vary from place to place and will have to be assessed realistically as per particular ground situation. In case earth is available from Govt. land, compensation for earth will not be required. The position is required to be clearly stated in the cost estimate.					
3.17	305		Construction of Embankment with Material Deposited from Roadway Cutting					
			Construction of embankment with approved materials deposited at site from roadway cutting and excavation from drain and foundation of other structures graded and compacted to meet requirement of table 300-2.					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor	day	0.500	245.00	122.50	L-13
			b) Machinery					
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Motor grader for grading @ 100 cum per hour	hour	1.000	1854.00	1854.00	P&M-032
			Water tanker6 KL capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8-10 tonnes @ 100 cum per hour	hour	1.000	1292.00	1292.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			d) Overhead charges @ 10%				681.00	
			e) Contractor's profit @ 10%				749.10	
			Rate for 100 cum				8240.10	
			Rate per cum				82.40	
						say	82.00	
		Note	In case the earth cutting is done by dozer and pushed for filling in the embankment, the input of dozer in the cost of embankment shall be deleted as the same is already provided in the cost of excavation. However, if the earth is dumped by tippers from roadway cutting, the input of dozer for spreading is required to be provided.					
3.18	305		Construction of Subgrade and Earthen Shoulders					
			Construction of sub-grade and earthen shoulders with approved material obtained from borrow pits with all lifts & leads, transporting to site, spreading, grading to required slope and compacted to meet requirement of table No. 300-2					
			Unit = cum					
			Taking output = 100 cum					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Hydraulic excavator1 cum bucket capacity @ 60 cum per hour	hour	1.670	966.00	1613.22	P&M-026
			Tipper 10 tonne capacity	tonne.km	175.000	1.90	332.50	
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				33.25	
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Motor grader for grading @ 50 cum per hour	hour	2.000	1854.00	3708.00	P&M-032
			Water tanker with 6 kl capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8-10 tonnes @ 80 cum per hour	hour	1.250	1292.00	1615.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			Compensation for earth and royalty charges with Lead	cum	100.000	112.00	11200.00	M-092
			d) Overhead charges @ 10%				2229.40	
			e) Contractor's profit @ 10%				2452.34	
			Cost for 100 cum				26975.70	
			Rate per cum				269.76	
						say	270.00	
3.18 A	305		Construction of Subgrade and Earthen Shoulders with 20% flyash					
			Construction of sub-grade and earthen shoulders with 20% flyash all lifts & leads, transporting to site, spreading, grading to required slope and compacted to meet requirement of table No. 300-2					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Hydraulic excavator1 cum bucket capacity @ 60 cum per hour	hour	1.670	966.00	1613.22	P&M-026
			Tipper 10 tonne capacity	tonne.km	140.000	1.90	266.00	
			Add 06 per cent of cost of carriage to cover cost of loading and unloading				15.96	
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Motor grader for grading @ 50 cum per hour	hour	2.000	1854.00	3708.00	P&M-032
			Water tanker with 6 kl capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8-10 tonnes @ 80 cum per hour	hour	1.250	1292.00	1615.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			Compensation for earth taken from private land	cum	80.000	112.00	8960.00	M-092
			Flyash with Lead	cum	20.000	116.00	2320.00	M-092
			d) Overhead charges @ 10%				2229.02	
			e) Contractor's profit @ 10%				2451.92	
			Cost for 100 cum				26971.12	
			Rate per cum				269.71	
						say	270.00	
3.18 B	305		Construction of Subgrade and Earthen Shoulders with 20% pond ash					
			Construction of sub-grade and earthen shoulders with 20% pondash all lifts & leads, transporting to site, spreading, grading to required slope and compacted to meet requirement of table No. 300-2					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Hydraulic excavator1 cum bucket capacity @ 60 cum per hour	hour	1.670	966.00	1613.22	P&M-026
			Tipper 10 tonne capacity	tonne.km	140.000	1.90	266.00	Lead 55km
			Add 06 per cent of cost of carriage to cover cost of loading and unloading				15.96	
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Motor grader for grading @ 50 cum per hour	hour	2.000	1854.00	3708.00	P&M-032
			Water tanker with 6 kl capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8-10 tonnes @ 80 cum per hour	hour	1.250	1292.00	1615.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			Compensation for earth taken from private land	cum	80.000	112.00	8960.00	M-092
			pond ash	cum	20.000	84.12	1682.44	M-092
			d) Overhead charges @ 10%				2165.26	
			e) Contractor's profit @ 10%				2381.79	
			Cost for 100 cum				26199.67	
			Rate per cum				262.00	
						say	262.00	
3.18C	305		Construction of Sungrade with Material Deposited from Roadway Cutting					
			Construction of subgrade with approved materials deposited at site from roadway cutting and excavation from drain and foundation of other structures graded and compacted to meet requirement of table 300-2.					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor	day	0.500	245.00	122.50	L-13
			b) Machinery					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.625	2640.00	1650.00	P&M-014
			Motor grader for grading @ 100 cum per hour	hour	1.250	1854.00	2317.50	P&M-032
			Water tanker6 KL capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8-10 tonnes @ 100 cum per hour	hour	1.250	1292.00	1615.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			d) Overhead charges @ 10%				792.65	
			e) Contractor's profit @ 10%				871.92	
			Rate for 100 cum				9591.07	
			Rate per cum				95.91	
						say	*96.00*	
3.19	305.3.4		Compacting Original Ground					
		Case-I	Compacting original ground supporting sub-grade					
			Loosening of the ground upto a level of 500 mm below the sub-grade level, watered, graded and compacted in layers to meet requirement of table 300-2 for sub-grade construction.					
			Unit = cum					
			Taking output = 600 cum					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Mazdoor	day	3.000	245.00	735.00	L-13
			b) Machinery					
			Tractor with ripper attachment	hour	9.000	280.00	2520.00	P&M-055
			Motor grader for grading	hour	6.000	1854.00	11124.00	P&M-032
			Water tanker 6 KL capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8-10 tonne @ 80 cum/hour	hour	7.500	1292.00	9690.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			d) Overhead charges @ 10%				2631.80	
			e) Contractor's profit @ 10%				2894.98	
			Cost for 600 cum				31844.78	
			Rate per cum				53.07	
						say	*53.00*	
3.19		Case-II	:Compacting original ground supporting embankment					
			Loosening, leveling and Compacting original ground supporting embankment to facilitate placement of first layer of embankment, scarified to a depth of 150 mm, mixed with water at OMC and then compacted by rolling so as to achieve minimum dry density as given in Table 300-2 for embankment construction.					
			Unit = cum					
			Taking output = 600 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Tractor with ripper attachment	hour	6.000	280.00	1680.00	P&M-055
			Vibratory road roller 8-10 tonne capacity	hour	7.500	1292.00	9690.00	P&M-059
			Water tanker6 KL capacity	hour	4.000	374.00	1496.00	P&M-060
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			d) Overhead charges @ 10%				1409.80	
			e) Contractor's profit @ 10%				1550.78	
			Cost for 600 cum				17058.58	
			Rate per sqm				28.43	
						say	*28.00*	
3.20	305		Stripping and Storing Top Soil					
			Stripping, storing of top soil by road side at 15 m internal and re-application on embankment slopes, cut slopes and other areas in localities where the available embankment material is not conducive to plant growth.					
			Unit = cum					
			Taking output = 10 cum					
			a) Labour					
			Mate	day	0.200	275.00	55.00	L-12
			Mazdoor	day	5.000	245.00	1225.00	L-13
			b) Machinery					
			Dozer 80 HP @ 100 cum per hour	hour	0.100	2640.00	264.00	P&M-014
			c) Overhead charges @ 10%				154.40	
			d) Contractor's profit @ 10%				169.84	
			Cost for 10 cum				1868.24	
			Rate per cum				186.82	
						say	*187.00*	
3.21			Stripping, Storing and Re-laying Top Soil from Borrow Areas in Agriculture Fields.					
			Stripping of top soil from borrow areas located in agriculture fields, storing at a suitable place, spreading and re-laying after taking the borrow earth to maintain fertility of the agricultural field, finishing it to the required levels and satisfaction of the farmer.					
			Unit = cum					
			Taking output = 300 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Dozer, 80 HP	hour	6.000	2640.00	15840.00	P&M-014
			c) Overhead charges @ 10%				1635.20	
			d) Contractor's profit @ 10%				1798.72	
			Cost for 300 cum				19785.92	
			Rate per cum				65.95	
						say	*66.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
3.22	307		Turfing with Sods					
			Furnishing and laying of the live sods of perennial turf forming grass on embankment slope, verges or other locations shown on the drawing or as directed by the engineer including preparation of ground, fetching of sods and watering.					
			Unit = sqm					
			Taking output = 100 sqm					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Mazdoor for preparation of ground and fetching of sods	day	3.000	245.00	735.00	L-13
			b) Machinery					
			Water tanker including watering for 3 months	hour	2.000	374.00	748.00	P&M-060
			Tractor-trolley	hour	1.000	280.00	280.00	P&M-053
			c) Material					
			Farm yard manure @ 0.18 cum per 100 sqm at site of work	cum	0.180	110.00	19.80	M-167
			Cost of water	KL	12.000	30.00	360.00	M-189
			d) Overhead charges @ 10%				217.58	
			e) Contractor's profit @ 10%				239.34	
			Cost for 100 sqm				26.33	
			Rate per 100 sqm				26.33	
						say	*26.00*	
3.23	308		Seeding and Mulching					
			Preparation of seed bed on previously laid top soil, furnishing and placing of seeds, fertilizer, mulching material, applying bituminous emulsion at the rate of 0.23 litres per sqm and laying and fixing jute netting, including watering for 3 months all as per clause 308.					
			Unit = sqm					
			Taking output = 240 sqm					
			a) Labour					
			Mate	day	0.400	275.00	110.00	L-12
			Mazdoor	day	10.000	245.00	2450.00	L-13
			b) Machinery					
			Water tanker 6 KL capacity including watering for 3 months	hour	14.000	374.00	5236.00	P&M-060
			Tractor-trolley	hour	2.400	280.00	672.00	P&M-053
			c) Material					
			Seeds	kg	3.600	120.00	432.00	M-162
			Sludge/Farm yard manure @ 0.18 cum per 100 sqm	cum	0.430	110.00	47.30	M-167
			Bitumen Emulsion	litre	55.200	31.53	1740.59	M-077
			Jute netting, open weave, 2.5 cm square opening	sqm	264.000	12.00	3168.00	M-121
			Cost of water for 3 months	KL	84.000	30.00	2520.00	M-189
			d) Overhead charges @ 0.1 on (a+b+c)				1637.59	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				1801.35	
			Cost for 240 sqm = a+b+c+d+e				19814.83	
			Rate per sqm = (a+b+c+d+e)/240				82.56	
						say	*83.00*	
3.24	309		Surface Drains in Soil					
			Construction of unlined surface drains of average cross sectional area 0.40 sqm in soil to specified lines, grades, levels and dimensions to the requirement of clause 301 and 309. Excavated material to be used in embankment within a lead of 50 metres (average lead 25 metres)					
			Unit = metre					
			Taking output = 10 metres					
		A	Mechanical means					
			a) Labour					
			Mate	day	0.010	275.00	2.75	L-12
			Mazdoor for dressing of bed and side of drain	day	0.250	245.00	61.25	L-13
			b) Machinery					
			Hydraulic Excavator 0.3 cum bucket capacity @ 30 metres per hour	hour	0.330	1008.00	332.64	P&M-026
			c) Overhead charges @ 10%				39.66	
			d) Contractor's profit @ 10%				43.63	
			Cost for 10 metres				479.93	
			Rate per metr				47.99	
						say	*48.00*	
3.24		B	Manual Means					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Overhead charges @ 10%				51.20	
			c) Contractor's profit @ 10%				56.32	
			Cost for 10 metres				619.52	
			Rate per metre				61.95	
						say	*62.00*	
		Note	Where lining of drain is provided, quantity shall be worked out based on approved design and drawing and priced on rate of cement concrete of approved grade or stone/brick masonry as the case may be.					
3.25	309		Surface Drains in Ordinary Rock					
			Construction of unlined surface drain of average cross sectional area 0.4 sqm in ordinary rock to specified lines, grades, levels and dimensions as per approved design and to the requirement of clause 301 to 309. Excavated material to be used in embankment at site.					
			Unit = metre					
			Taking output = 10 metres					
		A	Mechanical Means					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor for dressing of bed and side of drain	day	0.500	245.00	122.50	L-13
			b) Machinery					
			Hydraulic Excavator 0.3 cum bucket capacity @ 15 metres per hour	hour	0.670	1008.00	675.36	P&M-026

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			c) Overhead charges @ 10%				80.34	
			d) Contractor's profit @ 10%				88.37	
			Cost for 10 metres				972.07	
			Rate per metre				97.21	
						say	97.00	
3.25		B	Manual Means					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Mazdoor	day	3.000	245.00	735.00	L-13
			b) Overhead charges @ 10%				76.80	
			c) Contractor's profit @ 10%				84.48	
			Cost for 10 metres				929.28	
			Rate per metre				92.93	
						say	93.00	
3.26	309		Surface Drains in Hard Rock					
			Rate per metre may be worked out based on quantity of hard rock as per design.					
			For rate of hard rock cutting, refer relevant item in this chapter					
3.27	309		Sub-Surface Drains with Perforated Pipe					
			Construction of subsurface drain with perforated pipe of 100 mm internal diameter of metal/ asbestos cement/ cement concrete/PVC, closely jointed, perforations ranging from 3 mm to 6 mm depending upon size of material surrounding the pipe, with 150 mm bedding below the pipe and 300 mm cushion above the pipe, cross section of excavation 450 x 550 mm. Excavated material to be utilised in roadway at site.					
			Unit = metre					
			Taking output = 10 metres					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor for excavation and back filling	day	2.000	245.00	490.00	L-13
			c) Material					
			Perforated pipe of cement concrete, internal dia 100 mm	metre	10.000	175.00	1750.00	M-135
			Crushed stone as per table 300-3	cum	2.400	485.00	1164.00	M-012
			d) Overhead charges @ 0.15 on (a+b+c)				512.25	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				392.73	
			Cost for 10 metres = a+b+c+d+e				4319.98	
			Rate per metre = (a+b+c+d+e)/10				432.00	
						Say	432.00	
		Note	Type of pipe may be modified depending upon provision in design.					
3.28	309		Aggregate Sub-Surface Drains					
			Construction of aggregate sub surface drain 300 mm x 450 mm with aggregates conforming to table 300-4, excavated material to be utilised in roadway.					
			Unit = metre					
			Taking output = 10 metres					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor for excavation and back filling with aggregates	day	1.500	245.00	367.50	L-13
			b) Material					
			Crushed stone as per table 300-3	cum	1.350	485.00	654.75	M-012
			c) Overhead charges @ 0.15 on (a+b)				154.16	
			d) Contractor's profit @ 0.1 on (a+b+c)				118.19	
			Cost for 10 metres = a+b+c+d				1300.10	
			Rate per metre = (a+b+c+d)/10				130.01	
						Say	130.00	
3.29	309		Underground Drain at Edge of Pavement					
			Construction of an underground drain 1 m x 1 m (inside dimensions) lined with RCC 20 cm thick and covered with RCC slab10 cm in thickness on urban roads.					
			Unit = Running metre					
			Taking output = one metre					
			a) Earthwork in soil	cum	1.500	29.00	43.50	Item No. 3.13
			b) RCC work M-20	cum	0.495	#NAME?	#NAME?	Item 12.8 (C) RCC
			Rate per metre = (a+b)				#NAME?	
			Rates for these items may be taken from chapters on earth work and substructures respectively.			say	#NAME?	
3.30	310		Preparation and Surface Treatment of Formation.					
			Preparation and surface treatment of formation by removing mud and slurry, watering to the extent needed to maintain the desired moisture content, trimming to the required line, grade, profile and rolling with 8-10 tonne smooth wheeled roller, complete as per clause 310.					
			Unit = sqm					
			Taking output = 3500sqm					
			a) Labour					
			Mate	day	0.280	275.00	77.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			Mazdoor skilled	day	1.000	245.00	245.00	L-15
			b) Machinery					
			Smooth 3 wheeled steel roller 8-10 tonnes	hour	3.000	386.00	1158.00	P&M-044
			Water tanker 6 KL, one trip per hour	hour	3.000	374.00	1122.00	P&M-060
			c) Material					
			Cost of water	KL	18.000	30.00	540.00	M-189
			d) Overhead charges @ 10%				461.20	
			e) Contractor's profit @ 10%				507.32	
			Cost for 3500 sqm				5580.52	
			Rate per sqm				1.59	
						say	2.00	
3.31	313		Construction of Rock fill Embankment					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Construction of rock fill embankment with broken hard rock fragments of size not exceeding 300 mm laid in layers not exceeding 500 mm thick including filling of surface voids with stone spalls, blinding top layer with granular material, rolled with vibratory road roller, all complete as per clause 313.					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.500	245.00	367.50	L-13
			b) Machinery					
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Vibratory road roller 8-10 tonnes @ 100 cum per hour	hour	1.000	386.00	386.00	P&M-059
			Water tanker 6 KL, one trip per hour	hour	2.000	374.00	748.00	P&M-060
			c) Material					
			Cost of water	KL	12.000	30.00	360.00	M-189
			d) Overhead charges @ 10%				319.25	
			e) Contractor's profit @ 10%				351.18	
			Cost for 100 cum				3862.93	
			Rate per cum				38.63	
						say	*39.00*	
		Note	It is assumed that rock is available locally at site from roadway cutting. In case, portion of the rock requires breaking to acceptable size of 300 mm, breaking charges will have to be added.					
			EARTH WORK ON HILL ROAD					
3.32	301		Excavation in Hill Area in Soil by Mechanical Means					
			Excavation in soil in hilly area by mechanical means including cutting and trimming of side slopes and disposing of excavated earth with all lifts and lead upto 1000 metres.					
			Unit = cum					
			Taking output = 260 cum					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor for trimming slopes and helping in excavation etc.	day	6.000	245.00	1470.00	L-13
			b) Machinery					
			Dozer 80 HP (D-80 A 12)@ 43.28 cum per hour	hour	6.000	2640.00	15840.00	P&M-014
			Front end loader	hour	6.000	624.00	3744.00	P&M-017
			Tipper 5.5cum capacity, 4 trips per hour.	hour	12.000	240.00	2880.00	P&M-048
			c) Overhead charges @ 10%				2400.00	
			d) Contractor's profit @ 10%				2640.00	
			Cost for 260 cum				29040.00	
			Rate per cum				111.69	
						say	*112.00*	
		Note	In case the land on the valley side is barren and there is no objection for disposing of excavated earth on the valley side, the provision of front end loader and tipper shall be deleted as excavated earth shall be disposed off on the valley side.					
3.33	301		Excavation in Hilly Area in Ordinary Rock by Mechanical Means not Requiring Blasting.					
			Excavation in hilly area in ordinary rock not requiring blasting by mechanical means including cutting and trimming of slopes and disposal of cut material with all lift and lead upto 1000 metres.					
			Unit = cum					
			Taking output = 170 cum					
			a) Labour					
			Mate	day	0.320	275.00	88.00	L-12
			Mazdoor	day	8.000	245.00	1960.00	L-13
			b) Machinery					
			Dozer 80 HP (D-80 A 12)@ 28.32 cum per hour	hour	6.000	2640.00	15840.00	P&M-014
			Front end loader	hour	7.000	624.00	4368.00	P&M-017
			Tipper 5.5cum capacity, 4 trips per hour.	hour	7.000	240.00	1680.00	P&M-048
			c) Overhead charges @ 10%				2393.60	
			d) Contractor's profit @ 10%				2632.96	
			Cost for 170 cum				28962.56	
			Rate per cum				170.37	
						say	*170.00*	
		Note	In case the land on the valley side is barren and there is no objection for disposing of excavated earth on the valley side, the provision of front end loader and tipper shall be deleted as excavated earth can be disposed off on the valley side.					
3.34	301		Excavation in Hilly Areas in Hard Rock Requiring Blasting					
			Excavation in hilly areas in hard rock requiring blasting, by mechanical means including trimming of slopes and disposal of cut material with all lifts and lead upto 1000 metres.					
			Unit = cum					
			Taking output = 170 cum					
			a) Labour					
			Mate	day	0.490	275.00	134.75	L-12
			Mazdoor	day	10.000	245.00	2450.00	L-13
			Driller	day	2.000	245.00	490.00	L-06
			Blaster	day	0.250	250.00	62.50	L-03
			b) Machinery					
			Dozer 80 HP (D-80 A 12)@ 28.32 cum per hour	hour	6.000	2640.00	15840.00	P&M-014
			Air compressor 250 cfm with two jack hammer @ 20 cum per hour	hour	5.000	257.00	1285.00	P&M-001
			Front end loader	hour	7.000	624.00	4368.00	P&M-017
			Tipper 5.5cum capacity, 4 trips per hour.	hour	7.000	240.00	1680.00	P&M-048
			c) Materials					
			Gelatine 80 per cent	kg	35.000	102.00	3570.00	M-104
			Electric Detonators @ 1 Detonator for 2 Gelatine sticks of 125 gms each	each	140.000	6.12	856.80	M-094 /100

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			c) Overhead charges @ 10%				3073.71	
			d) Contractor's profit @ 10%				3381.08	
			Cost for 170 cum				37191.83	
			Rate per cum				218.78	
						say	*219.00*	
		Note	In case the land on the valley side is barren and there is no objection for disposing of excavated earth on the valley side, the provision of front end loader and tipper shall be deleted as excavated earth can be disposed off on the valley side.					
			In case of hill roads, the altitude effect comes into play. The output of men and machines decreases progressively after 2100 m elevation leading to increase in cost . High altitude effect has been explained in the basic approach.					
3.35			Work in Urban Roads					
			The cost of earth work in urban roads inhabited area will be comparatively higher due to following reasons:					
			a) There is mixed traffic on urban roads like slow moving hand and animal driven carts, rickshaws, cycles, two/ three wheeler apart from the usual vehicular traffic resulting into traffic jams. This causes loss of working time which may be in the range of 10 -15 per cent					
			b) There is considerable disruption of traffic adversely affecting the efficiency of the working parties including machines due to congestion caused by pedestrian traffic, local road side venders, parking of vehicles by the road side, encroachments by the shopkeepers and local shops who make use of the berms of the road in front of these shops and unauthorised conversion of road berms into mini local market The output of manpower and machines is substantially reduced due to factors mentioned above.					
			c) Cost of living in urban areas is comparatively more resulting into higher wages.					
			d) At times, work is executed during night time due to heavy traffic during day time. This involves extra expenditure by way of making arrangement for lighting and special transport for working parties due to odd hour					
			In the light of above, the authorities engaged in preparing the cost estimates may exercise their judgment and cater for the additional cost to the extent of 2 to 3 per cent, keeping in view the severity of factors mentioned above. Supporting details for the extra cost based on the actual conditions in specific cases will have to give in justification.					
3.36	Suggestive		Embankment Construction with Flyash/Pond ash available from coal or lignite burning Thermal Plants as waste material.					
			Construction of embankment with Flyash conforming to table 1 of IRC: SP: 58 - 2001 obtained from coal or lignite burning thermal power stations as waste material, spread and compacted in layer of 200mm thickness each at OMC, all as specified in IRC: SP: 58-2001 and as per approved plans.					
			Unit = cum					
			Taking output = 360 cum					
			a) Labour					
			Mate	day	0.160	275.00	44.00	L-12
			Mazdoor	day	4.000	245.00	980.00	L-13
			b) Machinery					
			Hydraulic Excavator 0.9 cum bucket capacity @ 60 cum/hour	hour	6.000	1008.00	6048.00	P&M-026
			Tipper 10Tcapacity flyash 360 x 1.2 = 432 tonnes	tonne.km	432.000	1.90	820.80	With all Lead
			Add 10 per cent of cost of carriagefor loading and unloading				0.00	
			Dozer 80 HP for spreading @ 200 cum/hour	hour	1.800	2640.00	4752.00	P&M-014
			Motor Grader for grading @ 100 cum/hour	hour	3.600	1854.00	6674.40	P&M-032
			Water tanker6 KL capacity	hour	12.000	374.00	4488.00	P&M-060
			Vibratory Roller 8-10 tonne @ 100 cum/hour	hour	3.600	1292.00	4651.20	P&M-059
			c) Material					
			Fly ash	Cum	360.000	116.00	41760.00	
			d) Overhead charges @ 10%				7021.84	
			e) Contractor's profit @ 10%				7724.02	
			Cost for 360 cum				84964.26	
			Rate per cum				236.01	
						say	*236.00*	
		Note	1.As flyash is available free of cost as waste material from Thermal Plants, cost of material has not been added.					
			2.The earth cover on sides and intermediate layers of earth sandwiching the flyash have not been included in this analysis. The same are required to be provided as per approved design and priced separately as embankment construction.					

3.16	305		Construction of Embankment with Material obtained available earth					
			Laying and spreading available soil in the sub-grade on a prepared surface, pulverising, mixing the spread soil in place with rotavator with 3 per cent slaked lime having minimum content of 70 per cent of CaO, grading with motor grader and compacting with the road roller at OMC to the desired density to form a layer of improved sub grade					**Embankment 3% lime +97% Available Earth**
			Unit = cum					
			Taking output = 100 cum					
			By Mechanical Means					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Skilled mazdoor for alignment and geometrics	day	1.000	245.00	245.00	L-15
			Mazdoor for spraying lime	day	2.667	245.00	653.33	L-13
			b) Machinery					
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-055
			Motor grader for grading @ 100 cum per hour	hour	1.000	1854.00	1854.00	P&M-032
			Water tanker6 KL capacity	hour	4.000	374.00	1496.00	P&M-059
			Vibratory roller 8-10 tonnes @ 100 cum per hour	hour	1.000	1292.00	1292.00	P&M-060
			c) Material					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Lime at site	tonne	5.250	4055.00	21288.75	M-188
			Cost of water	KL	24.000	30.00	720.00	M-189
			d) Overhead charges @ 10%				2888.01	
			e) Contractor's profit @ 10%				3176.81	
			Cost for 100 cum				34944.90	
			Rate per cum				349.45	
						say	*349.00*	

3.16	3.05		Construction of Embankment with Material obtained from Borrowpits						
			Laying and spreading available soil in the sub-grade on a prepared surface, pulverising, mixing the spread soil in place with rotavator with 3 per cent slaked lime having minimum content of 70 per cent of CaO, grading with motor grader and compacting with the road roller at OMC to the desired density to form a layer of improved sub grade						**Embankment 3% lime +97% Barrow Earth**
			Unit = cum						
			Taking output = 100 cum						
			a) Labour						
			Mate	day	0.040	275.00	11.00	L-12	
			Mazdoor	day	1.000	245.00	245.00	L-13	
			Mazdoor for spraying lime	day	2.667	245.00	653.33	L-13	
			b) Machinery						
			Hydraulic Excavator1 cum bucket capacity @ 60 cum per hour	hour	1.670	1008.00	1683.36	P&M-026	
			Tipper 10 tonne capacity	tonne.km	160.000	1.90	304.00	1km Lead	
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				30.40		
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014	
			Motor grader for grading @ 100 cum per hour	hour	1.000	1854.00	1854.00	P&M-032	
			Water tanker6 KL capacity	hour	4.000	374.00	1496.00	P&M-060	
			Vibratory roller 8 -10 tonnes @ 100 cum per hour	hour	1.000	1292.00	1292.00	P&M-059	
			c) Material						
			Cost of water	KL	24.000	30.00	720.00	M-189	
			Lime at site	tonne	5.250	4055.00	21288.75	M-188	3%
			Compensation for earth with Royalty, Extra Lead	cum	97.000	112.00	10864.00	M-092	97%
			d) Overhead charges @ 10%				4176.18		
			e) Contractor's profit @ 10%				4593.80		
			Cost for 100 cum				50531.83		
			Rate per cum				505.32		
						say	*505.00*		

CHAPTER - 4

SUB-BASES, BASES (NON- BITUMINOUS) AND SHOULDERS

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
4.1	401		Granular Sub-Base with Close Graded Material (Table:-400-1)					
		A	Plant Mix Method					
			Construction of granular sub-base by providing close graded Material, mixing in a mechanical mix plant at OMC, carriage of mixed Material to work site, spreading in uniform layers with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per clause 401					
			Unit = cum					
			Taking output = 225 cum (450 tonne)					
			a) Labour					
			Mate	day	0.400	275.00	110.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor	day	8.000	245.00	1960.00	L-13
			b) Machinery					
			Wet mix plant @ 75 tonne capacity per hour	hour	6.000	1010.00	6060.00	P&M-093
			Electric generator 125 KVA	hour	6.000	674.40	4046.40	P&M-018
			Water tanker 6 KL capacity 5 km lead with one trip per hour	hour	4.500	374.00	1683.00	P&M-060
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne	tonne.km	450 x L	1.90	8550.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover loading and unloading				855.00	
			Motor Grader 110 HP	hour	6.000	1854.00	11124.00	P&M-032
			Vibratory roller 8-10 t	hour	6.000	1292.00	7752.00	P&M-059
			c) Material					
			Close graded Granular sub-base Material as per table 400-1					
			For Grading-I Material					
			53 mm to 9.5 mm @ 50 per cent	cum	144.000	890.15	128180.88	M-013
			9.5 mm to 2.36 mm @ 20 per cent	cum	57.000	774.52	44147.64	M-017
			2.36 mm below @ 30 per cent	cum	86.400	774.52	66918.53	M-020
			Cost of water	KL	27.000	30.00	810.00	M-189
			OR					
			For Grading-II Material					
			26.5 mm to 9.5 mm @ 35 per cent	cum	100.800	874.52	88151.62	M-015
			9.5 mm to 2.36 mm @ 25 per cent	cum	72.000	774.52	55765.44	M-017
			2.36 mm below @ 40 per cent	cum	115.200	774.52	89224.70	M-020
			Cost of water	KL	27.000	30.00	810.00	M-189
			OR					
			For Grading-III Material					
			9.5 mm to 4.75 mm @ 35 per cent	cum	100.800	774.52	78071.62	M-016
			4.75 mm to 2.36 mm @ 12.5 per cent	cum	36.000	774.52	27882.72	M-018
			2.36 mm below @ 52.5 per cent	cum	151.200	774.52	117107.42	M-020
			Cost of water	KL	27.000	30.00	810.00	M-189
4.1A		(i)	Rate per cum for grading-I Material					
			d) Overhead charges @ 10%				28643.14	
			e) Contractor's profit @ 10%				31507.46	
			Cost for 225 cum				346582.05	
			Rate per cum				1540.36	
						say	*1540.00*	
4.1A		(ii)	Rate per cum for grading-II Material					
			d) Overhead charges @ 10%				28032.62	
			e) Contractor's profit @ 10%				30835.88	
			Cost for 225 cum				339194.65	
			Rate per cum				1507.53	
						say	*1508.00*	
4.1A		(iii)	Rate per cum for grading-III Material					
			d) Overhead charges @ 10%				27024.62	
			e) Contractor's profit @ 10%				29727.08	
			Cost for 225 cum				326997.85	
			Rate per cum				1453.32	
						say	*1453.00*	
		Note	Any one of the grading for material may be adopted as per design					
4.1		B	By Mix in Place Method					
			Construction of granular sub-base by providing close graded material, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per clause 401					
			Unit = cum					
			Taking output = 300 cum					
			a) Labour					
			Mate	day	0.480	275.00	132.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor unskilled	day	10.000	245.00	2450.00	L-13
			b) Machinery					
			Motor Grader 110 HP @ 50 cum	hour	6.000	1854.00	11124.00	P&M-032
			Vibratory roller 8 -10 tonne	hour	6.000	1292.00	7752.00	P&M-059
			Tractor - Rotavator	hour	12.000	280.00	3360.00	P&M-054
			Water tanker 6 KL capacity	hour	3.000	374.00	1122.00	P&M-060
			c) Material					
			Close graded Granular sub-base Material as per table 400-1					
			For Grading-I Material					
			53 mm to 9.5 mm @ 50 per cent	cum	192.000	890.15	170907.84	M-013
			9.5 mm to 2.36 mm @ 20 per cent	cum	76.000	774.52	58863.52	M-017
			2.36 mm below @ 30 per cent	cum	115.200	774.52	89224.70	M-020
			Cost of water	KL	18.000	30.00	540.00	M-189
			OR					
			For Grading-II Material					
			26.5 mm to 9.5 mm @ 35 per cent	cum	134.400	874.52	117535.49	M-015
			9.5 mm to 2.36 mm @ 25 per cent	cum	96.000	774.52	74353.92	M-017
			2.36 mm below @ 40 per cent	cum	153.600	774.52	118966.27	M-020
			Cost of water	KL	18.000	30.00	540.00	M-189
			OR					
			For Grading-III Material					
			9.5 mm to 4.75 mm @ 35 per cent	cum	134.400	774.52	104095.49	M-016
			4.75 mm to 2.36 mm @ 12.5 per cent	cum	48.000	774.52	37176.96	M-018
			2.36 mm below @ 52.5 per cent	cum	201.600	774.52	156143.23	M-020

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Cost of water	KL	18.000	30.00	540.00	M-189
4.1B		(i)	Rate per cum for grading-I Material					
			d) Overhead charges @ 10%				34596.61	
			e) Contractor's profit @ 10%				38056.27	
			Cost for 300 cum				418618.94	
			Rate per cum				1395.40	
						say	*1395.00*	
4.1B		(ii)	Rate per cum for grading-II Material					
			d) Overhead charges @ 10%				33782.57	
			e) Contractor's profit @ 10%				37160.82	
			Cost for 300 cum				408769.07	
			Rate per cum				1362.56	
						say	*1363.00*	
4.1B		(iii)	Rate per cum for grading-III Material					
			d) Overhead charges @ 10%				32438.57	
			e) Contractor's profit @ 10%				35682.42	
			Cost for 300 cum				392506.67	
			Rate per cum				1308.36	
						say	*1308.00*	
		Note	Any one of the grading for material may be adopted as per design					
4.2	401		Granular Sub-Base with Coarse Graded Material (Table:-400- 2)					
			Construction of granular sub-base by providing coarse graded material, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per clause 401.					
			Unit = cum					
			Taking output = 300 cum					
			a) Labour					
			Mate	day	0.400	275.00	110.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor	day	8.000	245.00	1960.00	L-13
			b) Machinery					
			Mortar Grader 110 HP @ 50 cum per hour	hour	6.000	1854.00	11124.00	P&M-032
			Vibratory roller 8 -10 tonne	hour	6.000	1292.00	7752.00	P&M-059
			Water tanker 6 KL capacity	hour	3.000	374.00	1122.00	P&M-060
			c) Material					
			For coarse graded Granular sub-base Materials per table 400-2					
			For grading-I Material					
			53 mm to 26.5 mm @ 35 per cent	cum	134.400	949.52	127615.49	M-029
			26.5 mm to 4.75 mm @ 45 per cent	cum	172.800	849.52	146797.06	M-026
			2.36 mm below @ 20 per cent (Coarse Sand)	cum	76.800	687.02	52763.14	M-022
			Cost of water	KL	18.000	30.00	540.00	M-189
			OR					
			For Grading-II Material					
			26.5 mm to 4.75 mm @ 75 per cent	cum	288.000	874.52	251861.76	M-026
			2.36 mm below @ 25 per cent	cum	96.000	774.52	74353.92	M-022
			Cost of water	KL	18.000	30.00	540.00	M-189
			OR					
			For Grading-III Material					
			9.5 mm to 4.75 mm @ 66 per cent	cum	255.000	774.52	197502.60	M-025
			2.36 mm below @ 34 per cent	cum	129.000	774.52	99913.08	M-022
			Cost of water	KL	18.000	30.00	540.00	M-189
4.2		(i)	Rate per cum for grading-I Material					
			d) Overhead charges @ 10%				35027.37	
			e) Contractor's profit @ 10%				38530.10	
			Cost for 300 cum				423831.15	
			Rate per cum				1412.77	
						say	*1413.00*	
4.2		(ii)	Rate per cum for grading-II Material					
			d) Overhead charges @ 10%				34931.37	
			e) Contractor's profit @ 10%				38424.50	
			Cost for 300 cum				422669.55	
			Rate per cum				1408.90	
						say	*1409.00*	
4.2		(iii)	Rate per cum for grading-III Material					
			d) Overhead charges @ 10%				32051.37	
			e) Contractor's profit @ 10%				35256.50	
			Cost for 300 cum				387821.55	
			Rate per cum				1292.74	
						say	*1293.00*	
		Note	Any one of the grading for material may be adopted as per design					
4.3	402		Lime Stabilisation for Improving Sub-grade					
			Laying and spreading available soil in the sub-grade on a prepared surface, pulverising, mixing the spread soil in place with rotavator with 3 per cent slaked lime having minimum content of 70 per cent of CaO, grading with motor grader and compacting with the road roller at OMC to the desired density to form a layer of improved sub grade					
			Unit = cum					
			Taking output = 300 cum (525 tonne)					
		A	By Mechanical Means					
			a) Labour					
			Mate	day	0.360	275.00	99.00	L-12
			Skilled mazdoor for alignment and geometrics	day	1.000	245.00	245.00	L-15
			Mazdoor for spraying lime	day	8.000	245.00	1960.00	L-13
			b) Machinery					
			Tractor with ripper and rotavator attachments @ 60 cum per hour for ripping and 25 cum per hour for mixing	hour	12.000	280.00	3360.00	P&M-055
			Motor Grader 110 HP @ 50 cum per hour	hour	6.000	1854.00	11124.00	P&M-032
			Vibratory roller 8 - 10 tonne capacity	hour	3.900	1292.00	5038.80	P&M-059

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Water tanker 6 KL capacity	hour	12.000	374.00	4488.00	P&M-060
			c) Material					
			Lime at site	tonne	15.750	4055.00	63866.25	M-188
			Cost of water	KL	72.000	30.00	2160.00	M-189
			d) Overhead charges @ 10%				9234.11	
			e) Contractor's profit @ 10%				10157.52	
			Cost for 300 cum				111732.67	
			Rate per cum				372.44	
						say	*372.00*	
		Note	* Though vibratory roller is required only for 3 hours as per norms, but the same has to be available at site for 6 hours as other machines for spreading and mixing will take 6 hours. The usage rates of roller have been multiplied with a factor of 0.65.					
4.3		B	By Manual Means					
			Unit = cum					
			Taking output = 150 cum (263 tonnes)					
			a) Labour					
			Mate	day	1.440	275.00	396.00	L-12
			Mazdoor skilled	day	1.000	245.00	245.00	L-15
			Mazdoor	day	35.000	245.00	8575.00	L-13
			b) Machinery					
			Vibratory roller 8 - 10 tonne @ 60 cum per hour	hour	2.500	1292.00	3230.00	P&M-059
			Water tanker 6 KL capacity	hour	6.000	374.00	2244.00	P&M-060
			c) Material					
			Lime at site	tonne	8.000	4055.00	32440.00	M-188
			Cost of water	KL	36.000	30.00	1080.00	M-189
			d) Overhead charges @ 10%				4821.00	
			e) Contractor's profit @ 10%				5303.10	
			Cost for 150 cum				58334.10	
			Rate per cum				388.89	
						say	*389.00*	
4.4	402		Lime Treated Soil for Sub- Base					
			Providing, laying and spreading soil on a prepared sub grade, pulverising, mixing the spread soil in place with rotavator with 3 per cent slaked lime with minimum content of 70 per cent of CaO, grading with motor grader and compacting with the road roller at OMC to achieve at least 98 per cent of the max dry density to form a layer of sub base.					
			Unit = cum					
			Taking output = 300 cum (525 tonnes)					
			a) Labour					
			Mate	day	0.480	275.00	132.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor	day	10.000	245.00	2450.00	L-13
			b) Machinery					
			Excavator 0.90 cum bucket capacity	hour	6.000	1008.00	6048.00	P&M-026
			Tipper for carriage of soil	tonne.km	525 x L	1.90	4987.50	Lead =5 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				498.75	
			Motor Grader 110 HP @ 50 cum per hour	hour	6.000	1854.00	11124.00	P&M-032
			Vibratory roller 8 - 10 tonne	hour	6.000	1292.00	7752.00	P&M-059
			Tractor with Rotavator and blade @ 25 cum per hour	hour	12.000	280.00	3360.00	P&M-054
			Water tanker 6 KL capacity	hour	12.000	374.00	4488.00	P&M-060
			c) Material					
			Lime at site	tonne	15.750	4055.00	63866.25	M-188
			Cost of water	KL	72.000	30.00	2160.00	M-189
			d) Overhead charges @ 10%				10735.65	
			e) Contractor's profit @ 10%				11809.22	
			Cost for 300 cum				129901.37	
			Rate per cum				433.00	
						say	*433.00*	
4.5	403		Cement Treated Soil Sub Base/ Base					
			Providing, laying and spreading soil on a prepared sub grade, pulverising, adding the designed quantity of cement to the spread soil, mixing in place with rotavator, grading with the motor grader and compacting with the road roller at OMC to achieve the desired unconfined compressive strength and to form a laver of sub-base/base.					
			Unit = cum					
			Taking output = 300 cum (525 tonnes)					
			For 4 per cent quantity of cement by weight of soil					
			a) Labour					
			Mate	day	0.480	275.00	132.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor	day	10.000	245.00	2450.00	L-13
			b) Machinery					
			Excavator 0.90 cum bucket capacity	hour	6.000	1008.00	6048.00	P&M-026
			Tipper for carriage of soil	tonne.km	525 x L	1.90	4987.50	Lead =5 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				498.75	
			Motor Grader 110 HP @ 50 cum per hour	hour	6.000	1854.00	11124.00	P&M-032
			Vibratory roller 8 - 10 tonne	hour	6.000	1292.00	7752.00	P&M-059
			Tractor with Rotavator and blade @ 25 cum per hour	hour	12.000	293.00	3516.00	P&M-054
			Water tanker 6 KL capacity	hour	12.000	374.00	4488.00	P&M-060
			c) Material					
			Cement at site (@ 4 per cent of 525 tonne)	tonne	21.000	7598.00	159558.00	M-081
			Cost of water	KL	72.000	30.00	2160.00	M-189
			d) Overhead charges @ 10%				20320.43	
			e) Contractor's profit @ 10%				22352.47	
			Cost for 300 cum				245877.14	
			Rate per cum				819.59	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
						say	820.00	
4.6	403		Cement Treated Crushed Rock or combination as per clause 403.2 and table 400.4in Sub base/ Base					
			Providing, laying and spreading Material on a prepared sub grade, adding the designed quantity of cement to the spread Material, mixing in place with rotavator, grading with the motor grader and compacting with the road roller at OMC to achieve the desired unconfined compressive strength and to form a layer of sub-base/base.					
			Unit = cum					
			Taking output = 300 cum (600 tonnes)					
			Quantity of cement assumed as 4 per cent of quantity of crushed rock by weight.					
			a) Labour					
			Mate	day	0.48	275.00	132.00	L-12
			Mazdoor skilled	day	2.00	245.00	490.00	L-15
			Mazdoor	day	10.00	245.00	2450.00	L-13
			b) Machinery					
			Motor Grader 110 HP @ 50 cum per hour	hour	6.00	1854.00	11124.00	P&M-032
			Vibratory roller 8 - 10 tonne	hour	6.00	1292.00	7752.00	P&M-059
			Tractor with Rotavator and blade @ 25 cum per hour	hour	12.00	293.00	3516.00	P&M-054
			Water tanker 6 KL capacity	hour	10.00	374.00	3740.00	P&M-060
			c) Material					
			Cement at site @ 4 per cent by weight of crushed aggregate (600 tonne)	tonne	24.00	7598.00	182352.00	M-081
			Grading of material for sub-base course					
			37.5 mm to 9.5 mm @ 55 per cent	cum	211.20	854.52	180474.62	M-014
			9.5 mm to 4.75 mm @ 20 per cent	cum	76.80	774.52	59483.14	M-025
			4.75 mm to 75 micron @ 25 per cent	cum	96.00	774.52	74353.92	M-019
			Cost of water	KL	60.00	30.00	1800.00	M-189
			or					
			Grading of material for Base course					
			37.5 mm to 9.5 mm @ 32.5 per cent	cum	124.80	854.52	106644.10	M-028
			9.5 mm to 4.75 mm @ 5 per cent	cum	19.20	774.52	14870.78	M-025
			4.75 mm to 75 micron @ 62.5 per cent	cum	240.00	774.52	185884.80	M-023
			Cost of water	KL	60.00	30.00	1800.00	M-189
4.6		(i)	For Sub-Base course					
			d) Overhead charges @ 10%				52766.77	
			e) Contractor's profit @ 10%				58043.44	
			Cost for 300 cum				638477.89	
			Rate per cum				2128.26	
						say	2128.00	
4.6		(ii)	For Base course					
			d) Overhead charges @ 10%				52075.57	
			e) Contractor's profit @ 10%				57283.12	
			Cost for 300 cum				630114.37	
			Rate per cum				2100.38	
						say	2100.00	
		Note	Quantities of aggregates provided under 'c' above are uncompacted quantities.					
4.7	404.3.1		Making 50 mm x 50 mm Furrows					
			Making 50 mm x 50 mm furrows, 25mm/ 50mm deep, 450 to the center line of the road and at one metre interval in the existing thin bituminous wearing coarse including sweeping and disposal of excavated material within 1000 metres lead					
			Unit = sqm					
			Taking output = 30 m x 7 m = 210 sqm					
		(i)	25mm deep furrow cutting					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.200	280.00	56.00	P&M-053
			d) Overhead charges @ 10%				56.80	
			e) Contractor's profit @ 10%				62.48	
			Cost for 210 sqm				687.28	
			Rate per sqm				68.73	
						say	69.00	
		(ii)	50mm deep furrow cutting					
			a) Labour					
			Mate	day	0.160	275.00	44.00	L-12
			Mazdoor	day	4.000	245.00	980.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.400	280.00	112.00	P&M-053
			c) Overhead charges @ 10%				113.60	
			d) Contractor's profit @ 10%				124.96	
			Cost for 210 sqm				1374.56	
			Rate per sqm				1364.56	
						say	1365.00	
4.8	404.3.2		Inverted Choke					
			Construction of inverted choke by providing, laying, spreading and compacting screening B type/ coarse sand of specified grade in uniform layer on a prepared surface with motor grader and compacting with power roller etc					
			Unit = cum					
			Taking output = 600 cum					
			a) Labour					
			Mate	day	0.920	275.00	253.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor	day	21.000	245.00	5145.00	L-13
			b) Machinery					
			Motor Grader 110 HP	hour	6.000	1854.00	11124.00	P&M-032
			Vibratory roller 8-10 tonnes @ 60 cum per hour	hour	6.000	1292.00	7752.00	P&M-059
			Water tanker 6 KL capacity	hour	18.000	374.00	6732.00	P&M-060
			c) Material					
			Screening type 'B' or coarse sand	cum	720.000	1184.68	852969.60	M-004

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Cost of water	KL	108.000	30.00	3240.00	M-189
			d) Overhead charges @ 10%				88770.56	
			e) Contractor's profit @ 10%				97647.62	
			Cost for 600 cum				1074123.78	
			Rate per cum				1790.21	
						say	1790.00	
4.9	404		Water Bound Macadam					
			Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with 3 wheeled steel/ vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density.					
		A	By Manual Means					
			Unit = cum					
			Taking output = 360 cum					
			a) Labour					
			Mate	day	10.080	275.00	2772.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor	day	250.000	245.00	61250.00	L-13
			b) Machinery					
			Vibratory roller 8 - 10 tonne @ 60cum per hour	hour	6.000	1292.00	7752.00	P&M-059
			or					
			Smooth 3 wheeled steel roller @ 30cum/hour	hour	12.000			
			Water tanker 6 KL capacity	hour	24.000	374.00	8976.00	P&M-060
			c) Material (Refer table 400 - 7, 8 & 9)					
4.9A		(i)	Grading-I					
			Aggregate					
			Grading-I 90 mm to 45 mm@ 1.21cum per 10 sqm for compacted thickness of 100 mm	cum	435.600	907.85	395460.91	M-039
			Stone Screening					
			Type A 13.2 mm for grading-I @ 0.27 cum per 10 sqm	cum	97.200	599.52	58273.34	M-052
			OR					
			Crushable type such as Moorum or Gravel for grading-I @ 0.30 cum per 10 sqm	cum	108.000	112.00	12096.00	M-007
			Binding material					
			Binding Material @ 0.08cum per 10 sqm for grading I material	cum	28.800	112.00	3225.60	M-007
			Cost of water	KL	144.000	30.00	4320.00	M-189
4.9A (i)		(a)	Using Scrining Crushable type such as Moorum or Gravel					
			d) Overhead charges @ 10%				49311.69	
			e) Contractor's profit @ 10%				54242.86	
			Cost for 360 cum				596671.46	
			Rate per cum				1657.42	
						say	1657.00	
			OR					
4.9A (i)		(b)	Using Scrining Type-A (13.2mm agg.)					
			d) Overhead charges @ 10%				54251.99	
			e) Contractor's profit @ 10%				59677.18	
			Cost for 360 cum				656449.03	
			Rate per cum				1823.47	
						say	1823.00	
4.9A		(ii)	Grading-II					
			Aggregate					
			Grading-II 63 mm to 45 mm /Grading-III 53 mm to 22.4 mm@ 0.91 cum per 10 sqm for compacted thickness of 75 mm	cum	435.600	907.85	395460.91	M-038
			Stone Screening					
			Type A 13.2 mm for grading-II@ 0.12 cum per 10 sqm	cum	57.600	774.52	44612.35	M-052
			OR					
			Crushable type such as Moorum or Gravel for grading II &III @ 0.22 cum per 10 sqm	cum	105.590	112.00	11826.08	M-007
			OR					
			Type B11.2 mm for grading-III @ 0.18 cum per 10 sqm	cum	86.400	774.52	66918.53	M-051
			Binding material					
			Binding Material @ 0.06cum per 10 sqm for grading II material	cum	28.800	112.00	3225.60	M-007
			Cost of water	KL	144.000	30.00	4320.00	M-189
4.9A (ii)		(a)	Using Scrining Crushable type such as Moorum or Gravel					
			d) Overhead charges @ 0.15 on (a+b+c)				73927.05	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				56677.40	
			Cost for 360 cum = a+b+c+d+e				623451.44	
			Rate per cum = (a+b+c+d+e)/360				1731.81	
						say	1732.00	
			OR					
4.9A (ii)		(b)	Using Scrining Type-A (13.2mm agg.)					
			d) Overhead charges @ 0.15 on (a+b+c)				79328.83	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				60818.77	
			Cost for 360 cum = a+b+c+d+e				669006.46	
			Rate per cum = (a+b+c+d+e)/360				1858.35	
						say	1858.00	
4.9A (ii)		(c)	Using Scrining Type-B (11.2mm agg.)					
			d) Overhead charges @ 0.15 on (a+b+c)				82674.76	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				63383.98	
			Cost for 360 cum = a+b+c+d+e				697223.78	
			Rate per cum = (a+b+c+d+e)/360				1936.73	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
						say	1937.00	
4.9A		(iii)	Grading-III					
			Aggregate					
			Grading-III 53 mm to 22.4 mm@ 0.91 cum per 10 sqm for compacted thickness of 75 mm	cum	435.600	959.52	417966.91	M-036
			Stone Screening					
			Type B 11.2 mm for grading-III @ 0.18 cum per 10 sqm	cum	86.400	774.52	66918.53	M-051
			OR					
			Crushable type such as Moorum or Gravel for grading II &III @ 0.22 cum per 10 sqm	cum	105.590	112.00	11826.08	M-007
			Binding material					
			Binding Material @ 0.06cum per 10 sqm for grading II material	cum	28.800	112.00	3225.60	M-007
			Cost of water	KL	144.000	30.00	4320.00	M-189
4.9A (iii)		(a)	Using Scrining Crushable type such as Moorum or Gravel					
			d) Overhead charges @ 0.15 on (a+b+c)				77302.95	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				59265.59	
			Cost for 360 cum = a+b+c+d+e				651921.53	
			Rate per cum = (a+b+c+d+e)/360				1810.89	
						say	1811.00	
			OR					
4.9A (iii)		(b)	Using Scrining Type-B (11.2mm agg.)					
			d) Overhead charges @ 0.15 on (a+b+c)				86050.66	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				65972.17	
			Cost for 360 cum = a+b+c+d+e				725693.87	
			Rate per cum = (a+b+c+d+e)/360				2015.82	
						say	2016.00	
			(Anyone of the aggregate grading, screening and binding material may be used as per design)					
4.9		B	By Mechanical Means:					
			Unit = cum					
			Taking output = 360 cum					
			a) Labour					
			Mate	day	0.680	275.00	187.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor	day	15.000	245.00	3675.00	L-13
			b) Machinery					
			Motor grader 110 HP @ 50cum/hr. for spreading	hour	7.200	1854.00	13348.80	P&M-032
			Vibratory roller 8-10 tonnes @ 60cum/hr.	hour	6.000	386.00	2316.00	P&M-059
			or					
			Smooth 3 wheeled steel roller @ 30cum/hr.	hour	12.000			
			Water tanker 6 KL capacity	hour	24.000	374.00	8976.00	P&M-060
			c) Material (Refer table 400 - 7, 8 & 9)					
4.9B		(i)	Grading-I					
			Aggregate					
			Grading-I 90 mm to 45 mm@ 1.21cum per 10 sqm for compacted thickness of 100 mm	cum	435.600	907.85	395460.91	M-039
			Stone Screening					
			Type A 13.2 mm for grading-I @ 0.27 cum per 10 sqm	cum	97.200	774.52	75283.34	M-052
			OR					
			Crushable type such as Moorum or Gravel for grading-I @ 0.30 cum per 10 sqm	cum	108.000	112.00	12096.00	M-007
			Binding material					
			Binding Material @ 0.08cum per 10 sqm for grading I material	cum	28.800	112.00	3225.60	M-007
			Cost of water	KL	144.000	30.00	4320.00	M-189
4.9B (i)		(a)	Using Scrining Crushable type such as Moorum or Gravel					
			d) Overhead charges @ 0.15 on (a+b+c)				66130.46	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				50700.02	
			Cost for 360 cum = a+b+c+d+e				557700.19	
			Rate per cum = (a+b+c+d+e)/360				1549.17	
						say	1549.00	
			OR					
4.9B (i)		(b)	Using Scrining Type-A (13.2mm agg.)					
			d) Overhead charges @ 0.15 on (a+b+c)				76092.40	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				58337.51	
			Cost for 360 cum = a+b+c+d+e				641712.56	
			Rate per cum = (a+b+c+d+e)/360				1782.53	
						say	1783.00	
4.9B		(ii)	Grading-II					
			Aggregate					
			Grading-II 63 mm to 45 mm /Grading-III 53 mm to 22.4 mm@ 0.91 cum per 10 sqm for compacted thickness of 75 mm	cum	435.600	907.85	395460.91	M-038
			Stone Screening					
			Type A 13.2 mm for grading-II@ 0.12 cum per 10 sqm	cum	57.600	774.52	44612.35	M-052
			OR					
			Crushable type such as Moorum or Gravel for grading II &III @ 0.22 cum per 10 sqm	cum	105.590	112.00	11826.08	M-007
			OR					
			Type B11.2 mm for grading-III @ 0.18 cum per 10 sqm	cum	86.400	774.52	66918.53	M-051
			Binding material					
			Binding Material @ 0.06cum per 10 sqm for grading II material	cum	28.800	112.00	3225.60	M-007
			Cost of water	KL	144.000	30.00	4320.00	M-189
4.9B (ii)		(a)	Using Scrining Crushable type such as Moorum or Gravel					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			d) Overhead charges @ 0.15 on (a+b+c)				66089.97	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				50668.98	
			Cost for 360 cum = a+b+c+d+e				557358.74	
			Rate per cum = (a+b+c+d+e)/360				1548.22	
						say	*1548.00*	
			OR					
4.9B (ii)		(b)	Using Scrining Type-A (13.2mm agg.)					
			d) Overhead charges @ 0.15 on (a+b+c)				71491.75	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				54810.34	
			Cost for 360 cum = a+b+c+d+e				602913.75	
			Rate per cum = (a+b+c+d+e)/360				1674.76	
						say	*1675.00*	
4.9B (ii)		(c)	Using Scrining Type-B (11.2mm agg.)					
			d) Overhead charges @ 0.15 on (a+b+c)				74837.68	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				57375.55	
			Cost for 360 cum				631131.07	
			Rate per cum = (a+b+c+d+e)/360				1753.14	
						say	*1753.00*	
4.9B		(iii)	Grading-III					
			Aggregate					
			Grading-III 53 mm to 22.4 mm@ 0.91 cum per 10 sqm for compacted thickness of 75 mm	cum	435.600	955.77	416333.41	M-036
			Stone Screening					
			Type B11.2 mm for grading-III @ 0.18 cum per 10 sqm	cum	86.400	774.52	66918.53	M-051
			OR					
			Crushable type such as Moorum or Gravel for grading II &III @ 0.22 cum per 10 sqm	cum	105.590	112.00	11826.08	M-007
			Binding material					
			Binding Material @ 0.06cum per 10 sqm for grading II material	cum	28.800	112.00	3225.60	M-007
			Cost of water	KL	144.000	30.00	4320.00	M-189
4.9B (iii)		(a)	Using Scrining Crushable type such as Moorum or Gravel					
			d) Overhead charges @ 0.15 on (a+b+c)				69220.84	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				53069.31	
			Cost for 360 cum = a+b+c+d+e				583762.45	
			Rate per cum = (a+b+c+d+e)/360				1621.56	
						say	*1622.00*	
			OR					
4.9B (iii)		(b)	Using Scrining Type-B (11.2mm agg.)					
			d) Overhead charges @ 0.15 on (a+b+c)				77968.55	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				59775.89	
			Cost for 360 cum = a+b+c+d+e				657534.78	
			Rate per cum = (a+b+c+d+e)/360				1826.49	
						say	*1826.00*	
		Note	As three wheeled smooth rollers are also very commonly used, the same has been provided as an alternative.					
4.10	405		Crushed Cement Concrete Sub-base / Base					
			Breaking and crushing of material obtained by breaking damaged cement concrete slabs to size range not exceeding 75 mm as specified in table 400.7 transporting the aggregates obtained from breaking of cement concrete slabs at a lead of L km., laying and compacting the same as sub base/ base course, constructed as WBM to clause 404 except the use of screening or binding Material.					
			Unit = cum					
			Taking output =360 cum					
			a) Labour					
			Mate	day	4.160	275.00	1144.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor for crushing broken cement concrete pavement/slabs into aggregate	day	102.000	245.00	24990.00	L-13
			b) Machinery					
			Motor Grader,110 HP @ 50 cum/hr.	hour	6.000	1854.00	11124.00	P&M-032
			Vibratory roller 8 - 10 tonne@ 60 cum per hour	hour	6.000	1292.00	7752.00	P&M-059
			or					
			Smooth 3 wheeled steel roller @ 30cum/hr.	hour	12.000			
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	720 x L	1.90	13680.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				1368.00	
			Water tanker 6 KL capacity with 5 km lead @ 1 trip per hour	hour	12.000	374.00	4488.00	P&M-060
			c) Material					
			Material available from dismantled concrete slab after crushing / breaking and only carriage is required to be provided					
			Cost of water	KL	72.000	30.00	2160.00	M-189
			d) Overhead charges @ 10%				7094.00	
			e) Contractor's profit @ 10%				7803.40	
			Cost for 360 cum				85837.40	
			Rate per cum				238.44	
						say	*238.00*	
		Note	1. It is assumed that dismantling of concrete slab/pavement has been considered separately. Hence same is not added in this analysis. Only labour for crushing the dismantled slab into aggregate has been added. Carriage from stock pile to work site has been provided with a lead of L km.					
			2. In case of breaking of slabs is done locally without involvement of transportation, the provision of tipper, front end loader and loading/unloading charges may be deleted.					
			3. As three wheeled smooth steel rollers are commonly in use, the same has been provided as an alternative.					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
4.11	405.2		Penetration Coat Over Top Layer of Crushed Cement Concrete Base					
			Spraying of bitumen over cleaned dry surface of crushed cement concrete base at the rate of 25 kg per 10 sqm by a bitumen pressure distributor, spreading of key aggregates at the rate of 0.13 cum per 10 sqm by a mechanical gritter and rolling the surface as per clause 506.3.8					
			Unit = sqm					
			Taking output = 7500 sqm					
			a) Labour					
			Mate	day	0.560	275.00	154.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor	day	12.000	245.00	2940.00	L-13
			b) Machinery					
			Mechanical broom hydraulic @ 1250 sqm per hour	hour	6.000	276.00	1656.00	P&M-031
			Hydraulic self propelled chips spreader	hour	6.000	1785.00	10710.00	P&M-025
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	hour	6.000	225.00	1350.00	P&M-048
			Vibratory roller 8 -10 tonnes @ 30 cum per hour	hour	6.00x0.65*	1292.00	5038.80	P&M-059
			Bitumen pressure distributor @ 1750 sqm per hour	hour	4.280	593.00	2538.04	P&M-004
			c) Material					
			Crushed stone aggregate 11.2 mm size	cum	97.500	774.52	75515.70	M-051
			Bitumen (60-70 grade)	tonne	0.250	43209.95	10802.49	M-074
			d) Overhead charges @ 10%				11493.90	
			e) Contractor's profit @ 10%				12643.29	
			Cost for 7500 sqm				139076.22	
			Rate per sqm				18.54	
						say	*19.00*	
		Note	Though vibratory roller is required only for 3 hours as per norms, the same is required to be available at site for 6 hours to match with other machines. The usage rates of vibratory roller may be multiplied with a factor of 0.65.					
4.12	406		Wet Mix Macadam					
			Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the Material with water at OMC in mechanical mix plant carriage of mixed Material by tipper to site, laying in uniform layers with paver in sub- base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density.					
			Unit = cum					
			Taking output = 225 cum (495 tonnes)					
			a) Labour					
			Mate	day	0.480	275.00	132.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor	day	10.000	245.00	2450.00	L-13
			b) Machinery					
			Wet mix plant of 75 tonne hourly capacity	hour	9.000	1010.00	9090.00	P&M-094
			Electric generator 125 KVA	hour	6.000	674.40	4046.40	P&M-018
			Front end loader 1 cum capacity	hour	6.000	624.00	3744.00	P&M-017
			Paver finisher	hour	6.000	786.00	4716.00	P&M-035
			Vibratory roller 8 - 10 tonne	hour	6x0.65	1292.00	5038.80	P&M-059
			or					
			Smooth 3 wheeled steel roller @ 8-10 tonnes.	hour	12.000			
			Water tanker 6 KL capacity	hour	3.000	374.00	1122.00	P&M-060
			Tipper	tonne.km	14850.000	1.90	28215.00	Lead 30km
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				2821.50	
			c) Material (Table 400-11)					
			45 mm to 22.4 mm@ 30 per cent	cum	89.100	974.52	86829.73	M-034
			22.4 mm to 2.36 mm @ 40 per cent	cum	118.800	831.66	98801.55	M-031
			2.36 mm to 75 micron@ 30 per cent	cum	89.100	687.02	61213.48	M-022
			Cost of water	KL	18.000	30.00	540.00	M-189
			d) Overhead charges @ 10%				30925.05	
			e) Contractor's profit @ 10%				34017.55	
			Cost for 225 cum				374193.06	
			Rate per cum				1663.08	
						say	*1663.00*	
		Note	1. Though vibratory roller is required only for 3 hours as per norms, the same is required to be available at site for 6 hours to match with other machines. The usage rates of vibratory roller may be multiplied with a factor of 0.65					
			2. As three wheeled smooth steel rollers are commonly in use, the same has been provided as an alternative which can be used if the thickness of individual layer does not exceed 100 mm..					
4.13	407		Construction of Median and Island with Soil Taken from Roadway Cutting					
			Construction of Median and Island above road level with approved material deposited at site from roadway cutting and excavation for drain and foundation of other structures, spread, graded and compacted as per clause 407					
			Unit = cum					
			Taking output =21 cum					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			b) Machinery					
			Water tanker 6 KL with 5 km lead and 1 trip per hour	hour	1.000	374.00	374.00	P&M-060
			Plate compactor @ 3.5 cum per hour	hour	6.000	250.00	1500.00	P&M-086
			c) Material					
			Cost of water	KL	6.000	30.00	180.00	M-189
			d) Overhead charges @ 10%				359.00	
			e) Contractor's profit @ 10%				394.90	
			Cost for 21 cum				4343.90	
			Rate per cum				206.85	
						say	*207.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		Note	This analysis provides for median and island with earthen top. In case the surface is required to be turfed or planted with shrubs, the same is required to be provided separately as per analysis given in the chapter on horticulture. In case granular fill is required to be paved, quantities of paving are required to be calculated as per approved design and paid separately.					
4.14	407		Construction of Median and Island with Soil Taken from Borrow Areas					
			Construction of median and Island above road level with approved material brought from borrow pits, spread, sloped and compacted as per clause 407					
			Unit = cum					
			Taking output = 21 cum					
			a) Labour					
			Mate	day	0.160	275.00	44.00	L-12
			Mazdoor	day	4.000	245.00	980.00	L-13
			b) Machinery					
			Water tanker with 5 km lead	hour	1.000	374.00	374.00	P&M-060
			Plate Compactor @ 3.5 cum per hour	hour	6.000	250.00	1500.00	P&M-086
			Hydraulic Excavator1.0 cum bucket capacity @60 cum per hour	hour	0.500	1008.00	504.00	P&M-026
=			Tipper 10 tonne capacity	tonne.km	52.5 x L	1.90	498.75	Lead =5 km & P&M-058
			Add 10 per cent of cost of transportation to cover cost of loading and unloading				49.88	
			c) Material					
			Cost of Earth	Cum	21.000	92.00	1932.00	
			Cost of water	KL	6.000	30.00	180.00	M-189
			d) Overhead charges @ 10%				606.26	
			e) Contractor's profit @ 10%				666.89	
			Cost for 21 cum				7335.78	
			Rate per cum				349.32	
						say	*349.00*	
		Note	This analysis provides for median and island with earthen top. In case the surface is required to be turfed or planted with shrubs, the same is required to be provided separately as per analysis given in the chapter on horticulture. In case surface finish is of hard type, the same may be provided separately as per approved design.					
4.15			Construction of Shoulders					
			A. Earthen Shoulders					
			The rate as applicable for sub-grade construction may be adopted.					
			B. Hard Shoulders					
			Rate as applicable for sub-base and or base may be adopted as per approved design.					
			C. Paved shoulders					
			The rate may be adopted as applicable for different layers of pavement depending upon approved design of paved shoulders.					
4.16	409		Footpaths and Separators					
			Construction of footpath/separator by providing a 150 mm compacted granular sub base as per clause 401 and 25 mm thick cement concrete grade M15, over laid with pre-cast concrete tiles in cement mortar 1:3 including provision of all drainage arrangements but excluding kerb channel..					
			Unit = sqm					
			Taking output = 300 sqm					
			a) Labour					
			Mate	day	1.360	275.00	374.00	L-12
			Mason	day	4.000	245.00	980.00	L-11
			Mazdoor	day	30.000	245.00	7350.00	L-13
			b) Machinery					
			Vibratory road roller 8 -10 tonnes @60 cum per hour	hour	0.750	1292.00	969.00	P&M-059
			Water tanker 6 KL capacity @ 1 trip per hour	hour	2.000	374.00	748.00	P&M-060
			Concrete mixer 0.4/0.28 cum per hour	hour	6.000	180.00	1080.00	P&M-009
			c) Material					
			i) For Granular sub base material					
			53 mm to 26.5 mm @ 35 per cent	cum	20.790	949.52	19740.52	M-029
			26.5 mm to 4.75 mm @ 45 per cent	cum	26.730	874.52	23375.92	M-026
			2.36 mm below @ 20 per cent	cum	11.880	774.52	9201.30	M-022
			ii) For cement concrete grade M157.5 cum					
			Aggregate 12 mm crushed @ 0.9 cum of concrete	cum	6.750	774.52	5228.01	M-052
			Sand @ 0.45 cum/cum of concrete	cum	3.380	1184.68	4004.22	M-005
			Cement	tonne	1.880	7598.00	14284.24	M-081
			iii) For cement plaster 1:3					
			Sand	cum	3.840	1184.68	4549.17	M-005
			Cement	tonne	1.830	7598.00	13904.34	M-081
			iv) Pre-cast cement concrete tiles					
			Tiles size 300 x 300 mm and 25 mm thick	each	3300.000	12.20	40260.00	M-184
			v) RCC pipes					
			Pipes 200 mm dia,2.5 m long for drainage	metre	22.500	255.00	5737.50	M-137
			vi) Cost of water	KL	12.000	30.00	360.00	M-189
			d) Overhead charges @ 20%				30429.24	
			e) Contractor's profit @ 10%				18257.55	
			Cost for 300 sqm				200833.01	
			Rate per sqm				669.44	
						say	*669.00*	
4.17	410		Crusher Run Macadam Base					
			Providing crushed stone aggregate, depositing on a prepared surface by hauling vehicles, spreading and mixing with a motor grader, watering and compacting with a vibratory roller to clause 410 to form a layer of sub-base/Base					
			Unit = cum					
			Taking output = 360 cum					
		A	By Mix in Place Method					
			a) Labour					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mate	day	0.480	275.00	132.00	L-12
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			Mazdoor	day	10.000	245.00	2450.00	L-13
			b) Machinery					
			Tractor attached with rotavator @ 25 cum per hour	hour	12.000	293.00	3516.00	P&M-054
			Motor grader 110 HP	hour	6.000	1854.00	11124.00	P&M-032
			Vibratory roller 8 -10 tonnes @ 60 cum per hour	hour	6.000	1292.00	7752.00	P&M-059
			Water tanker 6 KL capacity	hour	6.000	374.00	2244.00	P&M-060
			c) Material					
			Aggregate at site					
			i) For 53 mm maximum size					
			63 mm to 45 mm @ 33 per cent	cum	157.460	937.02	147543.17	M-038
			22.5 mm to 5.6 mm@ 32 per cent	cum	151.060	854.52	129083.79	M-032
			Below 5.6 mm @ 35 per cent	cum	166.680	774.52	129096.99	M-030
			Cost of water	KL	36.000	30.00	1080.00	M-189
			Or					
			ii) For 45 mm maximum size					
			45 mm to 22.5 mm@ 5 per cent	cum	24.120	974.52	23505.42	M-034
			22.4 mm to 5.6 mm@ 50 per cent	cum	237.600	814.52	193529.95	M-032
			Below 5.6 mm@ 45 per cent	cum	213.480	774.52	165344.53	M-030
			Cost of water	KL	36.000	30.00	1080.00	M-189
4.17A		(i)	For 53 mm maximum size					
			d) Overhead charges @ 10%				43451.20	
			e) Contractor's profit @ 10%				47796.31	
			Cost for 360.0cum				525759.46	
			Rate per cum				1460.44	
			or			say	1460.00	
4.17A		(ii)	For 45 mm maximum size					
			d) Overhead charges @ 10%				41116.79	
			e) Contractor's profit @ 10%				45228.47	
			Cost for 360.0cum				497513.16	
			Rate per cum				1381.98	
						say	1382.00	
		Note	Any one of the aggregate grading may be adopted					
4.17		B	By Mixing Plant :					
			Unit = cum					
			Taking output = 225 cum (450 tonnes)					
			a) Labour					
			Mate	day	0.280	275.00	77.00	L-12
			Mazdoor skilled	day	1.000	245.00	245.00	L-15
			Mazdoor	day	6.000	245.00	1470.00	L-13
			b) Machinery					
			Wet mix plant @ 75 tonne per hour	hour	6.000	1010.00	6060.00	P&M-093
			Electric generator 125 KVA	hour	6.000	674.40	4046.40	P&M-018
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Motor grader 110 HP	hour	6.000	1854.00	11124.00	P&M-032
			Vibratory roller 8 - 10 tonne	hour	6.000	1292.00	7752.00	P&M-059
			Water tanker 6 KL capacity	hour	3.000	374.00	1122.00	P&M-060
			Tipper 10 tonne capacity	tonne.km	450 x L	1.90	8550.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				855.00	
			c) Material					
			Aggregate at site					
			i) For 53 mm maximum size					
			63 mm to 45 mm @ 33 per cent	cum	98.400	874.52	86052.77	M-038
			22.5 mm to 5.6 mm@ 32 per cent	cum	94.410	841.19	79416.43	M-032
			Below 5.6 mm @ 35 per cent	cum	104.180	774.52	80689.49	M-030
			Or					
			ii) For 45 mm maximum size					
			45 mm to 22.5 mm@ 5 per cent	cum	15.060	974.52	14676.27	M-034
			22.4 mm to 5.6 mm@ 50 per cent	cum	148.500	814.52	120956.22	M-032
			Below 5.6 mm@ 45 per cent	cum	133.430	774.52	103344.20	M-030
			Cost of water	KL	18.000	30.00	540.00	M-189
4.17 B		(i)	For 53 mm maximum size					
			d) Overhead charges @ 10%				29120.41	
			e) Contractor's profit @ 10%				32032.45	
			Cost for 225cum				352356.95	
			Rate per cum				1566.03	
						say	1566.00	
4.17 B	(ii)		For 45 mm maximum size					
			d) Overhead charges @ 10%				28456.21	
			e) Contractor's profit @ 10%				31301.83	
			Cost for 360.0cum				344320.13	
			Rate per cum				956.44	
						say	956.00	
4.18	Suggestive		Lime, Flyash Stabilised Soil Sub-Base					
			Construction of Sub-base using lime - Flyash admixture with granular soil, free from organic matter/ deleterious material or clayey silts and low plasticity clays having PI between 5 and 20 and liquid limit less than 25 and commercial dry lime, slaked at site or pre-slaked with CaO content not less than 50 per cent, Flyash to conform to gradation as per clause 4.3 of IRC: 88-1984, lime + Flyash content ranging between 10 to 30 per cent, the minimum un-confined compressive strength and CBR value after 28 days curing and 4 days soaking to be 7.5kg/sq, cm and 25 per cent respectively, all as specified in IRC: 88-1984					
			Unit = cum					
			Taking output = 480 cum (720 tonnes, density 1.50 t/cum)					
			Assumptions made					
			Total mass taken for analysis = 720 t					
			Lime + Flyash admixture @ 20 per cent = 0.2 x 720=144 t					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Soil = 720 -144 = 576 t					
			576 /1.6 = 360 cum					
			Lime + Flyash = 144 t					
			Ratio Lime 4 : Flyash 16					
			Lime = 29 kg.					
			Flyash = 115 kg.					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			Mazdoor (Skilled)	day	1.000	245.00	245.00	L-15
			b) Machinery					
			Hydraulic Excavator 0.90 cum bucket capacity @ 60cum/hr. for 360 cum soil	hour	6.000	1008.00	6048.00	P&M-026
			Tipper 10T capacity for carriage of soil 576 tonnes	tonne.km	576.000	1.90	1094.40	Lead =5 km & P&M-058
			Tipper 10T capacity for carriage of 115 tonnes Flyash	tonne.km	115.000	1.90	218.50	Lead =input km & P&M-058
			Tipper 10T capacity for carriage of 29 tonnes of lime from store to work site	hour	3.000	225.00	675.00	P&M-048
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				67.50	
			Tractor with disc harrows for pulverisation	hour	6.000	293.00	1758.00	P&M-053
			Motor Grader 110 HP @ 50 cum per hour for mixing in-place and grading	hour	9.600	1854.00	17798.40	P&M-032
			Vibratory roller 8 - 10 tonne	hour	6.000	1292.00	7752.00	P&M-059
			Water tanker 6 KL capacity	hour	12.000	374.00	4488.00	P&M-060
			c) Material					
			Slaked Lime	tonne	29.000	4055.00	117595.00	M-188
			Compensation for earth taken from private source	cum	360.000	92.00	33120.00	M-092
			d) Overhead charges @ 10%				19239.58	
			e) Contractor's profit @ 10%				21163.54	
			Cost for 480 cum				232798.92	
			Rate per cum				485.00	
						say	*485.00*	
		Note	1.Compensation for earth will vary from place to place and will have to be assessed realistically as per particular ground situation. In case earth is available from Govt. land, compensation for earth will not be required. The position is required to be clearly stated in the cost estimate.					
			2.Cost of Flyash has not been considered as same will be available free of cost. Only carriage of Flyash has been provided.					
			3.Lime + Flyash has been taken as 20 per cent of total mass and ratio of lime and Flyash as 1:4 for estimating purposes. Total quantities will be as per approved design.					

3.18	305		Construction of Subgrade and Earthen Shoulders with borrow earth (Lime 3%)					
			Construction of sub-grade and earthen shoulders with approved material obtained from borrow pits with all lifts & leads, transporting to site, spreading, grading to required slope and compacted to meet requirement of table No. 300-2					**Subgrade 3% Lime +97% Barrow Earth**
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Hydraulic excavator1 cum bucket capacity @ 60 cum per hour	hour	1.670	966.00	1613.22	P&M-026
			Tipper 10 tonne capacity	tonne.km	175.000	1.90	332.50	
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				33.25	
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Motor grader for grading @ 50 cum per hour	hour	2.000	1854.00	3708.00	P&M-032
			Water tanker with 6 kl capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8-10 tonnes @ 80 cum per hour	hour	1.250	1292.00	1615.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			Lime	Tonne	5.250	4055.00	21288.75	
			Compensation for earth with Royalty, Extra Lead	cum	97.000	112.00	10864.00	M-092
			d) Overhead charges @ 10%				4324.67	
			e) Contractor's profit @ 10%				4757.14	
			Cost for 100 cum				52328.53	
			Rate per cum				523.29	
						say	*523.00*	

CHAPTER - 5
BASES AND SURFACE COURSES (BITUMINOUS)

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
5.1	502		Prime Coat					
			Providing and applying primer coat with bitumen emulsion on prepared surface of granular Base including clearing of road surface and spraying primer at the rate of 0.60 kg/sqm using mechanical means.					
			Unit = sqm					
			Taking output = 3500 sqm					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	2.800	276.00	772.80	P&M-031
			Air compressor 250 cfm	hour	2.800	257.00	719.60	P&M-001
			Bitumen pressure distributor @ 1750 sqm per hour	hour	2.000	593.00	1186.00	P&M-004
			Water tanker 6 KL capacity @ 1 trip per hour	hour	1.000	374.00	374.00	P&M-060
			c) Material					
			Bitumen emulsion @ 0.6 kg per sqm	tonne	2.100	31532.50	66218.25	M-077
			Cost of water	KL	6.000	30.00	180.00	M-189
			d) Overhead charges @ 10%				6996.27	
			e) Contractor's profit @ 10%				7695.89	
			Cost for 3500 sqm				84654.81	
			Rate per sqm				24.19	
						say	*24.00*	
		Note	Bitumen primer has been provided @ 0.60 kg per sqm as per clause 502.8. Payment shall be made with adjustment, plus or minus, for the variation between this quantity and the actual quantity approved by the Engineer after the preliminary trials referred to in clause No. 502.4.3.					
5.2	503	A	Tack Coat					
			Providing and applying tack coat with bitumen emulsion using emulsion pressure distributor at the rate of 0.20 kg per sqm on the prepared bituminous surface cleaned with mechanical broom.					
			Unit = sqm					
			Taking output = 3500 sqm					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	2.800	276.00	772.80	P&M-031
			Air compressor 250 cfm	hour	2.800	257.00	719.60	P&M-001
			Emulsion pressure distributor @ 1750 sqm per hour	hour	2.000	593.00	1186.00	P&M-004
			c) Material					
			Bitumen emulsion @ 0.2 kg per sqm	tonne	0.700	31532.50	22072.75	M-077
			d) Overhead charges @ 10%				2526.32	
			e) Contractor's profit @ 10%				2778.95	
			Cost for 3500 sqm				30568.41	
			Rate per sqm				8.73	
						say	*9.00*	
		Note	1. Bitumen emulsion has been provided @ 0.20 kg per sqm as per clause 503.8. Payment shall be made with adjustment, plus or minus, for the variation between this quantity and actual quantity approved by the Engineer after preliminary trials referred to in clause No. 503.4.3					
			2. An output of 3500 sqm has been considered in case of prime coat and tack coat which can be covered by bituminous courses on the same day.					
		B	Tack Coat					
			Providing and applying tack coat with bitumen emulsion using emulsion pressure distributor at the rate of 0.25 kg per sqm on the prepared granular surface cleaned with mechanical broom.					
			Unit = sqm					
			Taking output = 3500 sqm					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	2.800	276.00	772.80	P&M-031
			Air compressor 250 cfm	hour	2.800	257.00	719.60	P&M-001
			Emulsion pressure distributor @ 1750 sqm per hour	hour	2.000	593.00	1186.00	P&M-004
			c) Material					
			Bitumen emulsion @ 0.2 kg per sqm	tonne	0.875	31532.50	27590.94	M-077
			d) Overhead charges @ 10%				3078.13	
			e) Contractor's profit @ 10%				3385.95	
			Cost for 3500 sqm				37245.42	
			Rate per sqm				10.64	
						say	*11.00*	
		Note	1. Bitumen emulsion has been provided @ 0.20 kg per sqm as per clause 503.8. Payment shall be made with adjustment, plus or minus, for the variation between this quantity and actual quantity approved by the Engineer after preliminary trials referred to in clause No. 503.4.3					
			2. An output of 3500 sqm has been considered in case of prime coat and tack coat which can be covered by bituminous courses on the same day.					
5.3	504		Bituminous Macadam					
			Providing and laying bituminous macadam with 100-120 TPH hot mix plant producing an average output of 75 tonnes per hour using crushed aggregates of specified grading premixed with bituminous binder, transported to site, laid over a previously prepared surface with paver finisher to the required grade, level and alignment and rolled as per clauses 501.6 and 501.7 to achieve the desired compaction					
			Unit = cum					
			Taking output = 205 cum (450 tonnes)					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor working with HMP, mechanical broom, paver, roller, asphalt cutter and assistance for setting out lines, levels and layout of construction	day	16.000	245.00	3920.00	L-13
			Skilled mazdoor for checking line & levels	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Batch mix HMP 100-120 TPH @ 75 tonne per hour actual output	hour	6.000	16600.00	99600.00	P&M-021

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mechanical broom hydraulic @ 1250 sqm per hour	hour	2.200	276.00	607.20	P&M-031
			Air compressor 250 cfm	hour	2.200	257.00	565.40	P&M-001
			Paver finisher hydrostatic with sensor control @ 75 cum per hour	hour	6.000	2070.00	12420.00	P&M-034
			Generator 250 KVA	hour	6.000	1348.80	8092.80	P&M-081
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	13500.000	1.90	25650.00	Lead 30km
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				2565.00	
			Smooth wheeled roller 8-10 tonnes for initial break down rolling.	hour	6.00x0.65*	386.00	1505.40	P&M-044
			Vibratory roller 8 tonnes for intermediate rolling.	hour	6.00x0.65*	1292.00	5038.80	P&M-059
			Finish rolling with 6-8 tonnes smooth wheeled tandem roller.	hour	6.00x0.65*	922.00	3595.80	P&M-045
			c) Material					
			i) Bitumen@ 3.3 per cent of mix	tonne	14.850	43209.95	641667.82	M-074
			weight of mix = 205 x 2.2 = 450 tonne					
			ii) Aggregate					
			Total weight of mix = 450 tonnes					
			Weight of bitumen = 14.85 tonnes					
			Weight of aggregate = 450 -14.85 = 435.15 tonnes					
			Taking density of aggregate = 1.5 ton/cum					
			Volume of aggregate = 290.1 cum					
			*Grading I (40 mm nominal size)					
			37.5 - 25 mm 15 per cent	cum	43.510	974.52	42401.37	M-049
			25 - 10 mm 45 per cent	cum	130.550	874.52	114168.59	M-046
			10 - 5 mm 25 per cent	cum	72.530	774.52	56175.94	M-040
			5 mm and below15 per cent	cum	43.510	774.52	33699.37	M-030
			or					
			GradingII(19 mm nominal size)					
			25 - 10 mm 40 per cent	cum	116.040	874.52	101479.30	M-046
			10 - 5 mm 40 per cent	cum	116.040	774.52	89875.30	M-040
			5 mm and below 20 per cent	cum	58.020	774.52	44937.65	M-030
			* Any one of the alternative may be adopted as per approved design					
		(i)	for Grading I (40 mm nominal size)					
			d) Overhead charges @ 10%				105687.35	
			e) Contractor's profit @ 10%				116256.08	
			Cost for 205 cum				1278816.90	
			Rate per cum				6238.13	
						say	*6238.00*	
		(ii)	for GradingII(19 mm nominal size)					
			d) Overhead charges @ 10%				104672.05	
			e) Contractor's profit @ 10%				115139.25	
			Cost for 205 cum				1266531.77	
			Rate per cum (For Grading-II)				6178.20	
						say	*6178.00*	
		Note	*1. Although the rollers are required only for 3 hours as per norms of output, but the same have to be available at site for six hours as the hot mix plant and paver will take six hours for mixing and paving the output of 450 tonnes considered in this analysis. To cater for the idle period of these rollers, their usage rates have been multiplied by a factor of 0.65.					
			2.Quantity of Bitumen has been taken for analysis purpose. The actual quantity will depend upon job mix formula.					
			3. Labour for traffic control, watch and ward and other miscellaneous duties at site including sundries have been included in administrative overheads of the contractor.					
			4. In case BM is laid over freshly laid tack coat, provision of Mechanical broom and 2 mazdoors for the same shall be deleted as the same has been included in the cost of tack coat.					
5.4	505		Bituminous Penetration Macadam					
			Construction of penetration macadam over prepared Base by providing a layer of compacted crushed coarse aggregate using chips spreader with alternate applications of bituminous binder and key aggregates and rolling with a smooth wheeled steel roller 8-10 tonne capacity to achieve the desired degree of compaction					
		A	50 mm thick					
			Unit = sqm					
			Taking output = 4500 sqm (225 cum)					
			a) Labour					
			Mate	day	0.320	275.00	88.00	L-12
			Mazdoor including for brooming of key aggregates	day	6.000	245.00	1470.00	L-13
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			b) Machinery					
			Hydraulic self propelled chip spreader both for aggregates and key aggregates@ 1500 sqm per hour for 4500 x 2 sqm = 9000 sqm	hour	6.000	1785.00	10710.00	P&M-025
			Bitumen pressure distributor for @ 1750 sqm per hour	hour	2.570	593.00	1524.01	P&M-004
			Tipper 5.5 cum capacity for carriage of aggregates from stockpile to chip spreader	hour	10.000	240.00	2400.00	P&M-048
			Vibratory roller 8 tonnes	hour	6.000	1292.00	7752.00	P&M-059
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			c) Material					
			Bitumen@ 5 kg per sqm	tonne	22.500	43209.95	972223.97	M-074
			Crushed stone coarse aggregate passing 45 mm and retained on 2.8 mm sieve @ 0.06 cum per sqm	cum	270.000	874.52	236120.40	M-033
			Key aggregates passing 22.4 mm and retained on 2.8 mm sieve @ 0.015 cum per sqm	cum	67.500	841.19	56780.10	M-031
			d) Overhead charges @ 10%				129330.25	
			e) Contractor's profit @ 10%				142263.27	
			Cost for 4500 sqm				1564896.00	
			Rate per sqm				347.75	
						say	*348.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		Note	2 tippers will be needed to match the capacity of chip spreader and front end loader.					
5.4		B	75 mm thick					
			Unit = sqm					
			Taking output = 4500 sqm (337.5 cum compacted).					
			a) Labour					
			Mate	day	0.400	275.00	110.00	L-12
			Mazdoor including for brooming of key aggregates	day	8.000	245.00	1960.00	L-13
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			b) Machinery					
			Hydraulic self propelled chip spreader both for aggregates and key aggregates@ 1500 sqm per hour for 4500 x 2 sqm	hour	6.000	1785.00	10710.00	P&M-025
			Bitumen pressure distributor for@ 1750 sqm per hour	hour	2.570	593.00	1524.01	P&M-004
			Tipper 5.5 cum capacity for carriage of aggregates from stockpile to chip spreader	hour	10.000	240.00	2400.00	P&M-048
			Vibratory roller 8 tonnes	hour	6.000	1292.00	7752.00	P&M-059
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			c) Material					
			Bitumen@ 6.8 kg per sqm	tonne	30.600	43209.95	1322224.60	M-074
			Crushed stone coarse aggregate (loose passing 63 mm and retained on 2.8 mm sieve @ 0.09 cum per sqm	cum	405.000	874.52	354180.60	M-037
			Key aggregates passing 26.5 mm and retained on 2.8 mm sieve @ 0.018 cum per sqm	cum	81.000	841.19	68136.12	M-026
			d) Overhead charges @ 10%				177323.13	
			e) Contractor's profit @ 10%				195055.45	
			Cost for 4500 sqm				2145609.91	
			Rate per sqm				476.80	
						say	*477.00*	
		Note	2 tippers and 2 rollers will be needed to match the capacity of chip spreader and front end loader.					
5.5	506		Built-up-Spray Grout					
			Providing, laying and rolling of built-up-spray grout layer over prepared base consisting of a two layer composite construction of compacted crushed coarse aggregates using motor grader for aggregates. key stone chips spreader may be used with application of bituminous binder after each layer, and with key aggregates placed on top of the second layer to serve as a Base conforming to the line, grades and cross-section specified, the compacted layer thickness being 75 mm					
			Unit = sqm					
			Taking output = 3000 sqm (225 cum)					
			a) Labour					
			Mate	day	0.400	275.00	110.00	L-12
			Mazdoor including for brooming of key aggregates	day	8.000	245.00	1960.00	L-13
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			b) Machinery					
			Hydraulic self propelled chip spreader both for aggregates and key aggregates@ 1500 sqm per hour for 3000 x 3 sqm	hour	6.000	1785.00	10710.00	P&M-025
			Bitumen pressure distributor for 3000 x 2 sqm @ 1750 sqm per hour	hour	3.430	593.00	2033.99	P&M-004
			Tipper 5.5 cum capacity	hour	10.000	240.00	2400.00	P&M-048
			Vibratory roller 8 tonnes	hour	6.000	1292.00	7752.00	P&M-059
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			c) Material					
			Bitumen30 kg per 10 sqm @ 15 kg per 10 sqm for each layer	tonne	9.000	43209.95	388889.59	M-074
			Crushed stone coarse aggregate passing 53 mm and retained on 2.8 mm sieve @ 0.5 cum per 10 sqm for each layer	cum	300.000	789.57	236870.40	M-035
			Key aggregates passing 22.4 mm and retained on 2.8 mm sieve @ 0.13 cum per 10 sqm	cum	39.000	841.19	32806.28	M-031
			d) Overhead charges @ 10%				68776.63	
			e) Contractor's profit @ 10%				75654.29	
			Cost for 3000 sqm				832197.17	
			Rate per sqm				277.40	
						say	*277.00*	
		Note	2 tippers will be needed to match the capacity of hydraulic chip spreader and front end loader.					
5.6	507		Dense Graded Bituminous Macadam					
			Providing and laying dense graded bituminous macadam with 100-120 TPH batch type HMP producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 4.0 to 4.5 per cent by weight of total mix and filler, transporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MoRTH specification clause No. 507 complete in all respects					
			Unit = cum					
			Taking output = 195 cum (450 tonnes)					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor working with HMP, mechanical broom, paver, roller, asphalt cutter and assistance for setting out lines, levels and layout of construction	day	16.000	245.00	3920.00	L-13
			Skilled mazdoor for checking line & levels	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Batch mix HMP @ 75 tonne per hour	hour	6.000	12280.00	73680.00	P&M-022
			Paver finisher hydrostatic with sensor control @ 75 cum per hour	hour	6.000	2070.00	12420.00	P&M-034
			Generator 250 KVA	hour	6.000	1348.80	8092.80	P&M-081
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	13500.000	1.90	25650.00	Lead 30km
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				2565.00	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			smooth wheeled roller 8-10 tonnes for initial break down rolling.	hour	6.00x0.65*	386.00	1505.40	P&M-044
			Vibratory roller 8 tonnes for intermediate rolling.	hour	6.00x0.65*	1292.00	5038.80	P&M-059
			Finish rolling with 6-8 tonnes smooth wheeled tandem roller.	hour	6.00x0.65*	922.00	3595.80	P&M-045
			c) Materials					
			Bitumen @ 4.25 per cent of weight of mix	tonne	19.130	43209.95	826606.42	M-074
			Aggregate					
			Total weight of mix = 450 tonnes					
			Weight of bitumen = 19.13 tonnes					
			Weight of aggregate = 450 -19.13 = 430.87 tonnes					
			Taking density of aggregate = 1.5 ton/cum					
			Volume of aggregate = 287.25 cum					
			Grading - I40 mm (Nominal Size)					
			37.5 - 25 mm 22 per cent	cum	63.190	974.52	61579.92	M-049
			25 - 10 mm 13 per cent	cum	37.340	907.85	33899.24	M-046
			10 -4.75 mm 19 per cent	cum	54.580	774.52	42273.30	M-040
			4.75 mm and below 44 per cent	cum	126.390	774.52	97891.58	M-030
			Filler @ 2 per cent of weight of aggregates.	tonne	8.620	7598.00	65494.76	M-188
			or					
			Grading - II19 mm (Nominal Size)					
			25 - 10 mm 30 per cent	cum	86.160	854.52	73625.44	M-046
			10 - 5 mm 28 per cent	cum	80.430	774.52	62294.64	M-040
			5 mm and below 40 per cent	cum	114.900	774.52	88992.35	M-030
			Filler @ 2 per cent of weight of aggregates.	tonne	8.620	7598.00	65494.76	M-188
			* Any one of the alternative may be adopted as per approved design					
		(i)	For Grading I (40 mm nominal size)					
			d) Overhead charges @ 10%				126941.30	
			e) Contractor's profit @ 10%				139635.43	
			Cost for 205 cum				1535989.77	
			Rate per cum				7876.87	
						say	*7877.00*	
		(ii)	For GradingII(19 mm nominal size)					
			d) Overhead charges @ 10%				125868.14	
			e) Contractor's profit @ 10%				138454.96	
			Cost for 205 cum				1523004.52	
			Rate per cum				7810.28	
						say	*7810.00*	
		Note	*1. Although the roller are required only for 3 hours as per norms of output, but the same have to be available at site for six hours as the hot mix plant and paver will take six hours for mixing and paving the output of 450 tonnes considered in this analysis. To cater for the idle period of these rollers, their usage rates have been multiplied by a factor of 0.65.					
			2.Quantity of Bitumen has been taken for analysis purpose. The actual quantity will depend upon job mix formula.					
			3. Labour for traffic control, watch and ward and other miscellaneous duties at site including sundries have been included in administrative overheads of the contractor.					
			4. In case DBM is laid over freshly laid tack coat, provision of mechanical broom and 2 mazdoors shall be deleted as the same has been included in the cost of tack coat.					
			5. The individual density for each size of aggregates to be used for construction I.e. 37.5-25 mm, 25-10 mm etc. should be found in the laboratory and accordingly the quantities should be ammended for use in field. The average density of 1.5 tonne/cum is only a reference density in this Data Book.					
			6. The individual percentage of aggregates should be calculated from the total weight of dry aggregates i.e.. excluding the weight of bitumen. The weight of filler will also be 2 per cent by weight of dry aggregates.					
5.7	508		Semi-Dense Bituminous Concrete					
			Providing and laying semi dense bituminous concrete with 100-120 TPH batch type HMP producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 4.5 to 5 per cent of mix and filler, transporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MoRTH specification clause No. 508 complete in all respects.					
			Unit = cum					
			Taking output = 195 cum (450 tonnes)					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor working with HMP, mechanical broom, paver, roller, asphalt cutter and assistance for setting out lines, levels and layout of construction	day	16.000	245.00	3920.00	L-13
			Skilled mazdoor for checking line & levels	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Batch mix HMP @ 75 tonne per hour	hour	6.000	12280.00	73680.00	P&M-022
			Paver finisher hydrostatic with sensor control @ 75 cum per hour	hour	6.000	2070.00	12420.00	P&M-034
			Generator 250 KVA	hour	6.000	1348.80	8092.80	P&M-081
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	13500.000	1.90	25650.00	Lead 30km
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				2565.00	
			Smooth wheeled roller 8-10 tonnes for initial break down rolling.	hour	6.00x0.65*	386.00	1505.40	P&M-044
			Vibratory roller 8 tonnes for intermediate rolling.	hour	6.00x0.65*	1292.00	5038.80	P&M-059
			Finish rolling with 6-8 tonnes smooth wheeled tandem roller	hour	6.00x0.65*	922.00	3595.80	P&M-045
			c) Material					
			* Grading I: 13 mm (Nominal Size)					
			i) Bitumen@ 4.5 per cent of weight of mix	tonne	20.250	43209.95	875001.57	M-074

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			ii) Aggregate					
			Total weight of mix = 450 tonnes					
			Weight of bitumen = 20.25 tonnes					
			Weight of aggregate = 450-20.25 = 429.75 tonnes					
			Taking density of aggregate = 1.5 ton/cum					
			Volume of aggregate = 286.5 cum					
			13.2 - 10 mm20 per cent	cum	57.300	774.52	44380.00	M-044
			10 - 5 mm 38 per cent	cum	108.870	774.52	84321.99	M-040
			5 mm and below 40 per cent	cum	114.600	774.52	88759.99	M-030
			Filler @ 2 per cent of weight of aggregates.	tonne	8.620	7598.00	65494.76	M-188
			or					
			Grading II: 10 mm (Nominal Size)					
			Bitumen@5 per cent of weight of mix	tonne	22.500	43209.95	972223.97	M-074
			weight of mix = 450 tonne					
			Aggregate					
			Total weight of mix = 450 tonnes					
			Weight of bitumen = 22.5 tonnes					
			Weight of aggregate = 450 -22.50 = 427.50 tonnes					
			Taking density of aggregate = 1.5 ton/cum					
			Volume of aggregate = 285 cum					
			9.5 - 4.75 mm@ 57 per cent	cum	162.450	774.52	125820.77	M-040
			4.75 and below@ 41 per cent	cum	116.850	774.52	90502.66	M-030
			Filler @ 2 per cent of weight of aggregates.	tonne	8.620	7598.00	65494.76	M-188
			*Any one of the alternative may be adopted as per approved design					
		(i)	for Grading I (13 mm nominal size)					
			d) Overhead charges @ 10%				129962.61	
			e) Contractor's profit @ 10%				142958.87	
			Cost for 205 cum				1572547.60	
			Rate per cum				8064.35	
						say	*8064.00*	
5.7		(ii)	for GradingII(10 mm nominal size)					
			d) Overhead charges @ 10%				139571.00	
			e) Contractor's profit @ 10%				153528.10	
			Cost for 205 cum				1688809.06	
			Rate per cum				8660.56	
						say	*8661.00*	
		Note	*1. Although the rollers are required only for 3 hours as per norms of output, but the same have to be available at site for six hours as the hot mix plant and paver will take six hours for mixing and paving the output of 450 tonnes considered in this analysis. To cater for the idle period of these rollers, their usage rates have been multiplied by a factor of 0.65					
			2.Quantity of Bitumen has been taken for analysis purpose. The actual quantity will depend upon job mix formula.					
			3. Labour for traffic control, watch and ward and other miscellaneous duties at site including sundries have been included in administrative overheads of the contractor.					
			4. In case SDBC is laid over freshly laid tack coat, provision of broom and 2 mazdoor shall be deleted as the same has been included in the cost of tack coat.					
			5. The quantity of Bitumen to be adjusted as per job mix formula.					
5.8	509		Bituminous Concrete					
			Providing and laying bituminous concrete with 100-120 TPH batch type hot mix plant producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 5.4 to 5.6 per cent of mix and filler, transporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MORTH specification clause No. 509 complete in all respects.					
			Unit = cum					
			Taking output = 191 cum (450 tonnes)					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor working with HMP, mechanical broom, paver, roller, asphalt cutter and assistance for setting out lines, levels and layout of construction	day	16.000	245.00	3920.00	L-13
			Skilled mazdoor for checking line & levels	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Batch mix HMP @ 75 tonne per hour	hour	6.000	12280.00	73680.00	P&M-022
			Paver finisher hydrostatic with sensor control @ 75 cum per hour	hour	6.000	2070.00	12420.00	P&M-034
			Generator 250 KVA	hour	6.000	1348.80	8092.80	P&M-081
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	13500.000	1.90	25650.00	Lead 30km
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				2565.00	
			Smooth wheeled roller 8-10 tonnes for initial break down rolling.	hour	6.00x0.65*	386.00	1505.40	P&M-044
			Vibratory roller 8 tonnes for intermediate rolling.	hour	6.00x0.65*	1292.00	5038.80	P&M-059
			Finish rolling with 6-8 tonnes smooth wheeled tandem roller.	hour	6.00x0.65*	922.00	3595.80	P&M-045
			c) Material					
			i) Bitumen@ 5.25% per cent of weight of mix	tonne	23.625	43209.95	1020835.17	M-074
			ii) Aggregate					
			Total weight of mix = 450 tonnes					
			Weight of bitumen = 22.5 tonnes					
			Weight of aggregate = 450 -22.50 = 427.50 tonnes					
			Taking density of aggregate = 1.5 ton/cum					
			Volume of aggregate = 285 cum					
			* Grading - I-19 mm (Nominal Size)					
			20 - 10 mm 35 per cent	cum	99.750	824.52	82245.87	M-045
			10 - 5 mm 23 per cent	cum	65.550	774.52	50769.79	M-040
			5 mm and below 40 per cent	cum	114.000	774.52	88295.28	M-030

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Filler @ 2 per cent of weight of aggregates.	tonne	8.620	7598.00	65494.76	M-188
			or					
			Grading - II-13 mm (Nominal Size)					
			13.2 - 10 mm30 per cent	cum	85.500	774.52	66221.46	M-044
			10 - 5 mm 25 per cent	cum	71.250	774.52	55184.55	M-040
			5 mm and below43 per cent	cum	122.550	774.52	94917.43	M-030
			Filler @ 2 per cent of weight of aggregates.	tonne	8.620	7598.00	65494.76	M-188
			*Any one of the alternative may be adopted as per approved design					
		(i)	for Grading-I (13 mm nominal size)					
			d) Overhead charges @ 10%				144930.87	
			e) Contractor's profit @ 10%				159423.95	
			Cost for 205 cum				1753663.48	
			Rate per cum				9181.48	
						say	*9181.00*	
5.8		(ii)	for Grading-II(10 mm nominal size)					
			d) Overhead charges @ 10%				144432.12	
			e) Contractor's profit @ 10%				158875.33	
			Cost for 205 cum				1747628.61	
			Rate per cum				9149.89	
						say	*9150.00*	
		Note	*1. Although the rollers are required only for 3 hours as per norms of output, but the same have to be available at site for six hours as the hot mix plant and paver will take six hours for mixing and paving the output of 450 tonnes considered in this analysis. To cater for the idle period of these rollers, their usage rates have been multiplied by a factor of 0.65					
			2.Quantity of Bitumen has been taken for analysis purpose. The actual quantity will depend upon job mix formula.					
			3. Labour for traffic control, watch and ward and other miscellaneous duties at site including sundries have been included in administrative overheads of the contractor.					
			4. In case BC is laid over freshly laid tack coat, provision of mechanical broom and 2 mazdoors shall be deleted as the same has been included in the cost of tack coat.					
			5. The individual density for each size of aggregates to be used for construction i.e. 37.5-25 mm, 25-10 mm etc. should be found in the laboratory and accordingly the quantities should be ammended for use in field. The average density of 1.5 tonne/cum is only a reference density in this Data Book.					
			6. The individual percentage of aggregates should be calculated from the total weight of dry aggregates i.e.. excluding the weight of bitumen. The weight of filler will also be 2 per cent by weight of dry aggregates.					
5.9	510		Surface Dressing					
			Providing and laying surface dressing as wearing course in single coat using crushed stone aggregates of specified size on a layer of bituminous binder laid on prepared surface and rolling with 8-10 tonne smooth wheeled steel roller					
			Unit = sqm					
			Taking output = 9000 sqm					
		Case -1	:-19 mm nominal chipping size					
			a) Labour					
			Mate	day	0.440	275.00	121.00	L-12
			Mazdoor	day	9.000	245.00	2205.00	L-13
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	7.200	276.00	1987.20	P&M-031
			Air compressor 250 cfm	hour	7.200	257.00	1850.40	P&M-001
			Hydraulic self propelled chip spreader @ 1500 sqm per hour	hour	6.000	1785.00	10710.00	P&M-025
			Tipper 10 tonne capacity for carriage of stone chips from stockpile on road side to chip spreader	hour	6.000	225.00	1350.00	P&M-048
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Bitumen pressure distributor	hour	6.000	593.00	3558.00	P&M-004
			Smooth wheeled roller 8-10 tonne weight	hour	6.000	386.00	2316.00	P&M-044
			c) Material					
			Bitumen@ 1.20 kg per sqm	tonne	10.800	43209.95	466667.51	M-074
			Crushed stone chipping,19 mm nominal size @ 0.015 cum per sqm	cum	135.000	778.09	105042.34	M-053
			d) Overhead charges @ 10%				60004.14	
			e) Contractor's profit @ 10%				66004.56	
			Cost for 9000 sqm				726050.15	
			Rate per sqm				80.67	
						say	*81.00*	
5.9		Case - II	13 mm nominal size chipping					
			a) Labour					
			Mate	day	0.440	275.00	121.00	L-12
			Mazdoor	day	9.000	245.00	2205.00	L-13
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	7.200	276.00	1987.20	P&M-031
			Air compressor 250 cfm	hour	7.200	257.00	1850.40	P&M-001
			Hydraulic self propelled chip spreader @ 1500 sqm per hour	hour	6.000	1785.00	10710.00	P&M-025
			Tipper 10 tonne capacity for carriage of stone chips from stockpile on road side to chip spreader	hour	6.000	225.00	1350.00	P&M-048
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Bitumen pressure distributor @ 1750 sqm per hour	hour	6.000	593.00	3558.00	P&M-004
			Vibratory roller 8-10 tonne weight	hour	6.000	1292.00	7752.00	P&M-059
			c) Material					
			Bitumen@ 1.00 kg per sqm	tonne	9.000	43209.95	388889.59	M-074
			Crushed stone chipping,13 mm nominal size @ 0.01 cum per sqm	cum	90.000	778.09	70028.23	M-052
			d) Overhead charges @ 10%				49268.54	
			e) Contractor's profit @ 10%				54195.40	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Cost for 9000 sqm				596149.35	
			Rate per sqm				66.24	
						say	*66.00*	
		Note	1.Where the proposed aggregate fails to pass the stripping test, an approved adhesion agent may be added to the binder as per clause 510.2.4. Alternatively, chips may be pre coated as per clause 510.2.5					
			2.Input for the second coat, where required, will be the same as per the lst coat mentioned above					
5.10	511		Open - Graded Premix Surfacing					
			Providing, laying and rolling of open - graded premix surfacing of 20 mm thickness composed of 13.2 mm to 5.6 mm aggregates either using penetration grade bitumen or cut-back or emulsion to required line, grade and level to serve as wearing course on a previously prepared base, including mixing in a suitable plant, laying and rolling with a smooth wheeled roller 8-10 tonne capacity, finished to required level and grades.					
			Unit = sqm					
			Taking output = 10250 sqm (205 cum)					
		(i)	Case - I: Mechanical method using Penetration grade Bitumen and HMP of appropriate capacity not less than 75 tonnes/hour .					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor working with HMP, road sweeper, paver and roller	day	16.000	245.00	3920.00	L-13
			Skilled mazdoor for checking line & levels	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			i) Batch type HMP 75 tonne per hour	hour	6.000	12280.00	73680.00	P&M-021
			ii) Electric Generator Set 250 KVA	hour	6.000	1348.80	8092.80	P&M-081
			iii) Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			iv) Tipper 10 tonne capacity	tonne.km	13500.000	1.90	25650.00	Lead 30km
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				2565.00	
			v) Paver finisher hydrostatic with sensor attachment	hour	6.000	2070.00	12420.00	P&M-034
			iv) Smooth wheeled/tandom roller 8-10 tonnes weight	hour	6.000	922.00	5532.00	P&M-045
			c) Material					
			Bitumen@ 14.60 kg per 10 sqm	tonne	14.970	43209.95	646853.02	M-074
			Crushed stone chipping,13.2 mm to 5.6 mm @ 0.27 cum per 10 sqm	cum	276.750	778.09	215336.80	M-043
			d) Overhead charges @ 10%				99924.96	
			e) Contractor's profit @ 10%				109917.46	
			Cost for 10250 sqm				1209092.04	
			Rate per sqm				117.96	
						say	*118.00*	
		Note	If a premix sand seal coat of 'B' type is proposed, the same is required to be provided over the open graded premix carpet immediately on the same day. As the same HMP and other machines will be used for laying of premix sand seal coat, out of 6 effective working hours, 4.00 hours may be utilised for laying of premix carpet and balance 2.00 hours for the seal coat. The rate for the premix sand seal coat under clause 513 (case II) has been worked out accordingly by utilising the HMP for 2.00 hours for the purpose of seal coat. In case type 'A' seal coat is proposed, HMP can be worked for six hours for the premix carpet as type 'A' seal coat does not require the use of HMP.					
5.10		(ii)	Case - II: Open-Graded Premix Surfacing using cationic Bitumen Emulsion					
			Unit = sqm					
			Taking output = 900 sqm (24.3 cum)					
			a) Labour					
			Mate	day	0.800	275.00	220.00	L-12
			Mazdoor	day	18.000	245.00	4410.00	L-13
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			b) Machinery					
			Concrete mixer 0.4/0.28 cum capacity	hour	6.000	172.00	1032.00	P&M-009
			Smooth wheeled steel roller 8-10 tonne	hour	6.000	922.00	5532.00	P&M-044
			c) Material					
			Cationic Bitumen Emulsion @ 21.50 kg per 10 sqm	tonne	1.940	31532.50	61173.05	M-073
			Crushed stone aggregates 13.2 mm to 5.6 mm @ 0.27 cum per 10 sqm	cum	24.300	778.09	18907.62	M-043
			d) Overhead charges @ 10%				9176.47	
			e) Contractor's profit @ 10%				10094.11	
			Cost for 900 sqm				111035.25	
			Rate per sqm				123.37	
						say	*123.00*	
5.11	512		Close Graded Premix Surfacing/Mixed Seal Surfacing					
		Case I	Mechanical means using HMP of appropriate capacity not less than 75 tonnes/hour.					
			Providing, laying and rolling of close-graded premix surfacing material of 20 mm thickness composed of 11.2 mm to 0.09 mm (Type-a) or 13.2 mm to 0.09 mm (Type-b) aggregates using penetration grade bitumen to the required line, grade and level to serve as wearing course on a previously prepared base, including mixing in a suitable plant, laying and rolling with a Smooth wheeled roller 8-10 tonne capacity, and finishing to required level and grade.					
			Unit = sqm					
			Taking output = 10250 sqm (205 cum)					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor working with HMP, road sweeper, paver and roller	day	16.000	245.00	3920.00	L-13
			Skilled mazdoor for checking line & levels	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			i) HMP of appropicate capacity.	hour	6.000	16600.00	99600.00	P&M-021
			ii) Electric Generator Set 250 KVA	hour	6.000	1348.80	8092.80	P&M-081

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			iii) Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			iv) Tipper 10 tonne capacity	tonne.km	13500.000	1.90	25650.00	Lead 30km
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				2565.00	
			v) Paver finisher hydrostatic with sensor attachment	hour	6.000	2070.00	12420.00	P&M-034
			iv) Smooth wheeled8-10 tonnes weight	hour	6.000	922.00	5532.00	P&M-044
			c) Material					
			Type - A					
			* Bitumen@ 22 kg per 10 sqm	tonne	22.500	43209.95	972223.97	M-074
			Stone crushed aggregates 11.2 mm to 0.09 @ 0.27 cum per 10 sqm	cum	276.750	739.52	204662.16	M-041
			or					
			Type - B					
			Bitumen @ 19 kg per 10 sqm	tonne	19.480	43209.95	841729.91	M-074
			Stone crushed aggregates 13.2 mm to 0.09 mm @ 0.27 cum per 10 sqm	cum	276.750	745.35	206276.54	M-042
			d) Overhead charges @ 10%				133986.59	
			e) Contractor's profit @ 10%				147385.25	
			Cost for 10250 sqm				1621237.78	
			Rate per sqm				158.17	
						say	158.00	
			* Any one of the alternative may be adopted					
5.12	513		Seal Coat					
			Providing and laying seal coat sealing the voids in a bituminous surface laid to the specified levels, grade and cross fall using Type A and B seal coats					
			Unit = sqm					
			Taking output = 10250 sqm (92.25 cum)					
		(i)	Case - I : Type A					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			b) Machinery					
			Hydraulic self propelled chip spreader	hour	6.000	1785.00	10710.00	P&M-025
			Tipper 5.5 cum capacity	hour	6.000	240.00	1440.00	P&M-048
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Bitumen pressure distributor @ 1750 sqm per hour	hour	6.000	593.00	3558.00	P&M-004
			Smooth wheeled roller 8 -10 tonne weight	hour	6.000	386.00	2316.00	P&M-044
			c) Material					
			Bitumen@ 9.80 kg per 10 sqm	tonne	10.050	43209.95	434260.04	M-074
			Crushed stone chipping of 6.7 mm size defined as 100 per cent passing 11.2 mm sieve and retained on 2.36 mm sieve applied @ 0.09 cum per 10 sqm	cum	92.250	716.19	66068.22	M-050
			d) Overhead charges @ 10%				52363.23	
			e) Contractor's profit @ 10%				57599.55	
			Cost for 10250 sqm				633595.03	
			Rate per sqm				61.81	
						say	62.00	
		Note	Since seal coat is provided immediately over the bituminous layers, mechanical broom for clearing has not been catered.					
5.12		(ii)	Case - II : Type B					
			Providing and laying of premix sand seal coat with HMP of appropriate capacity not less than 75 tonnes/ hours using crushed stone chipping 6.7 mm size and penetration bitumen of suitable grade.					
			Unit = sqm					
			Taking output = 7858 sqm (47.16 cum)					
			a) Labour					
			Mate	day	0.160	275.00	44.00	L-12
			Mazdoor	day	4.000	245.00	980.00	L-13
			b) Machinery					
			HMP of 75 tonnes/hour.	hour	2.000	12280.00	24560.00	P&M-022
			Electric Generator Set 250 KVA	hour	2.000	1348.80	2697.60	P&M-081
			Front end loader 1 cum bucket capacity	hour	2.000	624.00	1248.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	3120.000	1.90	5928.00	Lead 30km
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				592.80	
			Paver finisher hydrostatic with sensor attachment	hour	2.000	2070.00	4140.00	P&M-034
			Smooth wheeled 8-10 tonnes capacity	hour	2.000	386.00	772.00	P&M-044
			c) Material					
			Bitumen@ 6.80 kg per 10 sqm	tonne	5.340	43209.95	230741.16	M-074
			Crushed stone chipping of 6.7 mm size defined as passing 11.2 mm sieve and retained on 2.36 mm sieve applied @ 0.06 cum per 10 sqm	cum	47.160	716.19	33775.36	M-050
			d) Overhead charges @ 10%				30547.89	
			e) Contractor's profit @ 10%				33602.68	
			Cost for 7858 sqm				369629.49	
			Rate per sqm				47.04	
						say	47.00	
		Note	Since seal coat is required to be provided over the premix carpet on the same day, out of the 6 working hours of the HMP, 4.00 hours are proposed to be utilised for the premix carpet and the balance 2.00 hours for the seal coat. Hence 2.00 hours have been considered for this case. This may be linked to rate analysis worked out under clause 511.					
5.13	514		Supply of Stone Aggregates for Pavement Courses					
			Supply of stone aggregates from approved sources conforming to the physical requirement, specified in the respective specified clauses, including royalties, fees rents, collection, transportation, stacking and testing and measured in cum as per clause 514.5					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Competitive market rates to be as certained. Alternatively, rates for stone crushing given in chapter 1may be adopted, if found economical. In case for supply of aggregates at site are not available, nearest crusher site may be as certained. Loading and un-loading charges and cost of carriage may be added to these rates to arrive at the cost at site.					
5.14	515		Mastic Asphalt					
			Providing and laying 25 mm thick mastic asphalt wearing course with paving grade bitumen meeting the requirements given in table 500-29, prepared by using mastic cooker and laid to required level and slope after cleaning the surface, including providing antiskid surface with bitumen precoated finegrained hard stone chipping of 13.2 mm nominal size at the rate of 0.005cum per 10 sqm and at an approximate spacing of 10 cm center to center in both directions, pressed into surface when the temperature of surfaces is not less than 1000C, protruding 1 mm to 4 mm over mastic surface, all complete as per clause 515.					
			Unit = sqm					
			Taking output = 35.00 sqm (0.87 cum) assuming a density of 2.3 tonnes/cum.-2 tonnes					
			a) Labour					
			Mate	day	0.440	275.00	121.00	L-12
			Mazdoor	day	10.000	245.00	2450.00	L-13
			Mazdoor skilled	day	1.000	245.00	245.00	L-15
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	0.060	276.00	16.56	P&M-031
			Air compressor 250 cfm	hour	0.060	257.00	15.42	P&M-001
			Mastic cooker 1 tonne capacity	hour	6.000	50.00	300.00	P&M-030
			Bitumen boiler 1500 litres capacity	hour	6.000	140.00	840.00	P&M-005
			Tractor for towing and positioning of mastic cooker and bitumen boiler	hour	1.000	280.00	280.00	P&M-053
			c) Material					
			Base mastic (without coarse aggregates) = 60 per cent					
			Coarse aggregate (6.3mm to 13.2 mm) = 40 per cent .					
			Proportion of material required for mastic asphalt with coarse aggregates (based on mix design done by CRRI for a specific case)					
			I) Bitumen 85/25 or 30/40 @ 10.2 per cent by weight of mix. 2 x 10.2/100 = 0.204	tonne	0.204	43209.95	8814.83	M-074
			ii) Fine aggregate passing 2.36mm and retained on 0.075mm sieve @ 31.9 per cent by weight of mix = 2 x 31.9/100 = 0.638 tonnes = 0.638/1.625 = 0.39	cum	0.390	687.02	267.94	M-021
			iii) Lime stone dust filler with calcium content not less than 80 per cent by weight @ 17.92 per cent by weight of mix = 2 x 17.92/100 = 0.36	tonne	0.360	4055.00	1459.80	M-188
			iv) Coarse aggregates 6.3 mm to 13.2 mm @ 40 per cent by weight of mix = 2 x 40/100 = 0.8 MT = 0.8/1.456 = 0.55	cum	0.550	774.52	425.99	M-043
			v) Pre-coated stone chips of 13.2 mm nominal size for skid resistance = 35 x 0.005/10 = 0.018	cum	0.018	774.52	13.94	M-142
			vi) Bitumen for coating of chips @ 2 per cent by weight = 0.018 x 1.456 x 2/100 = 0.0005 MT = 0.5kg	kg	0.500	43.21	21.60	M-074
			d) Overhead charges @ 10%				1527.21	
			e) Contractor's profit @ 10%				1679.93	
			Cost for 35.00 sqm				18479.22	
			Rate per sqm				527.98	
						say	*528.00*	
		Note	1.The rates for 50 mm & 40 mm thick layers may be worked out on pro-rata basis.					
			2.Where tack coat is required to be provided before laying mastic asphalt, the same is required to be measured and paid separately.					
			3.The quantities of binder, filler and aggregates are for estimating purpose. Exact quantities shall be as per mix design.					
			4.This rate analysis is based on design made by CRRI for a specific case and is meant for estimating purposes only. Actual design is required to be done for each case.					
5.15	516		Slurry Seal					
			Providing and laying slurry seal consisting of a mixture of fine aggregates, portland cement filler, bituminous emulsion and water on a road surface including cleaning of surface, mixing of slurry seal in a suitable mobile plant, laying and compacting to provide even riding surface					
		(i)	5 mm thickness					
			Unit = sqm					
			Taking output = 16000 sqm (80 cum)					
			Taking density of 2.2 tonnes per cum					
			weight of mix = 176 tonnes					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			b) Machinery					
			Mechanical broom	hour	6.000	276.00	1656.00	P&M-031
			Air compressor 250 cfm	hour	6.000	257.00	1542.00	P&M-001
			Mobile slurry seal equipment	hour	6.000	715.00	4290.00	P&M-033
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 5.5 cum capacity for carriage of aggregate from stockpile on road side to slurry equipment, bitumen emulsion and filler.	hour	6.000	225.00	1350.00	P&M-048
			Pneumatic tyred roller with individual wheel load not exceeding 1.5 tonnes	hour	6.000	922.00	5532.00	P&M-037
			Water tanker6 KL capacity	hour	2.000	374.00	748.00	P&M-060
			c) Material					
			Residual Binder @ 11 per cent of mix 80 x 2.2 x 0.11	tonne	19.360	18000.00	348480.00	M-077
			Fine aggregate 4.75 mm and below 87 per cent of total mix,80 x 2.2 x 0.87 = 153.12 tonnes. Taking density1.5, = 153.12/1.5 = 102.08 cum	cum	102.080	716.19	73108.33	M-030
			Filler @ 2 per cent of total mix = 80 x 2.2 x 0.02	tonne	3.520	7598.00	26744.96	M-188
			Cost of water	KL	12.000	30.00	360.00	M-189

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			d) Overhead charges @ 10%				46909.13	
			e) Contractor's profit @ 10%				51600.04	
			Cost for 16000 sqm				567600.47	
			Rate per sqm				35.48	
						say	*35.00*	
5.15		(ii)	3 mm thickness					
			Unit = sqm					
			Taking output = 20000 sqm (60 cum)					
			a) Labour					
			Mate	day	0.200	275.00	55.00	L-12
			Mazdoor	day	5.000	245.00	1225.00	L-13
			b) Machinery					
			Mechanical broom	hour	6.000	276.00	1656.00	P&M-031
			Air compressor 250 cfm	hour	6.000	257.00	1542.00	P&M-001
			Mobile slurry seal equipment	hour	6.000	715.00	4290.00	P&M-033
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 5.5 cum capacity for carriage of aggregate from stockpile on road side to slurry equipment, bitumen emulsion and filler	hour	6.000	240.00	1440.00	P&M-048
			Water tanker6 KL capacity	hour	2.000	374.00	748.00	P&M-060
			c) Material					
			Residual Binder @ 13 per cent of mix = 60 x 2.2 x 0.13	tonne	17.160	18000.00	308880.00	M-077
			Fine aggregate 3 mm and below 85 per cent of total mix, 60x 2.2 x 0.85 = 112.2 tonnes. Taking density 1.5,	cum	74.800	687.02	51389.10	M-022
			Filler @ 2 per cent of total mix = 60x 2.2 x 0.02	tonne	2.640	7598.00	20058.72	M-188
			Cost of water	KL	12.000	30.00	360.00	M-189
			d) Overhead charges @ 10%				39538.78	
			e) Contractor's profit @ 10%				43492.66	
			Cost for 30000 sqm				478419.26	
			Rate per sqm				23.92	
						say	*24.00*	
5.15		(iii)	1.5 mm thickness					
			Unit = sqm					
			Taking output = 24000 sqm (36 cum)					
			a) Labour					
			Mate	day	0.200	275.00	55.00	L-12
			Mazdoor	day	5.000	245.00	1225.00	L-13
			b) Machinery					
			Mechanical broom	hour	6.000	276.00	1656.00	P&M-031
			Air compressor 250 cfm	hour	6.000	257.00	1542.00	P&M-001
			Mobile slurry seal equipment	hour	6.000	715.00	4290.00	P&M-033
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 5.5 cum capacity for carriage of aggregate from stockpile on road side to slurry equipment, bitumen emulsion and filler.	hour	6.000	225.00	1350.00	P&M-048
			Water tanker6 KL capacity	hour	2.000	374.00	748.00	P&M-060
			c) Material					
			Residual Binder @ 16 per cent of mix, 36 x 2.2 x 0.16	tonne	12.670	18000.00	228060.00	M-077
			Fine aggregate 2.36 mm and below,82 per cent of total mix,36x 2.2 x 0.82 = 64.94 tonnes. Taking density 1.5	cum	43.300	599.52	25959.22	M-022
			Filler @ 2 per cent of total mix = 36x 2.2 x 0.02	tonne	1.580	7598.00	12004.84	M-188
			Cost of water	KL	12.000	30.00	360.00	M-189
			d) Overhead charges @ 10%				28099.41	
			e) Contractor's profit @ 10%				30909.35	
			Cost for 24000 sqm				340002.81	
			Rate per sqm				14.17	
						say	*14.00*	
		Note	1.Tack coat, if required to be provided, before laying slurry seal may be measured and paid separately					
5.16	517		Recycling of Bituminous Pavement with Central Recycling Plant					
			Recycling pavement by cold milling of existing bituminous layers, planning the surface after cold milling, reclaiming excavated material to the extent of 30 per cent of the required quantity, hauling and stock piling the reclaimed material near the central recycling plant after carrying out necessary checks and evaluation, adding fresh material including rejuvenators as required, mixing in a hot mix plant, transporting and laying at site and compacting to the required grade, level and thickness, all as specified in clause 517					
			Unit = cum					
			Taking output = 120 cum (276 tonnes)					
			a) Labour					
			Mate	day	0.480	275.00	132.00	L-12
			Mazdoor	day	10.000	245.00	2450.00	L-13
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			b) Machinery					
			Cold milling machine @ 20 cum per hour	hour	6.000	800.00	4800.00	P&M-069
			Mechanical broom @ 1250 sqm per hour	hour	1.280	276.00	353.28	P&M-031
			Air compressor 250 cfm	hour	1.280	257.00	328.96	P&M-001
			Bitumen pressure distributor @ 1750 sqm per hour	hour	0.910	593.00	539.63	P&M-004
			Hot mix plant 100-120 TPH producing an average of 75 tonnes per hour	hour	3.000	16600.00	49800.00	P&M-021
			Electric generator set 250 KVA	hour	3.000	1348.80	4046.40	P&M-081
			Front end loader 1.00 cum bucket capacity	hour	3.000	624.00	1872.00	P&M-017
			Tipper 5.5 cum capacity	hour	18.000	240.00	4320.00	P&M-048
			Smooth wheeled roller 8-10 tonnes	hour	3.00x0.65*	386.00	752.70	P&M-044
			Vibratory roller 8 tonnes	hour	3.00x0.65*	1292.00	2519.40	P&M-059
			Smooth wheeled tandem roller 6-8 tonnes	hour	3.00x0.65*	922.00	1797.90	P&M-045
			c) Material					
			i) Bitumen					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			A bitumen content is 4.5 per cent bitumen weight of mix. For reclaimed material, fresh bitumen will be required to the extent of 60 per cent of normal requirement.					
			In a mix of 276 tonnes, 82.8 tonne is reclaimed and balance 193.2 tonne is fresh mix.					
			Bitumen required for reclaimed mix of 82.8 tonne @ 60 per cent = 82.8 x 0.60 x0.04 = 1.99	tonne	1.987	43209.95	85866.82	M-074
			Bitumen required for fresh mix of 193.2 tonnes = 193.2 x 0.04 = 7.73	tonne	7.728	43209.95	333926.53	M-074
			ii) Aggregates					
			Percentage of mix requiring fresh aggregates - 70 per cent					
			Weight of fresh mix = 276 x 0.70 = 193.2 tonne					
			Weight of fresh aggregate in the mix = 193.2 x 0.96 = 185.47 tonne					
			Taking average density of 1.5 tonnes/cum, total volume of aggregate = 123.65 cum.					
			Size wise requirement of fresh aggregates					
			37.5 - 25 mm @ 23 per cent	cum	28.440	974.52	27715.35	M-049
			25 - 10 mm @ 15 per cent	cum	18.550	874.52	16222.35	M-046
			10- 5 mm @ 20 per cent	cum	24.730	774.52	19153.88	M-040
			Below 5 mm @40 per cent	cum	49.460	687.02	33980.01	M-030
			Filler (cement) @ 2 per cent = 5.52tonnes of 276 tonne	tonne	5.520	7598.00	41940.96	M-081
			d) Overhead charges @ 10%				63300.82	
			e) Contractor's profit @ 10%				69630.90	
			Cost for 120 cum of DBM				765939.87	
			Rate per cum				6382.83	
						say	*6383.00*	
		Note	Although the total rolling time is only 4 hours as per norms, all the three rollers have to be available at site for 3 hours each to match with the output of re-cycling plant. To cater for their idling time, these have been multiplied with a factor of 0.65.					
5.17	518		Fog Spray					
			Providing and applying low viscosity bitumen emulsion for sealing cracks less than 3 mm wide or incipient fretting or disintegration in an existing bituminous surfacing.					
			Unit = sqm					
			Taking output = 10500 sqm					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Mazdoor	day	3.000	245.00	735.00	L-13
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	6.000	276.00	1656.00	P&M-031
			Air compressor 250 cfm	hour	6.000	257.00	1542.00	P&M-001
			Bitumen emulsion pressure distributor @ 1750 sqm per hour	tonne	6.000	593.00	3558.00	P&M-004
			c) Material					
			Bitumen emulsion @ 0.75 kg per sqm	tonne	7.880	31532.50	248476.10	M-077
			d) Overhead charges @ 10%				25600.01	
			e) Contractor's profit @ 10%				28160.01	
			Cost for 10500 sqm				309760.12	
			Rate per sqm				29.50	
						say	*30.00*	
			1.In case it is decided by the engineer to blind the fog spray, the following may be added					
			a) Labour					
			Mate	day	0.160	275.00	44.00	L-12
			Mazdoor for precoating of grit	day	4.000	245.00	980.00	L-13
			b) Material					
			Crushed stone grit 3 mm size @ 3.75 kg per sqm	cum	26.250	599.52	15737.40	M-024
			Bitumen emulsion for precoating grit @ 2 per cent of grit,39.38 x 0.02	tonne	0.790	31533	24910.68	M-077
							41672.08	
							3.97	
						say	*4.00*	
5.18	519		Bituminous Cold Mix (Including Gravel Emulsion)					
			Providing, laying and rolling of bituminous cold mix on prepared base consisting of a mixture of unheated mineral aggregate and emulsified or cutback bitumen, including mixing in a plant of suitable type and capacity, transporting, laying, compacting and finishing to specified grades and levels.					
			Unit = cum					
			Taking output = 205 cum (450 tonne)					
		(i)	Using bitumen emulsion and 9.5 mm or 13.2 mm size aggregate					
			Composition of mix (450 tonne) is assumed to be as under:-					
			Bitumen Emulsion 8 per cent	By weight of total mix				
			Filler2 per cent					
			Total aggregates 90 per cent					
			Proportion of aggregates					
			19 mm to 9.5 mm25 per cent					
			9.5 mm to 6 mm29 per cent					
			6 mm to 0.075 mm 36 per cent					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor	day	16.000	245.00	3920.00	L-13
			Mazdoor skilled	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Drum mix plant for cold mixes of appropriate capacity but not less than 75 tonnes/hour.	hour	6.000	8000.00	48000.00	P&M-077
			Electric generator 125 KVA	hour	6.000	674.40	4046.40	P&M-018
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	450 x L	1.90	8550.00	Lead =10 km & P&M-058

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				855.00	
			Paver finisher	hour	6.000	2070.00	12420.00	P&M-034
			Pneumatic tyred roller 12-15 tonnes	hour	6.00x0.65*	922.00	3595.80	P&M-037
			Smooth wheeled steel tandem roller 6-8 tonnes	hour	6.00x0.65*	386.00	1505.40	P&M-045
			c) Material					
			Bitumen emulsion @ 8 per cent	tonne	36.000	31532.50	1135170.00	M-077
			Filler (lime)@ 2 per cent	tonne	9.000	4055.00	36495.00	M-188
			Aggregates size 19 to 9.5 mm - 450 x 0.25 x 1/1.5	cum	75.000	774.52	58089.00	M-045
			Aggregates size 9.5 to 6 mm - 450 x 0.29 x 1/1.5	cum	87.000	774.52	67383.24	M-040
			Aggregates size 6 to 0.075 mm - 450 x 0.36 x 1/1.5	cum	108.000	716.19	77348.16	M-030
			d) Overhead charges @ 10%				146257.80	
			e) Contractor's profit @ 10%				160883.58	
			Cost for 205 cum				1769719.38	
			Rate per cum				8632.78	
						say	*8633.00*	
			(Applicable to cases I to IV)					
		Note	1.Density of aggregates has been assumed 1.5 gms/cc					
			2. Tack coat where provided will be measured and paid separately.					
			*3. Though the rollers are required only for 3.5 hours each as per norms of output, but these are required to be available at site for 6 hours as the drum mix plant and the paver would take 6 hours for mixing and paving. To cater for the idle period, their usage rates have been multiplied by a factor of 0.65					
5.18		(ii)	Using bitumen emulsion and 19 mm or 26.5 mm nominal size aggregate					
			Composition of mix (450 tonne) is assumed to be as under:-					
			Bitumen Emulsion 8 per cent					
			Filler2 per cent					
			Total aggregates 90 per cent					
			Proportion of aggregates					
			37.5 mm to 19 mm25 per cent					
			19 mm to 6 mm 30 per cent					
			6 mm to 0.075 mm 35 per cent					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor	day	16.000	245.00	3920.00	L-13
			Mazdoor skilled	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Drum mix plant for cold mixes 60-90 tonne per hour producing average output of 75 tonnes per hour	hour	6.000	8000.00	48000.00	P&M-077
			Electric generator 125 KVA	hour	6.000	674.40	4046.40	P&M-018
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	450 x L	1.90	8550.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				855.00	
			Paver finisher	hour	6.000	2070.00	12420.00	P&M-034
			Pneumatic tyred roller 12-15 tonnes	hour	6.00x0.65*	922.00	3595.80	P&M-037
			Smooth wheeled steel tandom roller 6-8 tonnes	hour	6.00x0.65*	386.00	1505.40	P&M-045
			c) Material					
			Bitumen emulsion @ 8 per cent	tonne	36.000	31532.50	1135170.00	M-077
			Filler (lime)@ 2 per cent	tonne	9.000	4055.00	36495.00	M-188
			Aggregates size 37.5 to 19 mm - 450 x 0.25 x 1/1.5	cum	75.000	974.52	73089.00	M-048
			Aggregates size 19 to 6 mm - 450 x 0.3 x 1/1.5	cum	90.000	774.52	69706.80	M-047
			Aggregates size 6 to 0.075 mm - 450 x 0.35 x 1/1.5	cum	105.000	716.19	75199.60	M-030
			d) Overhead charges @ 10%				147775.30	
			e) Contractor's profit @ 10%				162552.83	
			Cost for 205 cum				1788081.13	
			Rate per cum				8722.35	
						say	*8722.00*	
		Note	1.Density of aggregates has been assumed 1.5 gms/cc					
			2. Tack coat where provided will be measured and paid separately.					
			*3. Though the rollers are required only for 3.5 hours each as per norms of output, but these are required to be available at site for 6 hours as the drum mix plant and the paver would take 6 hours for mixing and paving. To cater for the idle period, their usage rates have been multiplied by a factor of 0.65					
5.18		(iii)	Using cutback bitumen and 9.5 mm or 13.2 mm nominal size aggregate					
			Composition of mix (450 tonne) is assumed to be as under:-					
			Cutback bitumen 5 per cent					
			Filler (lime) 2 per cent					
			Total aggregates 93 per cent					
			Proportion of aggregates					
			19 mm to 9.5 mm26 per cent					
			9.5 mm to 6 mm31 per cent					
			6 mm to 0.075 mm 36 per cent					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor	day	16.000	245.00	3920.00	L-13
			Mazdoor skilled	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Drum mix plant for cold mixes 60-90 tonne per hour producing average output of 75 tonnes per hour	hour	6.000	8000.00	48000.00	P&M-077
			Electric generator 125 KVA	hour	6.000	674.40	4046.40	P&M-018
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	450 x L	1.90	8550.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				855.00	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Paver finisher	hour	6.000	2070.00	12420.00	P&M-034
			Pneumatic tyred roller 12-15 tonnes	hour	6.00x0.65*	922.00	3595.80	P&M-037
			Smooth wheeled steel tandem roller 6-8 tonnes	hour	6.00x0.65*	386.00	1505.40	P&M-045
			c) Material					
			Cutback bitumen @ 5 per cent	tonne	22.500	67900.00	1527750.00	M-076
			Filler (lime)@ 2 per cent	tonne	9.000	4055.00	36495.00	M-188
			Aggregates size 19 to 9.5 mm - 450 x 0.26 x 1/1.5	cum	78.000	774.52	60412.56	M-045
			Aggregates size 9.5 to 6 mm - 450 x 0..31 x 1/1.5	cum	93.000	774.52	72030.36	M-040
			Aggregates size 6 to 0.075 mm - 450 x 0.36 x 1/1.5	cum	108.000	716.19	77348.16	M-030
			d) Overhead charges @ 10%				186212.87	
			e) Contractor's profit @ 10%				204834.15	
			Cost for 205 cum				2253175.70	
			Rate per cum				10991.10	
						say	*10991.00*	
		Note	1.Density of aggregates has been assumed 1.5 gms/cc					
			2. Tack coat where provided will be measured and paid separately.					
			*3. Though the rollers are required only for 3.5 hours each as per norms of output, but these are required to be available at site for 6 hours as the drum mix plant and the paver would take 6 hours for mixing and paving. To cater for the idle period, their usage rates have been multiplied by a factor of 0.65					
5.18		(iv)	Using cutback bitumen and 19 mm or 26.5 mm nominal size aggregate					
			Composition of mix (450 tonne) is assumed to be as under:-					
			Cutback bitumen 5 per cent					
			Filler2 per cent					
			Total aggregates 93 per cent					
			Proportion of aggregates					
			37.5 mm to 19 mm25 per cent					
			19 mm to 6 mm 30 per cent					
			6 mm to 0.075 mm 38 per cent					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor	day	16.000	245.00	3920.00	L-13
			Mazdoor skilled	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Drum mix plant for cold mixes 60-90 tonne per hour producing output of 75 tonnes per hour	hour	6.000	8000.00	48000.00	P&M-077
			Electric generator 125 KVA	hour	6.000	674.40	4046.40	P&M-018
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	450.000	1.90	855.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				85.50	
			Paver finisher	hour	6.000	2070.00	12420.00	P&M-034
			Pneumatic tyred roller 12-15 tonnes.	hour	6.00x0.65*	922.00	3595.80	P&M-037
			Smooth wheeled steel tandem roller 6-8 tonnes	hour	6.00x0.65*	922.00	3595.80	P&M-045
			c) Material					
			Cutback bitumen on @ 5 per cent	tonne	22.500	67900.00	1527750.00	M-076
			Filler (lime)@ 2 per cent	tonne	9.000	4055.00	36495.00	M-188
			Aggregates size 37.5 to 19 mm - 450 x 0.25 x 1/1.5	cum	75.000	974.52	73089.00	M-048
			Aggregates size 19 to 6 mm - 450 x 0.3 x 1/1.5	cum	90.000	824.52	74206.80	M-047
			Aggregates size 6 to 0.075 mm - 450 x0.38 x 1/1.5	cum	114.000	716.19	81645.28	M-030
			d) Overhead charges @ 10%				187490.46	
			e) Contractor's profit @ 10%				206239.50	
			Cost for 205 cum				2268634.54	
			Rate per cum				11066.51	
						say	*11067.00*	
		Note	1.Density of aggregates has been assumed 1.5 gms/cc					
			2. Tack coat where provided will be measured and paid separately.					
			*3. Though the rollers are required only for 3.5 hours each as per norms of output, but these are required to be available at site for 6 hours as the drum mix plant and the paver would take 6 hours for mixing and paving. To cater for the idle period, their usage rates have been multiplied by a factor of 0.65					
5.19	520		Sand Asphalt Base Course					
			Providing, laying and rolling sand-asphalt base course composed of sand, mineral filler and bituminous binder on a prepared sub-grade or sub-base to the lines, levels, grades and cross sections as per the drawings including mixing in a plant of suitable type and capacity, transporting, laying, compacting and finishing.					
			Unit = cum					
			Taking output = 205 cum (450 tonne)					
			a) Labour					
			Mate	day	0.840	275.00	231.00	L-12
			Mazdoor	day	16.000	245.00	3920.00	L-13
			Mazdoor skilled	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Hot Mix Plant of appropriate capacity but not less than 75 tonnes/hour	hour	6.000	12280.00	73680.00	P&M-023
			Electric generator set 250 KVA	hour	6.000	1348.80	8092.80	P&M-081
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Tipper 10 tonne capacity	tonne.km	450 x L	1.90	8550.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				855.00	
			Paver finisher	hour	6.000	2070.00	12420.00	P&M-034
			smooth wheeled roller 8-10 tonnes for initial break down rolling.	hour	6.00x0.65	386.00	1505.40	P&M-044
			Vibratory roller 8 tonnes for intermediate rolling.	hour	6.00x0.65	1292.00	5038.80	P&M-059
			Finish rolling with 6-8 tonnes smooth wheeled tandom rollers.	hour	6.00x0.65	386.00	1505.40	P&M-045

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			c) Material					
			Composition of mix (450 tonne) is assumed to be as under:-					
			Density 2.20 tonne per cum					
			Weight450 tonne					
			Bitumen5 per cent					
			Filler2 per cent					
			Sand of size 4.75 to 0.075 mm 93 per cent					
			Bitumen@ 5 per cent	tonne	22.500	43209.95	972223.97	M-074
			Filler (lime)@ 2 per cent	tonne	9.000	4055.00	36495.00	M-188
			Sand of size 4.75 to 0.075 mm - 450 x 0.93 x 1/1.5	cum	288.620	1184.68	341922.34	M-004
			d) Overhead charges @ 10%				147140.87	
			e) Contractor's profit @ 10%				161854.96	
			Cost for 205 cum				1780404.54	
			Rate per cum				8684.90	
						say	*8685.00*	
		Note	1. Tack coat will be measured and paid separately					
			2. Although the rollers are required only for 3 hours as per norms of output, but the same have to be available at site for six hours as the hot mix plant and paver will take six hours for mixing and paving the output of 450 tonnes considered in this analysis. To cater for the idle period of this roller, their usage rates has been multiplied by a factor of 0.65					
5.20	521		Modified Binder					
			Supply of modified binder produced by mixing bitumen with modifier such as natural rubber or crumb rubber or any other polymer found compatible with bitumen and which allows properties given in clause 521.3 and IRC:SP: 53 blending of modifier with bitumen to be done either at the refinery or at central unit with all facilities by proper industrial process, is essential.					
			Unit = tonne					
			The use of modified binder is expected to result in an extended service life of bituminous pavements subject to heavy traffic loads in extreme climatic conditions, thus justifying the entire cost of adding modifiers/fibres. Other advantages include lower temperature susceptibility, higher resistance to aging, higher fatigue life, higher resistance to cracking and better adhesion between aggregates and binder.					
			Detailed information and inductive dose level on the use of polymer modified binder is available in IRC : SP-53 / 2002. A number of proprietary products are now available in the market. For such proprietary products, test reports and cost effectiveness should be the basis for their selection in road works.					
			The modifier, in the required quantity shall be blended at the refinery or at central unit with all facilities by proper industrial process, is essential. If supplied in drums it shall be agitated in melted condition with suitable device for achieving homogeneity					
			Proposals to use glass fibre, polypropylene fibres or any other similar material in a bituminous mixture should be substantiated, complete with all details including test results, manufacturer's recommendations for addition or means of incorporating the fibres, homogeneously, without segregation, into the mixture.					
			Before agreeing to the use of a fibre, it should have been proved to be satisfactory in use under circumstances, similar to the work, elsewhere or it would have under gone appropriate performance trials. Documented evidence of use and trials of the fibre, in any country having conditions similar to Indian will be acceptable.					
			where information on use of trials is inadequate or lacking, trials may be required to be under taken before agreeing to the use of the fibre.					
		Note	1. The modified binder is usually manufactured by specialised firms as a proprietary product. The rate for this product is required to be as certained from the market.					
			2.The specifications for various item of road works using polymer/rubber modified bitumens are same as those for penetration grade bitumen except those for any special conditions which the manufacturer may indicate					
			3.The other controls during mixing, laying shall be same as specified in IRC - 14, 29, 94 and 95 for open graded premix carpet, bituminous concrete, DBM and SDBC respectively					
			4.The temperature of mixing and rolling will be slightly higher than conventional bituminous mixes as indicated in Table 8 of IRC: SP: 53 - 2002					
5.21	522		Crack Prevention Courses					
		(i)	Stress absorbing membrane (SAM) crack width less than 6 mm					
			Providing and laying of a stress absorbing membrane over a cracked road surface, with crack width below 6 mm after cleaning with a mechanical broom, using modified binder complying with clause 521, sprayed at the rate of 9 kg per 10 sqm and spreading 5.6 mm crushed stone aggregates @ 0.11 cum per 10 sqm with hydraulic chip spreader, sweeping the surface for uniform spread of aggregates and surface finished to conform to clause 902.					
			Unit = sqm					
			Taking output = 10500 sqm					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	6.000	276.00	1656.00	P&M-031
			Air compressor 250 cfm	hour	6.000	257.00	1542.00	P&M-001
			Bitumen pressure distributor @ 1750 sqm per hour	hour	6.000	593.00	3558.00	P&M-004
			Hydraulic Chip spreader	hour	6.000	1785.00	10710.00	P&M-025
			Smooth wheeled road roller 8-10 tonne	hour	6.000	386.00	2316.00	P&M-044
			c) Material					
			Modified binder	tonne	9.450	18000.00	170100.00	M-078
			Crushed stone aggregates 5.6 mm size	cum	105.000	716.19	75199.60	M-050

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			d) Overhead charges @ 10%				26661.76	
			e) Contractor's profit @ 10%				29327.94	
			Cost for 10500 sqm				322607.30	
			Rate per sqm				30.72	
						say	*31.00*	
5.21		(ii)	Stress absorbing membrane (SAM) with crack width 6 mm to 9 mm					
			Providing and laying of a stress absorbing membrane over a cracked road surface, with crack width 6 to 9 mm after cleaning with a mechanical broom, using modified binder complying with clause 521, sprayed at the rate of 11 kg per 10 sqm and spreading 11.2 mm crushed stone aggregates @ 0.12 cum per 10 sqm, sweeping the surface for uniform spread of aggregates and surface finished to conform to clause 902.					
			Unit = sqm					
			Taking output = 10500 sqm					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	6.000	276.00	1656.00	P&M-031
			Air compressor 250 cfm capacity	hour	6.000	257.00	1542.00	P&M-001
			Bitumen pressure distributor @ 1750 sqm per hour	hour	6.000	593.00	3558.00	P&M-004
			Hydraulic Chip spreader	hour	6.000	1785.00	10710.00	P&M-025
			Smooth wheeled road roller 8-10 tonne	hour	6.000	386.00	2316.00	P&M-044
			c) Material					
			Modified binder	tonne	11.550	18000.00	207900.00	M-078
			Crushed stone chipping 11.2 mm size	cum	105.000	716.19	75199.60	M-051
			d) Overhead charges @ 10%				30441.76	
			e) Contractor's profit @ 10%				33485.94	
			Cost for 10500 sqm				368345.30	
			Rate per sqm				35.08	
						say	*35.00*	
5.21		(iii)	Stress absorbing membrane (SAM) crack width above 9 mm and cracked area above 50 per cent					
			Providing and laying a single coat of a stress absorbing membrane over a cracked road surface, with crack width above 9 mm and cracked area above 50 per cent after cleaning with a mechanical broom, using modified binder complying with clause 521, sprayed at the rate of 15 kg per 10 sqm and spreading 11.2 mm crushed stone aggregates @ 0.12 cum per 10 sqm, sweeping the surface for uniform spread of aggregates and surface finished to conform to clause 902.					
			Unit = sqm					
			Taking output = 10500 sqm					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	6.000	276.00	1656.00	P&M-031
			Air compressor 250 cfm capacity	hour	6.000	257.00	1542.00	P&M-001
			Bitumen pressure distributor @ 1750 sqm per hour	hour	6.000	593.00	3558.00	P&M-004
			Hydraulic Chip spreader	hour	6.000	1785.00	10710.00	P&M-025
			Smooth wheeled road roller 8-10 tonne	hour	6.000	386.00	2316.00	P&M-044
			c) Material					
			Modified binder	tonne	15.750	18000.00	283500.00	M-078
			Crushed stone aggregates 11.2 mm size	cum	126.000	716.19	90239.52	M-051
			d) Overhead charges @ 10%				39554.75	
			e) Contractor's profit @ 10%				43510.23	
			Cost for 10500 sqm				478612.50	
			Rate per sqm				45.58	
						say	*46.00*	
		Note	In case 2nd coat is also required to be provided, material provided for the 2nd coat shall be as per table 500-47.					
5.21		(iv)	Case - IV : Bitumen impregnated geotextile					
			Providing and laying a bitumen impregnated geotextile layer after cleaning the road surface, geotextile conforming to requirements of clause 703.3, laid over a tack coat with 1.05 kg per sqm of paving grade bitumen 80 - 100 penetration and constructed to the requirement of clause 703.4.5					
			Unit = sqm					
			Taking output = 3500 sqm					
			a) Labour					
			Mate	day	0.560	275.00	154.00	L-12
			Mazdoor	day	12.000	245.00	2940.00	L-13
			Mazdoor skilled	day	2.000	245.00	490.00	L-15
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	2.800	276.00	772.80	P&M-031
			Air compressor 250 cfm capacity	hour	2.800	257.00	719.60	P&M-001
			Bitumen pressure distributor @ 1750 sqm per hour	tonne	2.000	593.00	1186.00	P&M-004
			Pneumatic roller	hour	2.000	922.00	1844.00	P&M-037
			c) Material					
			Paving grade bitumen of 80 - 100 penetration @ 1.05 kg per sqm	tonne	3.680	50351.34	185292.91	M-075
			Geotextile including 10 per cent for overlaps	sqm	3850.000	103.00	396550.00	M-108
			d) Overhead charges @ 10%				58994.93	
			e) Contractor's profit @ 10%				64894.42	
			Cost for 10500 sqm				713838.67	
			Rate per sqm				203.95	
						say	*204.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		NOTE	As bitumen overlay construction shall follow closely the fabric placement on the same day, an output of 3500 sqm only has been considered for the analysis which will cover a length of 500 m, of 7 m wide carriagway. This can be conveniently overlaid by a bitumenious course in a day					
5.22	519.3		Recipe Cold Mix					
			Providing and laying of premix of crushed stone aggregates and emulsion binder, mixed in a batch type cold mixing plant, laid over prepared surface, by paver finisher, rolled with a pneumatic tyred roller initially and finished with a smooth steel wheel roller, all as per clause 519.3					
			Unit = cum					
			Taking output = 205 cum (450 tonnes)					
		(i)	75 mm thickness					
			a) Labour					
			Mate	day	1.000	275.00	275.00	L-12
			Mazdoor	day	12.000	245.00	2940.00	L-13
			Mazdoor skilled	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Batch type cold mixing plant 100-120 TPH capacity producing an average output of 75 tonne per hour	hour	6.000	8000.00	48000.00	P&M-064
			Electric generator 125 KVA	hour	6.000	674.40	4046.40	P&M-018
			Front end loader 1 cum capacity	hour	6.000	624.00	3744.00	P&M-017
			Paver finisher hydrostatic with sensor control @ 75 cum per hour	hour	6.000	2070.00	12420.00	P&M-034
			Tipper 10 tonne capacity	tonne.km	450.000	1.90	855.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				85.50	
			Pneumatic tyred roller12-15 tonnes.	hour	3.900	922.00	3595.80	P&M-037
			Smooth wheeled steel roller6-8 tonnes.	hour	3.900	386.00	1505.40	P&M-044
			Water tanker6 KL capacity	hour	1.000	374.00	374.00	P&M-060
			c) Material					
			Bitumen emulsion @ 45 litres per tonne	tonne	20.250	593.00	12008.25	M-077
			Crushed stone aggregates 40 mm nominal size	cum	297.000	716.19	212707.44	M-055
			Cost of water	KL	6.000	30.00	180.00	M-189
			d) Overhead charges @ 10%				30396.18	
			e) Contractor's profit @ 10%				33435.80	
			Cost for 10500 sqm				367793.77	
			Rate per sqm				1794.12	
						say	*1794.00*	
		Note	(Case I to III)					
			1. These mixes are considered suitable for minor repair work and temporary road surface improvement.					
			2. In case concrete mixtures are required to be used for mixing, a number of these will be needed to match the capacity of road rollers.					
			3. Tack coat, where provided, will be measured and paid separately.					
			*4.Both the rollers have to be available at site to match with the output of batch mixing plant and paver finisher. A multiplying factor of 0.65 has been adopted to cater for the idling period of road rollers.					
5.22		(ii)	40 mm thickness					
			a) Labour					
			Mate	day	1.000	275.00	275.00	L-12
			Mazdoor	day	12.000	245.00	2940.00	L-13
			Mazdoor skilled	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Batch type cold mixing plant100-120 TPH capacity producing an average output of 75 tonne per hour	hour	6.000	8000.00	48000.00	P&M-064
			Electric generator 125 KVA	hour	6.000	674.40	4046.40	P&M-018
			Front end loader 1 cum capacity	hour	6.000	624.00	3744.00	P&M-017
			Paver finisher hydrostatic with sensor control @ 75 cum per hour	hour	6.000	2070.00	12420.00	P&M-034
			Tipper 10 tonne capacity	tonne.km	450.000	1.90	855.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				85.50	
			Pneumatic tyred roller 12-15 tonnes.	hour	6.00x0.65*	922.00	3595.80	P&M-037
			Smooth wheeled steel roller 6-8 tonnes.	hour	6.00x0.65*	386.00	1505.40	P&M-044
			Water tanker6 KL capacity	hour	1.000	374.00	374.00	P&M-060
			c) Material					
			Bitumen emulsion @ 70 litres per tonne	tonne	31.500	31532.50	993273.75	M-077
			Crushed stone aggregates 14 mm nominal size	cum	287.000	716.19	205545.57	M-052
			Cost of water	KL	6.000	30.00	180.00	M-189
			d) Overhead charges @ 10%				127806.54	
			e) Contractor's profit @ 10%				140587.20	
			Cost for 10500 sqm				1546459.16	
			Rate per sqm				7543.70	
						say	*7544.00*	
5.22		(iii)	25 mm thickness					
			a) Labour					
			Mate	day	1.000	275.00	275.00	L-12
			Mazdoor	day	12.000	245.00	2940.00	L-13
			Mazdoor skilled	day	5.000	245.00	1225.00	L-15
			b) Machinery					
			Batch type cold mixing plant 100-120 TPH capacity producing an average output of 75 tonne per hour	hour	6.000	8000.00	48000.00	P&M-064
			Electric generator 125 KVA	hour	6.000	674.40	4046.40	P&M-018
			Front end loader 1 cum capacity	hour	6.000	624.00	3744.00	P&M-017
			Paver finisher hydrostatic with sensor control @ 75 cum per hour	hour	6.000	2070.00	12420.00	P&M-034
			Tipper 10 tonne capacity	tonne.km	450.000	1.90	8550.00	Lead =10 km & P&M-058

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				855.00	
			Pneumatic tyred roller	hour	6.00x0.65*	922.00	3595.80	P&M-037
			Smooth wheeled steel roller	hour	6.00x0.65*	386.00	1505.40	P&M-044
			Water tanker6 KL capacity	hour	1.000	374.00	374.00	P&M-060
			c) Material					
			Bitumen emulsion @ 85 litres per tonne	tonne	38.250	31532.50	1206118.13	M-077
			Crushed stone aggregates 6 mm nominal size	cum	270.000	716.19	193370.40	M-050
			Cost of water	KL	6.000	30.00	180.00	M-189
			d) Overhead charges @ 10%				148719.91	
			e) Contractor's profit @ 10%				163591.90	
			Cost for 10500 sqm				1799510.94	
			Rate per sqm				8778.10	
						say	*8778.00*	

CHAPTER- 6
CEMENT CONCRETE PAVEMENTS

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
6.1	*601*		Dry Lean Cement Concrete Sub- base					
			Construction of dry lean cement concrete Sub- base over a prepared sub-grade with coarse and fine aggregate conforming to IS: 383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per table 600-1, cement content not to be less than 150 kg/ cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, laid with a paver with electronic sensor, compacting with 8-10 tonnes vibratory roller, finishing and curing.					
			Unit = cum					
			Taking output = 450 cum (990 tonne)					
			a) Labour					
			Mate	day	1.120	275.00	308.00	L-12
			Mazdoor skilled	day	6.000	245.00	1470.00	L-15
			Mazdoor	day	22.000	245.00	5390.00	L-13
			b) Machinery					
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Cement concrete batch mix plant @ 75 cum per	hour	6.000	1656.00	9936.00	P&M-068
			Electric generator 100 KVA	hour	6.000	562.00	3372.00	P&M-080
			Paver with electronic sensor	hour	6.000	2070.00	12420.00	P&M-034
			Vibratory roller 8-10 t capacity	hour	8.000	1292.00	10336.00	P&M-059
			Water tanker6 KL capacity	hour	8.000	374.00	2992.00	P&M-060
			Tipper	tonne.km	13860.000	1.90	26334.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				2633.40	
			c) Material					
			Crushed stone coarse aggregate of 25 mm and 12.5 mm nominal sizes graded as per table 600-1 @ 0.90 cum/cum of concrete conforming to clause 602.2.4.	cum	405.000	907.85	367680.60	M-052 and M-054
			Coarse Sand as per IS: 383 @ 0.45 cum/cum of concrete	cum	203.000	1184.68	240490.04	M-004
			Cement @ 150 kg/cum of concrete	tonne	67.500	7598.00	512865.00	M-081
			Cost of water	KL	48.000	30.00	1440.00	M-189
							120141.10	
							132155.21	
			Cost for 205 cum				1453707.36	
			Rate per cum				3230.46	
						say	*3230.00*	
		Note	Quantity provided for aggregate is for estimating purpose. Exact quantity shall be as per mix design.					
6.2	*602*		Cement Concrete Pavement					
			Construction of un-reinforced, dowel jointed, plain cement concrete pavement over a prepared sub base with 43 grade cement @ 400 kg per cum, coarse and fine aggregate conforming to IS 383, maximum size of coarse aggregate not exceeding 25 mm, mixed in a batching and mixing plant as per approved mix design, transported to site, laid with a fixed form or slip form paver, spread, compacted and finished in a continuous operation including provision of contraction, expansion, construction and longitudinal joints, joint filler, separation membrane, sealant primer, joint sealant, debonding strip, dowel bar, tie rod, admixtures as approved, curing compound, finishing to lines and grades as per drawing.					
			Unit = cum					
			Taking output = 1050 cum (2415 tonne)					
			a) Labour					
			Mate	day	2.000	275.00	550.00	L-12
			Mazdoor skilled	day	15.000	245.00	3675.00	L-15
			Mazdoor	day	35.000	245.00	8575.00	L-13
			b) Machinery					
			Road Sweeper @ 1250 sqm per hour	hour	2.800	276.00	772.80	P&M-031
			Front end loader 1 cum bucket capacity	hour	18.000	624.00	11232.00	P&M-017
			Cement concrete batch mix plant @ 175 cum per hour (effective output)	hour	6.000	1656.00	9936.00	P&M-067
			Electric generator 250 KVA	hour	6.000	1348.80	8092.80	P&M-081
			Slip form paver with electronic sensor	hour	6.000	1800.00	10800.00	P&M-006
			Water tanker6 KL capacity	hour	36.000	374.00	13464.00	P&M-060
			Transit truck agitator 5 cum capacity.	tonne.km	33810.000	1.90	64239.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				6423.90	
			Concrete joint cutting machine .	hour	12.000	250.00	3000.00	P&M-083
			Texturing machine .	hour	12.000	300.00	3600.00	P&M-088
			c) Material					
			Crushed stone coarse aggregates of 25mm and 12.5mm nominal size @ 0.90 cum/cum of concrete conforming to clause 602.2.4. .	cum	945.000	907.85	857921.40	M-052 and M-054
			Sand as per IS: 383 and conforming to clause 602.2.4 @ 0.45 cum/cum of concrete	cum	473.000	1184.68	560353.64	M-004
			Cement 43 grade @ 400 kg/cum of concrete	tonne	414.000	7598.00	3145572.00	M-081
			32 mm mild steel dowel bars of grade S 240	tonne	9.450	47198.00	446021.10	M-126
			16 mm deformed steel tie bars of grade S 415	tonne	1.170	49198.00	57561.66	M-082
			Separation Membrane of impermeable plastic sheeting 125 micron thick	sqm	3675.000	150.00	551250.00	M-164
			Pre moulded Joint filler, 25 mm thick for expansion joint.	sqm	16.330	591.60	9660.83	M-141
			Joint sealant	kg	875.000	100.00	87500.00	M-120
			Sealant primer	kg	116.670	100.00	11667.00	M-097
			Plastic sheath,1.25 mm thick for dowel bars	sqm	46.670	150.00	7000.50	M-138
			Curing compound	liter	1850.000	80.00	148000.00	M-090
			Super plastisizer admixture IS marked as per 9103-1999 @ 0.5 per cent by weight of cement	kg	2070.000	100.00	207000.00	M-180
			Cost of water	KL	216.000	30.00	6480.00	M-189
			Add 1 per cent of material for cost of miscellaneous materials like tarpauline, Hessian cloth, metal cap, cotton / compressible sponge and cradle for dowel bars, work bridges for men to approach concrete surface without walking over it, cutting blades and bites, minor equipments like scabbling machine, threads, ropes, guide wires and any other unforeseen items.				60959.88	
			d) Overhead charges @ 10%				630130.85	
			e) Contractor's profit @ 10%				693143.94	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Cost for 1050cum				7624583.30	
			Rate per cum				7261.51	
						say	*7262.00*	
		Note	The quantities for cement, coarse aggregate and fine aggregates are for estimating only .The exact quantities will be as per mix design.					
6.3	*603*		Rolled Cement Concrete Base					
			Construction of rolled cement concrete base course with coarse and fine aggregate conforming to IS:383, the size of coarse aggregate not exceeding 25 mm with minimum, aggregate cement ratio15:1 and minimum cement content of 200 kg/cum, aggregate gradation to be as per table 600-4 after blending, mixing in batching plant at optimum moisture content, transporting to site, laying with a paver with electronic sensor, compacting with 8-10 tonnes smooth wheeled vibratory roller to achieve, the designed flexural strength, finishing and curing					
			Unit = cum					
			Taking output = 450 cum (990 tonne)					
			a) Labour					
			Mate	day	1.200	275.00	330.00	L-12
			Mazdoor skilled	day	7.000	245.00	1715.00	L-15
			Mazdoor	day	23.000	245.00	5635.00	L-13
			b) Machinery					
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Cement concrete batch mix plant @ 75 cum per	hour	6.000	1656.00	9936.00	P&M-068
			Electric generator 100 KVA	hour	6.000	562.00	3372.00	P&M-080
			Paver with electronic sensor @ 75 cum/hr.	hour	6.000	2070.00	12420.00	P&M-034
			Vibratory roller 8-10 t capacity	hour	8.000	1292.00	10336.00	P&M-059
			Water tanker with 5 km lead 6 KL capacity	hour	8.000	374.00	2992.00	P&M-060
			Tipper	tonne.km	990x1	1.90	18810.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				1881.00	
			c) Material					
			Crushed stone coarse aggregates of 25mm and 12.5mm nominal size @ 0.90 cum/cum of concrete conforming to clause 602.2.3.	cum	405.000	974.52	394680.60	M-052 and M-054
			Sand as per IS: 383 and conforming to clause 602.2.3 @ 0.45 cum/cum of concrete	cum	203.000	1184.68	240490.04	M-004
			Cement @ 200 kg/cum of concrete	tonne	90.000	7598.00	683820.00	M-081
			Cost of water	KL	48.000	30.00	1440.00	M-189
			d) Overhead charges @ 10%				139160.16	
			e) Contractor's profit @ 10%				153076.18	
			Cost for 450cum				1683837.98	
			Rate per cum				3741.86	
						say	*3742.00*	
		Note	The quantities for cement, coarse aggregate and fine aggregates are for estimating only .The exact quantities will be as per mix design.					
6.4	*New*		Transition Section between Rigid and Flexible Pavement					
			Due to change in the properties of materials and type of construction, a gradual changeover from rigid pavement to flexible pavement is desirable to avoid any damage at the butting joint. After provision of an expansion joint in the cement concrete slab, the thickness of slab should be tapered to 10 cm over a length of 3 m towards the flexible pavement. The deficiency of thickness caused due to tapering of the slab should be made up by the asphaltic layers.					
			The quantities of items should be worked out based on the approved design and drawings and priced as per rates given under respective clauses for cement concrete and asphaltic work.					
6.5	*Suggestive*		Construction of Base/Sub-Base of Pavement with Lean Concrete - Flyash.					
			Construction of Base/sub-base using cement, sand, fly ash and coarse aggregates proportioned as per table 4 of IRC: 74/1979 and with water content ratio, slump and compressive strength as defined in the said table, mix prepared in a batching and mixing plant and compacted with a vibratory roller 8-10 tonnes capacity within the time limit laid down vide clause 7.6.3 of IRC: 74-1979, construction joints properly formed at the end of day's work, cured for 14 days, all as specified in IRC: 74-1979 and as per approved plans.					
			Unit = cum					
			Taking output = 450 cum (990 tonne)					
			a) Labour					
			Mate	day	1.120	275.00	308.00	L-12
			Mazdoor skilled	day	6.000	245.00	1470.00	L-15
			Mazdoor	day	22.000	245.00	5390.00	L-13
			b) Machinery					
			Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
			Cement concrete batch mix plant @ 75 cum per	hour	6.000	1656.00	9936.00	P&M-068
			Electric generator 100 KVA	hour	6.000	562.00	3372.00	P&M-080
			Paver finisher with electronic sensor	hour	6.000	2070.00	12420.00	P&M-034
			Vibratory roller 8-10 t capacity	hour	8.000	1292.00	10336.00	P&M-059
			Water tanker6 KL capacity	hour	8.000	374.00	2992.00	P&M-060
			Tipper 10 T Capacity	tonne.km	990 x L	1.90	18810.00	Lead =10 km & P&M-058
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				1881.00	
			c) Material					
			Crushed stone coarse aggregate of 40 mm nominal size @ 0.90 cum/cum of concrete conforming to table 2 of IRC: 74-1979.	cum	405.000	974.52	394680.60	M-055
			Coarse Sand as per IS: 383 - 1970	cum	110.960	1184.68	131452.09	M-004
			Cement @ 150 kg/cum of concrete	tonne	67.500	7598.00	512865.00	M-081
			Fly ash conforming to IS: 3812 (Part II)	cum	91.540	116.00	10618.64	M-011

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			(Total fine aggregates = 450 x 0.45 = 202.50 cum To be divided in ratio of 2 sand : 1.65 flyash. Refer table 4 of IRC: 74-1979).					
			d) Overhead charges @ 10%				112027.53	
			e) Contractor's profit @ 10%				123230.29	
			Cost for 450cum				1355533.15	
			Rate per cum				3012.30	
						say	*3012.00*	
		Note	1.Depending upon approved designs, crushed stone aggregates of nominal size 20mm can also be used as per gradation given in table 2 of IRC: 74-1979.					
			2.The ratio of specific gravities of fly ash and sand has been assumed to be 0.827.					
			3.The quantities of materials given in the analyses are for estimating purposes. Actual quantities shall be as per job mix formula.					
			4.Construction procedure as laid down in clause, of IRC: 74-1979 shall be followed.					
6.6	*Suggestive*		Cement - Flyash Concrete Pavement.					
			Construction reinforced-reinforced, dowel jointed, plain cement concrete pavement over a prepared sub base with 43 grade cement, coarse and fine aggregate conforming to IS 383, maximum size of coarse aggregate not exceeding 25 mm, replacing cement by fly ash to the extent of 15 per cent and sand by 10 per cent, mixed in a batching and mixing plant as per approved mix design, transported to site, laid with a fixed form or slip form paver, spread, compacted and finished in a continuous operation including provision of contraction, expansion, construction and longitudinal joints, joint filler, separation membrane, sealant primer, joint sealant, debonding strip, dowel bar, tie rod, admixtures as approved, curing compound, finishing to lines and grades as per drawing					
			Unit = cum					
			Taking output = 1050 cum (2415 tonne)					
			a) Labour					
			Mate	day	2.000	275.00	550.00	L-12
			Mazdoor skilled	day	15.000	245.00	3675.00	L-15
			Mazdoor	day	35.000	245.00	8575.00	L-13
			b) Machinery					
			Road Sweeper @ 1250 sqm per hour	hour	2.800	276.00	772.80	P&M-031
			Front end loader 1 cum bucket capacity	hour	18.000	624.00	11232.00	P&M-017
			Cement concrete batch mix plant @ 175 cum per hour (effective output)	hour	6.000	1656.00	9936.00	P&M-067
			Electric generator 250 KVA	hour	6.000	1348.80	8092.80	P&M-081
			Slip form paver with electronic sensor	hour	6.000	2070.00	12420.00	P&M-006
			Water tanker6 KL capacity	hour	36.000	374.00	13464.00	P&M-060
			Transit truck agitator 5 cum capacity.	tonne.km	2415.000	9.78	23613.33	P&M-050 Lead= 10 km
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				2361.33	
			Concrete joint cutting machine .	hour	12.000	250.00	3000.00	P&M-083
			Texturing machine .	hour	12.000	300.00	3600.00	P&M-088
			c) Material					
			Crushed stone coarse aggregates of 25mm and 12.5mm nominal size @ 0.90 cum/cum of concrete conforming to clause 602.2.4. .	cum	945.000	907.85	857921.40	M-052 and M-054
			Sand as per IS: 383 and conforming to clause 602.2.4	cum	425.000	1184.68	503489.00	M-004
			Cement 43 grade	tonne	357.000	7598.00	2712486.00	M-081
			Fly ash conforming to IS: 3812-1966 (Part-I)	tonne	109.000	116.00	12644.00	M-011
			32 mm mild steel dowel bars of grade S 240	tonne	9.450	47198.00	446021.10	M-126
			16 mm deformed steel tie bars of grade S 415	tonne	1.170	49198.00	57561.66	M-082
			Separation Membrane of impermeable plastic sheeting 125 micron thick	sqm	3675.000	150.00	551250.00	M-164
			Pre moulded Joint filler, 25 mm thick for expansion joint.	sqm	16.330	591.60	9660.83	M-141
			Joint sealant	kg	875.000	100.00	87500.00	M-120
			Sealant primer	kg	116.670	100.00	11667.00	M-097
			Plastic sheath,1.25 mm thick for dowel bars	sqm	46.670	150.00	7000.50	M-138
			Curing compound	liter	1850.000	80.00	148000.00	M-090
			Super plastisizer admixture IS marked as per 9103-1999 @ 0.5 per cent by weight of cement	kg	2070.000	100.00	207000.00	M-180
			Cost of water	KL	216.000	30.00	6480.00	M-189
			Add 1 per cent of material for cost of miscellaneous materials like tarpauline, Hessian cloth, metal cap, cotton / compressible sponge and cradle for dowel bars, work bridges for men to approach concrete surface without walking over it, cutting blades and bites, minor equipments like scabbling machine, threads, ropes, guide wires and any other unforeseen items.				47607.60	
			d) Overhead charges @ 10%				576758.14	
			e) Contractor's profit @ 10%				634433.95	
			Cost for 1050cum				6978773.44	
			Rate per cum				6646.45	
						say	*6646.00*	
		Note	1.The quantities for cement, coarse aggregate and fine aggregates are for estimating only .The exact quantities will be as per mix design.					
			2.IRC: 68-1976 may be referred for guidelines on the design of cement-fly ash concrete for rigid pavement construction.					
			*Calculation of cement, sand and fly ash.					
			Cement @ 400 kg/cum = 1050 x 400 = 420 tonnes. 15 per cent of cement to be replaced by fly ash = 63 tonnes. Balance cement = 357 tonnes. Quantity of fly ash = 63 x specific gravity of fly ash /specific gravity of cement = 63 x 2.25/3.15 = 45 tonnes.					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Sand @ 0.45 cum / cum of concrete = 1050 x 0.45 = 472.50 x 1.6 = 756 tonnes.10 per cent to be replaced by flyash. Balance sand = 756 x 0.9 = 680.4 tonnes = 680.4 / 1.6 = 425 cum. Quantity of flyash = (756-680.4) x specific gravity of fly ash/specific gravity of sand = 76.4 x 2.25 / 2.687 = 63.97 tonnes (say 64 tonnes)					
			Fly ash Total fly ash = 45 + 64 = 109 tonnes.					

CHAPTER-7
GEOSYNTHETICS AND REINFORCED EARTH

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
7.1	702		Sub-Surface Drain with Geotextiles					
			Construction of sub surface drain 200 mm dia using geotextiles treated with carbon black with physical properties as given in clause 702.2.3 formed in to a stable network and a planar geocomposite structure, joints wrapped with geotextile to prevent ingress of soil, all as per clause 702 and approved drawings including excavation and backfilling					
			Unit = Running metre					
			Taking output = one metre					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor skilled	day	0.250	245.00	61.25	L-15
			Mazdoor	day	0.500	245.00	122.50	L-13
			b) Material					
			Geonets, geomembrane and geotextile to make planar geocomposite stable network for sub surface drain including wrapping of joints with 160 mm over lapping with geotextile .					
			Geonets	sqm	1.000	300.00	300.00	M-107
			Geomembrane	sqm	1.000	315.00	315.00	M-106
			Geotextile	sqm	2.000	103.00	206.00	M-108
			Add 2 per cent cost of material for miscellaneous items like synthetic cord				16.42	
							103.22	
							113.54	
			Rate per metre = a+b+c+d				1248.93	
						say	*1249.00*	
		Note	Surplus excavated material to be used at site. Hence seprate cost for disposal not added.					
7.2	702.4		Narrow Filter Sub-Surface Drain					
			Construction of a narrow filter sub- surface drain consisting of porous or perforated pipe laid in narrow trench surrounded by a geotextile filter fabric, with a minimum of 450 mm overlap of fabric and installed as per clause 702.3 and 309.3.5 including excavation and backfilling					
			Unit = Running metre length					
			Taking output = one metre					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor skilled	day	0.250	245.00	61.25	L-15
			Mazdoor	day	0.500	245.00	122.50	L-13
			b) Material					
			Perforated geosynthetic pipe 150 mm dia	metre	1.000	250.00	250.00	M-134
			Geotextile filter fabric	sqm	1.250	75.00	93.75	M-109
			Add 2 per cent cost of material for miscellaneous item like synthetic cord				6.88	
			c) Overhead charges @ 10%				54.54	
			d) Contractor's profit @ 10%				59.99	
			Rate per metre				659.90	
						say	*660.00*	
		Note	Surplus excavated material to be used at site. Hence Separate cost for disposal not added.					
7.3	703		Laying Paving Fabric Beneath a Pavement Overlay					
			Providing and laying paving fabric with physical requirements as per table 704-2 over a tack coat of paving grade Bitumen 80-100 penetration, laid at the rate of 1 kg per sqm over thoroughly cleaned and repaired surface to provide a water resistant membrane and crack retarding layer. Paving fabric to be free of wrinkling and folding and to be laid before cooling of tack coat, brooming and rolling of surface with pneumatic roller to maximise paving fabric contact with pavement surface					
			Unit = sqm					
			Taking output = 2800 sqm					
			a) Labour					
			Mate	day	0.800	275.00	220.00	L-12
			Mazdoor	day	20.000	245.00	4900.00	L-13
			b) Machinery					
			Road sweeper 1250 sqm per hour	hour	2.240	276.00	618.24	P&M-031
			Pneumatic roller 14 tonnes 2000 sqm per hour	hour	1.400	922.00	1290.80	P&M-037
			Bitumen pressure distributor 1750 sqm per hour	hour	1.680	593.00	996.24	P&M-004
			c) Material					
			Paving Fabric	sqm	2940.000	103.00	302820.00	M-133
			Paving Bitumen 80-100	tonne	2.800	50351.34	140983.74	M-075
			c) Overhead charges @ 10%				45182.90	
			d) Contractor's profit @ 10%				49701.19	
			Cost for 2800 sqm				546713.11	
			Rate per sqm				195.25	
						say	*195.00*	
7.4	704		Laying Boulder Apron in Crates of Synthetic Geogrids					
			Providing, preparing and laying of geogrid crated apron 1 m x 5 m, 600 mm thick including excavation and backfilling with baffles at 1 metre interval, made with geogrids having characteristics as per clause 704.2, joining sides with connectors/ring staples, top corners to be tie tensioned, placing of suitable cross interval ties in layers of 300 mm connecting opposite side with lateral braces and tied with polymer braids to avoid bulging, constructed as per clause 704.3. filled with stone with minimum size of 200 mm and specific gravity not less than 2.65, packed with stone spalls, keyed to the foundation recess in case of sloping ground and laid over a layer of geotextile to prevent migration of fines, all as per clause 704 and laid as per clause 2503.3 and approved design					
			Unit = cum					
			Taking output = 3.00 cum					
			a) Labour					
			Mate	day	0.060	275.00	16.50	L-12
			Mazdoor skilled	day	0.500	245.00	122.50	L-15
			Mazdoor	day	1.500	245.00	367.50	L-13
			b) Material					
			Geo grids	sqm	21.000	103.00	2163.00	M-105
			Connectors/ Staples	each	50.000	5.00	250.00	M-085
			Polymer braids	metre	20.000	20.00	400.00	M-140
			Stones with minimum size of 200 mm	cum	3.450	799.52	2758.34	M-003

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Stones spall for filling voids	cum	0.450	974.52	438.53	M-008
			c) Overhead charges @ 10%				651.64	
			d) Contractor's profit @ 10%				716.80	
			Cost for 3 cum = a+b+c+d				7884.82	
			Rate per cum = (a+b+c+d)/ 3				606.52	
						say	607.00	
7.5	3100		Reinforced Earth Structures					
			Reinforced earth Structures have four main components as under:					
			a) Excavation for foundation, foundation concrete and cement concrete grooved seating in the foundation for facing elements (facia material).					
			b) Facia material and its placement.					
			c) Assembling, joining with facing elements and laying of the reinforcing elements.					
			d) Earth fill with granular material which is to be retained by the wall.					
			Each component is analysed separately as under:					
			considering Average height of wall = 8 m.					
7.5	3102	(i)	Assembling, joining and laying of reinforcing elements.					
		A	With reinforcing element of steel / Aluminium strips / polymeric strips.					
			Unit = Running Metre					
			Taking Output = 450 m					
			a) Labour					
			Mate	day	0.360	275.00	99.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			Mazdoor skilled	day	3.000	245.00	735.00	L-15
			b) Material					
			@ Reinforcement strips 60 mm wide 5 mm thick as per clause 3102.					
			1.Galvanised carbon steel strips	metre	495.000	300.00	148500.00	M-154
			or					
			2.Copper Strips	metre	495.000	input	#VALUE!	M-153
			or					
			3.Aluminium Strips	metre	450*1.1	input	#VALUE!	M-157
			or					
			4.Stainless steel strips	metre	450*1.1	input	#VALUE!	M-156
			or					
			5.Glass reinforced polymer/fibre reinforced polymer/polymeric strips	metre	450*1.1	input	#VALUE!	M-155
			@ Any one of the above alternative may be adopted as per approved design.					
			Add 10 per cent of the cost of reinforcing strip towards accessories like tie-strips, nuts and bolts and loops/lugs for joining reinforcing elements with the facia pannels, overlaps, heat bonding or extension.					
		Type 1	1.Galvanised carbon steel strips					
			c) Overhead charges @ 0.15 on (a+b)				22620.60	
			d) Contractor's profit @ 0.1 on (a+b+c)				15080.40	
			Cost of 450 m = a+b+c+d				188505.00	
			Rate per metre =(a+b+c+d)/450				418.90	
						say	419.00	
		Type 2	2.Copper Strips					
			c) Overhead charges @ 0.15 on (a+b)				#VALUE!	
			d) Contractor's profit @ 0.1 on (a+b+c)				#VALUE!	
			Cost of 450 m = a+b+c+d				#VALUE!	
			Rate per metre =(a+b+c+d)/450				#VALUE!	
						say	#VALUE!	
		Type 3	3.Aluminium Strips					
			c) Overhead charges @ 0.15 on (a+b)				#VALUE!	
			d) Contractor's profit @ 0.1 on (a+b+c)				#VALUE!	
			Cost of 450 m = a+b+c+d				#VALUE!	
			Rate per metre =(a+b+c+d)/450				#VALUE!	
						say	#VALUE!	
		Type 4	4.Stainless steel strips					
			c) Overhead charges @ 0.15 on (a+b)				#VALUE!	
			d) Contractor's profit @ 0.1 on (a+b+c)				#VALUE!	
			Cost of 450 m = a+b+c+d				#VALUE!	
			Rate per metre =(a+b+c+d)/450				#VALUE!	
						say	#VALUE!	
		Type 5	5.Glass reinforced polymer/fibre reinforced polymer/polymeric strips					
			c) Overhead charges @ 0.15 on (a+b)				#VALUE!	
			d) Contractor's profit @ 0.1 on (a+b+c)				#VALUE!	
			Cost of 450 m = a+b+c+d				#VALUE!	
			Rate per metre =(a+b+c+d)/450				#VALUE!	
						say	#VALUE!	
7.5(i)		B	With reinforcing elements of synthetic geogrids					
			Unit = sqm					
			Taking output = 300 sqm					
			a) Labour					
			Mate	day	0.360	275.00	99.00	L-12
			Mazdoor	day	6.000	245.00	1470.00	L-13
			Mazdoor skilled	day	3.000	245.00	735.00	L-15
			b) Material					
			Synthetic Geogrids as per clause 3102.8 and approved design and specifications.	sqm	300.000	103.00	30900.00	M-181
			Add 10 per cent of the cost of reinforcing elements (synthetic geogrids) for accessories like tie-strips, nuts and bolts and loops/lugs for joining reinforcing elements with the facia pannels, overlaps and other protective elements for synthetic geogrids.				3090.00	
			c) Overhead charges @ 10%				3629.40	
			d) Contractor's profit @ 10%				3992.34	
			Cost of 300 sqm of Synthetic geogrids				43915.74	
			Rate per sqm				146.39	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
						say	*146.00*	
7.5	3104	(ii)	Facing elements of RCC					
			Unit = sqm					
			Taking output = 75 sqm					
			a) Labour					
			Mate	day	0.180	275.00	49.50	L-12
			Mazdoor	day	3.000	245.00	735.00	L-13
			Mazdoor skilled	day	1.500	245.00	367.50	L-15
			b) Machinery					
			Light crane with lifting capacity upto 3 tonne	hour	6.000	241.00	1446.00	P&M-013
			c) Material					
			Pre-cast RCC M-35 facing elements of size as per design and 18 cm thick for 75 sqm. (Refer Item 12.8 (H))	cu.m	13.500	5187.72	70034.22	Item 12.8 (H)
			HYSD steel @ 5 kg / sqm (Refer Item 12.6)	tonnes	0.380	49198.00	18695.24	Item 13.6
			Add 2 per cent of cost of facia pannels, for all necessary temporary form work, scaffolding and provision of loops/lugs for lifting of pannels and joining the reinforcing elements.				1774.59	
			d) Overhead charges @ 10%				259.80	
			e) Contractor's profit @ 10%				285.78	
			Cost for 75 sqm				93647.63	
			Rate per sqm				1248.64	
						say	*1249.00*	
		Note	1.The specification and construction details to be adopted shall be as per section 3100 of MoRTH Specification.					
			2.Drainage arrangement shall be made as per approved design and drawings.					
			3.The quantity of filler media shall be calculated as per approved design and specifications and shall be priced separately.The rate for same to be adopted from chapter 15.					
			4.Excavation for foundation including foundation concrete and groove in the foundation for seating of bottom most facia panel and capping beam to be calculated as per design and priced separately. The rates for excavation and foundation concrete shall be taken from the chapter 12 & 13 in bridge section.					
			5.The earth fill to be retained is not included in this analysis. The same is to be worked out and provided separately complete as per clause 305.					
	'		6.For compaction of Earthwork, attention is invited to clause 3105.5 of MoRTH Specification.					
			7.Length of reinforcing strips will vary with the height of wall and will be as per approved design and drawings.					
			8.The type of reinforcing elements to be adopted shall be as per approved design and specifications.					
			9.Supply of moulds for facial panal, design and approval from compentant authourity, supply instal geogrid and supervision charges	Lumsum			2850.00	
			10.The earth fill material shall be clean, free draining, granular with high friction and low cohesion, non-corrosive, coarse grained with not 10 per cent of particles passing 75 micron sieve, free of any deleterious matter, chlorides, salts, acids, alkalies, mineral oil, fungus and microbes and shall be of specified PH value.					
			11.Capping beam is to be priced separately as per approved design. The rate for cement concrete shall be taken from the chapter of sub-structure in bridge section.					
			12.The cost of reinforced earth retaining wall shall include following:					
			(I) Excavation for foundation including backfilling.					
			(ii) Foundation concrete as per approved design.					
			(iii) Cost of facial pannels and their erection .					
			(iv) Cost of reinforcing elements including their fixing and joining with the facial pannels.					
			(v) Drainage arrangement including filter media as per approved design and drawings.					
			13. The compacted earth filling to be retained shall form part of embankment.					
			Total Per Sqm				4099.00	

CHAPTER-8								
TRAFFIC SIGNS, MARKINGS & OTHER ROAD APPURTENANCES								
Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
8.1	408		Cast in Situ Cement Concrete M20 Kerb					
			Construction of cement concrete kerb with top and bottom width 115 and 165 mm respectively, 250 mm high in M 20 grade PCC on M-10 grade foundation 150 mm thick, foundation having 50 mm projection beyond kerb stone, kerb stone laid with kerb laying machine, foundation concrete laid manually, all complete as per clause 408					
			Unit = Running metre					
			Taking output = 360 metre					
		A.	Using Concrete Mixer					
			Cement Concrete					
			Cement concrete of grade M20 = 12.60 cum					
			Cement concrete of grade M10 for base= 11.61 cum					
			Total Concrete = 24.21 cu.m					
			a) Labour					
			Mate	day	0.720	275.00	198.00	L-12
			Mason	day	2.000	245.00	490.00	L-11
			Mazdoor	day	16.000	245.00	3920.00	L-13
			b) Machinery					
			Kerb casting machine @ 60 metres/hour	hour	6.000	250.00	1500.00	P&M-029
			Concrete mixer 0.48/0.28 cum capacity	hour	12.000	172.00	2064.00	P&M-009
			Water tanker6 KL capacity	hour	5.000	374.00	1870.00	P&M-060
			c) Material					
			Crushed stone aggregate 20 mm nominal size 59 per cent	cum	21.790	874.52	19055.79	M-053
			Coarse sand 30 per cent	cum	10.900	1184.68	12913.01	M-005
			Cement 11 per cent	tonne	5.700	7598.00	43308.60	M-081
			Cost of water	KL	30.000	30.00	900.00	M-189
			d) Overhead charges @ 10%				8621.94	
			e) Contractor's profit @ 10%				9484.13	
			Cost for 360 meter				104325.48	
			Rate per metre				289.79	
						say	*290.00*	
		B	Using Concrete Batching and Mixing Plant					
			Cement Concrete					
			Cement concrete of grade M20 = 12.60 cum					
			Cement concrete of grade M10 for base = 11.61 cum					
			Total Concrete = 24.21 cu.m					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Mason	day	1.000	245.00	245.00	L-11
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Kerb casting machine @ 60 metres/hour	hour	6.000	250.00	1500.00	P&M-029
			Concrete batching and mixing plant @ 15 cum/hr.	hour	1.600	1656.00	2649.60	P&M-003
			Water tanker6 KL capacity	hour	5.000	374.00	1870.00	P&M-060
			Tipper 5.5 cum capacity	hour	6.000	240.00	1440.00	P&M-048
			c) Material					
			Crushed stone aggregate 20 mm nominal size 59 per cent	cum	21.790	874.52	19055.79	M-053
			Coarse sand 30 per cent	cum	10.900	1184.68	12913.01	M-004
			Cement 11 per cent	tonne	5.700	7598.00	43308.60	M-081
			Cost of water	KL	30.000	30.00	900.00	M-189
			d) Overhead charges @ 10%				8440.50	
			e) Contractor's profit @ 10%				9284.55	
			Cost for 360 meter				102130.05	
			Rate per metre				283.69	
						say	*284.00*	
8.2	408		Cast in Situ Cement Concrete M 20 Kerb with Channel					
			Construction of cement concrete kerb with channel with top and bottom width 115 and 165 mm respectively, 250 mm high in M 20 grade PCC on M10 grade foundation 150 mm thick, kerb channel 300 mm wide, 50 mm thick in PCCM20 grade, sloped towards the kerb, kerb stone with channel laid with kerb laying machine, foundation concrete laid manually, all complete as per clause 408					
		A	Using Concrete Mixer					
			Unit = Running metre					
			Taking output = 300 metre length					
			Cement Concrete					
			Cement concrete of grade M20= 17.48 cum					
			Cement concrete of grade M10 for base = 23.18 cum					
			Total Concrete = 40.66 cum					
			a) Labour					
			Mate	day	0.720	275.00	198.00	L-12
			Mason	day	2.000	245.00	490.00	L-11
			Mazdoor	day	16.000	245.00	3920.00	L-13
			b) Machinery					
			Kerb casting machine @ 50 metres/hour for laying kerb and channel	hour	6.000	250.00	1500.00	P&M-029
			Concrete mixer 0.48/0.28	hour	16.000	172.00	2752.00	P&M-009
			Water tanker6 KL capacity	hour	6.000	374.00	2244.00	P&M-060
			c) Material					
			Crushed stone aggregate 20 mm nominal size 60 per cent	cum	36.590	874.52	31998.69	M-053
			Coarse sand 30 per cent	cum	18.300	1184.68	21679.64	M-005
			Cement 10 per cent	tonne	9.010	7598.00	68457.98	M-081
			Cost of water	KL	36.000	30.00	1080.00	M-189
			d) Overhead charges @ 10%				13432.03	
			e) Contractor's profit @ 10%				14775.23	
			Cost for 360 meter				162527.58	
			Rate per metre				541.76	
						say	*542.00*	
8.2		B	Using Concrete Batching and Mixing Plant					
			Unit = Running metre					
			Taking output = 300 metre length					
			Cement Concrete					
			Cement concrete of grade M20= 17.48 cum					
			Cement concrete of grade M10 for base = 23.18 cum					
			Total Concrete = 40.66 cum					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Mason	day	1.000	245.00	245.00	L-11

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Kerb casting machine @ 50 metres/hour for laying kerb and channel	hour	6.000	250.00	1500.00	P&M-029
			Concrete batching and mixing plant @ 15 cum/hr.	hour	2.700	1656.00	4471.20	P&M-003
			Water tanker6 KL capacity	hour	6.000	374.00	2244.00	P&M-060
			Tipper of 5.5 cum capacity	hour	6.000	240.00	1440.00	P&M-048
			c) Material					
			Crushed stone aggregate 20 mm nominal size 60 per cent	cum	36.590	874.52	31998.69	M-053
			Coarse sand 30 per cent	cum	18.300	1184.68	21679.64	M-004
			Cement 10 per cent	tonne	9.010	7598.00	68457.98	M-081
			Cost of water	KL	36.000	30.00	1080.00	M-189
			d) Overhead charges @ 10%				13363.95	
			e) Contractor's profit @ 10%				14700.35	
			Cost for 300 meter				161703.81	
			Rate per metre				539.01	
						say	539.00	
8.3	801		Printing New Letter and Figures of any Shade					
			Printing new letter and figures of any shade with synthetic enamel paint black or any other approved colour to give an even shade					
		(i)	Hindi (Matras commas and the like not to be measured and paid for Half letter shall be counted as half)					
			Details for 100 letters of 16 cm height i.e. 1600 cm					
			Unit = per cm height per letter					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Painter	day	2.000	250.00	500.00	L-18
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Material					
			Paint	Litre	0.700	204.00	142.80	M-131
			d) Overhead charges @ 10%				92.08	
			e) Contractor's profit @ 10%				101.29	
			Cost for 1600 cm				1114.17	
			Rate per cm height per letter				0.70	
						say	0.70	
8.3		(ii)	English and Roman					
			Hyphens and the like not to be measured and paid for					
			Detail for 100 letters of 16 cm height. i.e.1600 cm					
			Unit = per cm height per letter					
			a) Labour					
			Mate	day	0.070	275.00	19.25	L-12
			Painter lst class	day	1.250	250.00	312.50	L-18
			Mazdoor	day	0.500	245.00	122.50	L-13
			b) Material					
			Paint	Litre	0.500	204.00	102.00	M-131
			d) Overhead charges @ 10%				55.63	
			e) Contractor's profit @ 10%				61.19	
			Cost for 1600 cm				673.06	
			Rate per cm height per letter				0.42	
						say	0.40	
8.4	801		Retro-Reflectorised Traffic Signs					
			Providing and fixing of retro- reflectorised cautionary, mandatory and informatory sign as per IRC :67 made of high intensity grade sheeting vide clause 801.3, fixed over aluminium sheeting, 1.5 mm thick supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm firmly fixed to the ground by means of properly designed foundation with M15 grade cement concrete 45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing					
			Unit = Each					
			Taking output = one traffic sign					
			i) Excavation for foundation	cum	0.216	248.00	53.57	Item No. 3.13
			ii) Cement concrete M15 grade	cum	0.120	5690.00	682.80	Item 12.8 (A)
			iii) Painting angle iron post two coats	sqm	0.430	56.00	24.08	Item 8.9
			a) Labour (For fixing at site)					
			Mate	day	0.010	275.00	2.75	L-12
			Mazdoor	day	0.250	245.00	61.25	L-13
			b) Material					
			Mild steel angle iron 75 x 75 x 6 mm	kg	19.000	51.20	972.76	M-179 /1000
			Aluminium sheeting fixed with encapsulated lens type reflective sheeting of size including lettering and signs as applicable					
			Add 2 per cent of cost of angle iron towards cost of drilling holes, nuts, bolts etc.					
		(i)	90 cm equilateral triangle	sqm	0.350	5610.00	1963.50	M-061
			or					
		(ii)	60 cm equilateral triangle	sqm	0.156	5610.00	875.16	M-061
			or					
		(iii)	60 cm circular	sqm	0.283	5610.00	1587.63	M-061
			or					
		(iv)	80 mm x 60 mm rectangular	sqm	0.480	5610.00	2692.80	M-061
			or					
		(v)	60 cm x 45 cm rectangular	sqm	0.270	5610.00	1514.70	M-061
			or					
		(vi)	60 cm x 60 cm square	sqm	0.360	5610.00	2019.60	M-061
			or					
		(vii)	90 cm high octagon	sqm	0.672	5610.00	3769.92	M-061
			c) Machinery					
			Tractor-trolley	hour	0.010	250.00	2.50	P&M-053
		(i)	90 cm equilateral triangle					
			d) Overhead charges @ 10%				300.28	
			e) Contractor's profit @ 10%				330.30	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Rate per traffic sign = (i+ii+iii+a+b+c+d+e)				4393.79	
						say	4394.00	
		(ii)	60 cm equilateral triangle					
			d) Overhead charges @ 10%				287.16	
			e) Contractor's profit @ 10%				220.16	
			Rate per traffic sign = (i+ii+iii+a+b+c+d+e)				3182.19	
						say	3182.00	
		(iii)	60 cm circular					
			d) Overhead charges @ 10%				394.03	
			e) Contractor's profit @ 10%				302.09	
			Rate per traffic sign = (i+ii+iii+a+b+c+d+e)				4083.47	
						say	4083.00	
		(iv)	80 mm x 60 mm rectangular					
			d) Overhead charges @ 10%				559.81	
			e) Contractor's profit @ 10%				429.19	
			Rate per traffic sign = (i+ii+iii+a+b+c+d+e)				5481.51	
						say	5482.00	
		(v)	60 cm x 45 cm rectangular					
			d) Overhead charges @ 10%				383.09	
			e) Contractor's profit @ 10%				293.71	
			Rate per traffic sign = (i+ii+iii+a+b+c+d+e)				3991.21	
						say	3991.00	
		(vi)	60 cm x 60 cm square					
			d) Overhead charges @ 10%				458.83	
			e) Contractor's profit @ 10%				351.77	
			Rate per traffic sign = (i+ii+iii+a+b+c+d+e)				4629.91	
						say	4630.00	
		(vii)	90 cm high octagon					
			d) Overhead charges @ 10%				721.38	
			e) Contractor's profit @ 10%				553.06	
			Rate per traffic sign = (i+ii+iii+a+b+c+d+e)				6844.06	
						say	6844.00	
		Note	1.Any one area of aluminium sheeting given at (i) to (vii) may be adopted as per site requirement and in accordance with IRC : 67					
			2.Rate for excavation, cement concrete M-15 and painting may be taken from respective chapters					
			3. The depth of foundation and quantity of cement concrete in the foundation are indicative. These may be increased for areas having higher wind velocities like in coastal areas. This is applicable to all road signs and directions boards.					
8.5	801		Direction and Place Identification Signs upto 0.9 sqm Size Board.					
			Providing and erecting direction and place identification retro reflectorised sign as per IRC:67 made of high intensity grade sheeting vide clause 801.3, fixed over aluminium sheeting, 2 mm thick with area not exceeding 0.9 sqm supported on a mild steel single angle iron post 75 x 75 x 6 mm firmly fixed to the ground by means of properly designed foundation with M15 grade cement concrete 45 x 45 x 60 cm, 60 cm below ground level as per approved drawing					
			Unit = sqm					
			Taking output = 0.9 sqm					
			i) Excavation for foundation	cum	0.216	248.00	53.57	Item No. 3.13
			ii) Cement concrete M15 grade	cum	0.120	5690.00	682.80	Item 12.8 (A)
			iii) Painting angle iron post two coats	sqm	0.430	56.00	24.08	Item 8.9
			a) Labour (For fixing at site)					
			Mate	day	0.010	275.00	2.75	L-12
			Mazdoor	day	0.200	245.00	49.00	L-13
			b) Material					
			Mild steel angle iron 75 mm x 75 mm x 6 mm,2.85 metres long	kg	19.000	51.20	972.76	M-179 /1000
			Aluminium sheeting fixed with encapsulated lens type reflective sheeting of size 0.9 sqm	sqm	0.900	8000.00	7200.00	M-061
			Add 2 per cent of cost of materials for drilling holes, nuts, bolts, fabrication etc.					
			c) Machinery					
			Tractor-trolley	hour	0.020	280.00	5.60	P&M-053
			d) Overhead charges @ 10%				823.01	
			e) Contractor's profit @ 10%				905.31	
			Cost for 0.9 sqm				10718.88	
			Rate per sqm (for sign having area upto 0.9 sqm)				11909.87	
						say	11910.00	
		Note	I) Lettering and arrow marks on sign board to be provided separately as per actual requirement. Rates for these items have been analysed separately					
			ii) Rate for excavation, cement concrete M-15 and painting may be taken from respective chapters					
8.6	801		Direction and Place Identification Signs with size more than 0.9 sqm size Board.					
			Providing and erecting direction and place identification retro reflectorised sign as per IRC :67 made of high intensity grade sheeting vide clause 801.3, fixed over aluminium sheeting, 2 mm thick with area exceeding 0.9 sqm supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm, 2 Nos. firmly fixed to the ground by means of properly designed foundation with M 15 grade cement concrete45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing					
			Unit = sqm					
			Taking output = 1.50 sqm					
			i) Excavation for foundation	cum	0.430	248.00	106.64	Item No. 3.13
			ii) Cement concrete M15 grade	cum	0.240	5690.00	1365.60	Item 12.8 (A)
			iii) Painting angle iron post 2 coats	sqm	0.860	56.00	48.16	Item 8.9
			a) Labour (For fixing at site)					
			Mate	day	0.010	275.00	2.75	L-12

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mazdoor	day	0.300	245.00	73.50	L-13
			b) Material					
			Mild steel angle iron 75 mm x 75 mm x 6 mm, 2.85 metres long, 2 nos	kg	38.000	51.20	1945.52	M-179 /1000
			Aluminium sheeting fixed with encapsulated lens type reflective sheeting	sqm	1.500	8000.00	12000.00	M-061
			Add 2 per cent of cost of materials for drilling holes, nuts, bolts, fabrication etc.					
			c) Machinery					
			Tractor-trolley	hour	0.020	280.00	5.60	P&M-053
			d) Overhead charges @ 10%				1395.11	
			e) Contractor's profit @ 10%				1542.25	
			Cost for 1.5 sqm				18485.14	
			Rate per sqm (for sign having area more than 0.9 sqm)				20539.04	
						say	20539.00	
		Note	i) Lettering and arrow marks on sign board to be provided separately as per actual requirement. Rates for these items have been analysed separately					
			ii) Rate for excavation, cement concrete M-15 and painting may be taken from respective chapters					
8.7	802		Overhead Signs					
			Providing and erecting overhead signs with a corrosion resistant 2mm thick aluminium alloy sheet reflectorised with high intensity retro-reflective sheeting of encapsulated lense type with vertical and lateral clearance given in clause 802.2 and 802.3 and installed as per clause 802.7 over a designed support system of aluminium alloy or galvanised steel trestles and trusses of sections and type as per structural design requirements and approved plans					
		A	Truss and Vertical Support					
			Unit = tonne					
			Taking output = 1 tonne					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Blacksmith	day	2.000	245.00	490.00	L-02
			Mazdoor including for handling & fixing at site.	day	4.000	245.00	980.00	L-13
			b) Material					
			Aluminium alloy/galvanised steel including 5 per cent wastage	tonne	1.050	50000.00	52500.00	M-060
			Add 1 per cent on cost of material for nuts, bolts and drilling and welding consumables				525.00	
			Add 15 per cent on cost of material for fabrication of trusses as per approved design				7953.75	
			c) Machinery					
			Crane 3 tonne capacity	hour	3.000	241.00	723.00	P&M-013
			Truck	hour	0.500	225.00	112.50	P&M-057
			d) Overhead charges @ 10%				6335.03	
			e) Contractor's profit @ 10%				6968.53	
			Rate per tonne				76653.80	
						say	76654.00	
8.7		B	Aluminium Alloy Plate for Over Head Sign					
			Unit = sqm					
			Taking output = 1 sqm					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Blacksmith	day	0.100	245.00	24.50	L-02
			Mazdoor	day	0.150	245.00	36.75	L-13
			b) Material					
			Aluminium alloy plate,2 mm thick, fixed with high intensity grade sheeting vide clause 801.3	sqm	1.000	2600.00	2600.00	M-059
			Miscellaneous					
			Add 1 per cent of cost of labour for lifting arrangement, like ladders, pulleys, ropes etc				0.67	
			c) Overhead charges @ 10%				266.74	
			d) Contractor's profit @ 10%				293.42	
			Rate per sqm				3227.58	
						say	3228.00	
		Note	1. The cost of excavation and foundation concrete for fixing of vertical support system to be worked out separately as per the approved drawing/design and to be included in the estimate.					
			2. Lettering and arrow marks on sign board to be provided separately as per actual requirement. Rates for these items have been included separately in this chapter.					
8.8	803		Painting Two Coats on New Concrete Surfaces					
			Painting two coats after filling the surface with synthetic enamel paint in all shades on new plastered concrete surfaces					
			Unit = sqm					
			Taking output = 40 sqm					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Painter	day	2.000	250.00	500.00	L-18
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Material					
			Paint conforming to requirement of clause 803.3.	Litre	6.000	204.00	1224.00	M-132
			Add for scaffolding @ 1 per cent of labour cost where required				12.24	
			Add @ 5 per cent cost of labour and materials to prepare the surface by filling minuts roughness on the surface and priming the surface before laying 2 coats of painting.				100.10	
			c) Overhead charges @ 10%				211.43	
			d) Contractor's profit @ 10%				232.58	
			Cost for 40 sqm				2558.35	
			Rate per sqm				63.96	
						say	64.00	
8.9	803		Painting on Steel Surfaces					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Providing and applying two coats of ready mix paint of approved brand on steel surface after through cleaning of surface to give an even shade					
			Unit = sqm					
			Taking output = 10 sqm					
			a) Labour					
			Mate	day	0.030	275.00	8.25	L-12
			Painter	day	0.450	250.00	112.50	L-18
			Mazdoor	day	0.250	245.00	61.25	L-13
			b) Material					
			Paint ready mixed approved brand.	Litre	1.250	204.00	255.00	M-131
			Add @ 1 per cent on cost of material for scaffolding				2.55	
			Add @ 5 per cent cost of labour and materials to prepare the surface by filling minuts roughness on the surface and priming the surface before laying 2 coats of painting.				21.85	
			c) Overhead charges @ 10%				46.14	
			d) Contractor's profit @ 10%				50.75	
			Cost for 10 sqm				558.29	
			Rate per sqm				55.83	
						say	*56.00*	
8.10	803		Painting on Wood Surfaces					
			Providing and applying two coats of ready mix paint of approved brand on wood surface after thorough cleaning of surface to give an even shade					
			Unit = sqm					
			Taking output = 10 sqm					
			a) Labour					
			Mate	day	0.030	275.00	8.25	L-12
			Painter	day	0.500	250.00	125.00	L-18
			Mazdoor	day	0.200	245.00	49.00	L-13
			b) Material					
			Paint ready mixed of approved brand.	Litre	1.500	204.00	306.00	M-131
			Add @ 1 per cent on cost of material for scaffolding				3.06	
			Add @ 5 per cent cost of labour and materials to prepare the surface by filling minuts roughness on the surface and priming the surface before laying 2 coats of painting.				24.41	
			c) Overhead charges @ 10%				51.57	
			d) Contractor's profit @ 10%				56.73	
			Cost for 10 sqm				624.02	
			Rate per sqm				62.40	
						say	*62.00*	
8.11	803		Painting Lines, Dashes, Arrows etc on Roads in Two Coats on New Work					
			Painting lines, dashes, arrows etc on roads in two coats on new work with ready mixed road marking paint conforming to IS:164 on bituminous surface, including cleaning the surface of all dirt, dust and other foreign matter, demarcation at site and traffic control					
		(i)	Over 10 cm in width					
			Unit = sqm					
			Taking output = 10 sqm					
			a) Labour					
			Mate	day	0.090	275.00	24.75	L-12
			Painter	day	0.550	250.00	137.50	L-18
			Mazdoor	day	1.550	245.00	379.75	L-13
			b) Material					
			Road marking Paint as per IS :164	Litre	1.480	326.00	482.48	M-132
			c) Overhead charges @ 10%				102.45	
			d) Contractor's profit @ 10%				112.69	
			Cost for 10 sqm				1239.62	
			Rate per sqm				123.96	
						say	*124.00*	
8.11		(ii)	Up to 10 cm in width					
			Unit = sqm					
			Taking output = 10 sqm					
			a) Labour					
			Mate	day	0.070	275.00	19.25	L-12
			Painter	day	0.350	250.00	87.50	L-18
			Mazdoor	day	1.350	245.00	330.75	L-13
			b) Material					
			Road marking paint	Litre	1.480	326.00	482.48	M-132
			c) Overhead charges @ 10%				92.00	
			d) Contractor's profit @ 10%				101.20	
			Cost for 10 sqm				1113.18	
			Rate per sqm				111.32	
						say	*111.00*	
8.12	803		Painting Lines, Dashes, Arrows etc on Roads in Two Coats on Old Work					
			Painting lines, dashes, arrows etc on roads in two coats on old work with ready mixed road marking paint conforming to IS: 164 on bituminous surface, including cleaning the surface of all dirt, dust and other foreign matter, demarcation at site and traffic control					
		(i)	Over 10 cm in width					
			Unit = sqm					
			Taking output = 10 sqm					
			a) Labour					
			Mate	day	0.060	275.00	16.50	L-12
			Painter Ist class	day	0.300	250.00	75.00	L-18
			Mazdoor	day	1.250	245.00	306.25	L-13
			b) Material					
			Road marking paint	Litre	0.900	326.00	293.40	M-132
			c) Overhead charges @ 10%				69.12	
			d) Contractor's profit @ 10%				76.03	
			Cost for 10 sqm				836.29	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Rate per sqm				83.63	
						say	84.00	
8.12		(ii)	Up to 10 cm in width					
			Unit = sqm					
			Taking output = 10 sqm					
			a) Labour					
			Mate	day	0.070	275.00	19.25	L-12
			Painter Ist class	day	0.350	250.00	87.50	L-18
			Mazdoor	day	1.350	245.00	330.75	L-13
			b) Material					
			Road marking Paint	Litre	0.900	326.00	293.40	M-132
			c) Overhead charges @ 10%				73.09	
			d) Contractor's profit @ 10%				80.40	
			Cost for 10 sqm				884.39	
			Rate per sqm				88.44	
						say	88.00	
8.13	803		Road Marking with Hot Applied Thermoplastic Compound with Reflectorising Glass Beads on Bituminous Surface					
			Providing and laying of hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250 gms per sqm area, thickness of 2.5 mm is exclusive of surface applied glass beads as per IRC:35 .The finished surface to be level, uniform and free from streaks and holes.					
			Unit = sqm					
			Taking output = 600 sqm					
			a) Labour					
			Mate	day	0.030	275.00	8.25	L-12
			Mazdoor	day	0.750	245.00	183.75	L-13
			b) Machinery					
			Road marking machine @ 60 sqm per hour	hour	10.000	60.00	600.00	P&M-043
			Tractor-trolley	hour	0.500	280.00	140.00	P&M-053
			c) Material					
			Hot applied thermoplastic compound	Litre	1500.000	100.00	150000.00	M-118
			Reflectorising glass beads	kg	150.000	50.00	7500.00	M-152
			d) Overhead charges @ 10%				15843.20	
			e) Contractor's profit @ 10%				17427.52	
			Cost for 600 sqm				191702.72	
			Rate per sqm				319.50	
						say	320.00	
		Note	1. A sealing primer may be applied in advance on cement concrete pavement to ensure proper bonding. Any laitance and/or curing compound to be removed where paint is required to be applied on concrete surface.					
			2.Cost of painter is already included in hire charges of road marking machine.					
8.14	804		Kilometre Stone					
			Reinforced cement concrete M15grade kilometre stone of standard design as per IRC:8-1980, fixing in position including painting and printing etc					
		(i)	5th kilometre stone (precast)					
			Unit = Nos.					
			Taking output = 6 Nos.					
			a) M-15 grade of concrete	cum	2.350	5690.00	13371.50	Item 12.8 (A)
			b) Steel reinforcement @ 5 kg per sqm	kg	22.080	71.42	1577.02	Item 13.6 /1000
			c) Excavation in soil for foundation	cum	1.680	248.00	416.64	Item No. 3.13
			d) Painting two coats on concrete surface	sqm	9.850	204.00	2009.40	Item 8.8
			e) Lettering on km post (average 30 letters of 10 cm height each)	per cm per letter	1800.000	0.40	720.00	Item 8.3
			Transportation and fixing					
			f) Labour					
			Mate	day	0.260	275.00	71.50	L-12
			Mason	day	0.600	245.00	147.00	L-11
			Mazdoor including loading/unloading	day	6.000	245.00	1470.00	L-13
			g) Machinery					
			Tractor-trolley	hour	6.000	280.00	1680.00	P&M-053
			h) Overhead charges @ 10%				336.85	
			i) Contractor's profit @ 10%				370.54	
			Cost for 6 Nos. 5th km stone				22170.44	
			Rate for each 5th km stone				3695.07	
						say	3695.00	
8.14		(ii)	Ordinary kilometer stone (precast)					
			Unit = Nos.					
			Taking output = 14 Nos.					
			a) M-15 grade of concrete	cum	3.770	5690.00	21451.30	Item 12.8 (A)
			b) Steel reinforcement @ 5 kg per sqm	kg	26.320	71.42	1879.85	Item 13.6 /1000
			c) Excavation in soil for foundation	cum	2.770	248.00	686.96	Item No. 3.13
			d) Painting two coats on concrete surface	sqm	11.410	204.00	2327.64	Item 8.8
			e) Lettering on km post (average 12 letters of 10 cm height each)	per cm per letter	1680.000	0.40	672.00	Item 8.3
			Transportation and fixing					
			f) Labour					
			Mate	day	0.320	275.00	88.00	L-12
			Mason	day	1.000	245.00	245.00	L-11
			Mazdoor	day	7.000	245.00	1715.00	L-13
			g) Machinery					
			Tractor-trolley	hour	6.000	280.00	1680.00	P&M-053
			h) Overhead charges @ 10%				372.80	
			i) Contractor's profit @ 10%				410.08	
			Cost for 14 Nos. ordinary km stone				31528.63	
			Rate for each ordinary km stone				2252.05	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
						say	*2252.00*	
8.14		(iii)	Hectometer stone (precast)					
			Unit = Nos.					
			Taking output = 33 Nos.					
			a) M-15 grade of concrete	cum	1.580	5690.00	8990.20	Item 12.8 (A)
			b) Steel reinforcement @ 5 kg per sqm	kg	66.000	71.42	4713.92	Item 13.6 /1000
			c) Excavation in soil for foundation	cum	1.390	248.00	344.72	Item No. 3.13
			d) Painting two coats on concrete surface	sqm	6.270	204.00	1279.08	Item 8.8
			e) Lettering on km post (average 1 letter of 10 cm height each)	per cm per letter	330.000	0.40	132.00	Item 8.3
			Transportation and fixing					
			f) Labour					
			Mate	day	0.340	275.00	93.50	L-12
			Mason	day	1.500	245.00	367.50	L-11
			Mazdoor	day	7.000	245.00	1715.00	L-13
			g) Machinery					
			Tractor-trolley	hour	6.000	280.00	1680.00	P&M-053
			h) Overhead charges @ 10%				385.60	
			i) Contractor's profit @ 10%				424.16	
			Cost for 33 Nos. Hectometer stone				20125.68	
			Rate for each Hectometer stone				609.87	
						say	*610.00*	
		Note	The rate for excavation, cement concrete, steel reinforcement, painting and lettering may be taken from respective chapters.					
8.15	805		Road Delineators					
			Supplying and installation of delineators (road way indicators, hazard markers, object markers), 80-100 cm high above ground level, painted black and white in 15 cm wide strips, fitted with 80 x 100 mm rectangular or 75 mm dia circular reflectorised panels at the top, buried or pressed into the ground and conforming toIRC-79 and the drawings.					
			Unit = Each					
			Taking output= 30 Nos.					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor for fixing	day	1.000	245.00	245.00	L-13
			b) Material					
			Cost of approved type of delineators from ISI certified firm as per the standard drawing given in	each	30.000	250.00	7500.00	M-091
			Add 10 per cent cost of material for installation				750.00	
			c) Overhead charges @ 10%				850.60	
			d) Contractor's profit @ 10%				935.66	
			Cost for 30 Nos. delineators				10292.26	
			Rate per delineators				343.08	
						say	*343.00*	
		Note	In case of soft ground, a proper foundation may be provided as per approved design. In case foundation is required to be provided, the items of excavation and foundation concrete are required to be measured and paid separately.					
8.16	806		Boundary pillar					
			Reinforced cement concrete M15 grade boundary pillars of standard design as per IRC:25-1967, fixed in position including finishing and lettering but excluding painting					
			Unit = Each					
			Taking output = 57 Nos.					
			a) M-15 grade of the boundary stone	cum	1.250	5690.00	7112.50	Item 12.8 (A)
			b) Steel reinforcement	kg	79.800	71.42	5699.56	Item 13.6 /1000
			c) Excavation in soil	cum	10.720	248.00	2658.56	Item No. 3.13
			d) Lettering, each 10 cm high	per letter per cm high	2280.000	0.40	912.00	Item 8.3
			Transportation and fixing					
			e) Labour					
			Mate	day	0.570	275.00	156.75	L-12
			Mazdoor	day	14.250	245.00	3491.25	L-13
			f) Machinery					
			Tractor-trolley	hour	6.000	280.00	1680.00	P&M-053
			g) Material					
			Stone spall	cum	11.970	974.52	11665.00	M-008
			h) Overhead charges @ 10%				1699.30	
			i) Contractor's profit @ 10%				1869.23	
			Cost for 57 Nos. boundary pillar				36944.15	
			Rate for each boundary pillar				648.14	
						say	*648.00*	
		Note	In case of soft ground, a proper foundation may be provided as per approved design. In case foundation is required to be provided, the items of excavation and foundation concrete are required to be measured and paid separately.					
8.17	807		G.I Barbed Wire Fencing 1.2 Metre High					
			Providing and fixing 1.2 metres high GI barbed wire fencing with 1.8 m angle iron posts 40 mm x 40 mm x 6 mm placed every 3 metres center to center founded in M15 grade cement concrete, 0.6 metre below ground level, every 15th post, last but one end post and corner post shall be strutted on both sides and end post on one side only and provided with 9 horizontal lines and 2 diagonals interwoven with horizontal wires, fixed with GI staples, turn buckles etc complete as per clause 807					
			Unit = per running metre					
			Taking output = 30 metres					
			a) Labour					
			Mate	day	0.090	275.00	24.75	L-12

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Blacksmith	day	0.250	245.00	61.25	L-02
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Material					
			Barbed wire 335 metres length @ 9.38 kg per 100 metres	kg	31.420	35.00	1099.70	M-063
			MS angle iron 40 mm x 40mm x 6 mm, 23 metres in length @ 3.5 kg per metre	kg	80.500	51.20	4121.44	M-179 /1000
			Add for GI staple binding wire, drilling holes etc. @ 2 per cent of the cost of material				104.42	
			c) Painting					
			Applying two coats of painting on exposed surface of angle iron posts (Rate as per item no. 8.9)	sqm	2.110	56.00	118.16	Item 8.9
			d) Overhead charges @ 10%				590.16	
			e) Contractor's profit @ 10%				649.17	
			Cost for 30 metres fencing				7259.05	
			Rate per metre				241.97	
						say	242.00	
		Note	Cost of excavation for foundation and foundation concrete to be added separately in the cost estimate as per approved design. The rate for these items may be taken from respective chapters.					
8.18	807		G.I Barbed Wire Fencing 1.8 Metre High					
			Providing and fixing 1.8 metres high GI barbed wire fencing with 2.4 m angle iron posts 50 mm x 50 mm x 6 mm placed every 3 metres center to center founded in M15 grade cement concrete, 0.6 metre below ground level, every 15th post, last but one end post and corner post shall be strutted on both sides and end post on one side only and provided with 12 horizontal lines and 2 diagonals interwoven with horizontal wires, fixed with GI staples, turn buckles etc complete as per clause 807					
			Unit = per running metre					
			Taking output = 30 metres					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Blacksmith	day	0.400	245.00	98.00	L-02
			Mazdoor	day	2.500	245.00	612.50	L-13
			b) Material					
			Barbed wire 428 metres length @ 9.38 kg per 100 metres	kg	40.150	35.00	1405.25	M-063
			MS angle iron 50 mm x 50 mm x 6 mm,33.8 metres in length @ 4.5 kg per metre	kg	152.000	51.20	7782.10	M-179 /1000
			Add for GI staple, binding wire, drilling holes etc. @ 2 per cent of the cost of material				183.75	
			c) Painting					
			Applying two coats of painting on exposed surface of angle iron posts	sqm	3.960	56.00	221.76	Item 8.9
			d) Overhead charges @ 10%				1011.46	
			e) Contractor's profit @ 10%				1112.61	
			Cost for 30 metres fencing				12460.42	
			Rate per metre fencing				415.35	
						say	415.00	
		Note	Cost of excavation for foundation and foundation concrete to be added separately in the cost estimate as per approved design. The rate for these items may be taken from respective chapters.					
8.19	Suggestive		Fencing With Welded Steel Wire Fabric 75 mm x 50 mm					
			Providing 1.20 metre high fencing with angle iron posts 50 mm x 50 mm x 6 mm at 3 metre center to center with 0.40 metre embedded in M15 grade cement concrete, corner, end and every 10th post to be strutted, provided with welded steel wire fabric of 75 mm x 50 mm mesh or 75 mm x 25 mm mesh and fixed to iron posts by flat iron 50 x 5 mm and bolts etc. complete in all respects.					
			Unit = Running metre					
			Taking output = 30 m					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Welder	day	1.000	250.00	250.00	L-02
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Material					
			i) Angle iron for posts 50 x 50 x 6 mm	kg	106.000	51.20	5426.99	M-179 /1000
			ii) Runner flat 50 x 5 mm	kg	26.000	51.20	1331.15	M-179 /1000
			iii) Welded steel wire fabric 75x50 mm mesh @ 4 kg/sqm,4 x 30 x 1.2 + 5 per cent wastage	kg	151.000	50.00	7550.00	M-191
			OR					
			Welded steel wire fabric 75 x 25 mm mesh @ 7.75 kg/sqm, 7.75 x 30 x 1.2 + 5 per cent wastage	kg	293.000			
			Add 2.5 per cent of cost of material for drilling holes in angles, flats, splitting angle at bottom, nuts and bolts and welded consumables					
			c) Machinery					
			Tractor-trolley	hour	0.100	280.00	28.00	P&M-053
			d) Painting					
			Painting two coats including priming	sqm	8.000	56.00	448.00	Item 8.9
			e) Overhead charges @ 10%				1510.91	
			f) Contractor's profit @ 10%				1662.00	
			Cost for 30 metre				18730.05	
			Rate per metre				624.34	
						say	624.00	
		Note	i) Adopt any one type of welded steel wire fabric 75 x 50 mm or 75 x 25 mm as per approved design.					
			ii) The item of excavation and cement concrete in foundation shall be measured and paid separately					
8.20	808		Tubular Steel Railing on Medium Weight Steel Channel (ISMC series) 100 mm x 50 mm					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Providing, fixing and erecting 50 mm dia steel pipe railing in 3 rows duly painted on medium weight steel channels (ISMC series) 100 mm x 50 mm, 1.2 metres high above ground, 2 m centre to centre, complete as per approved drawings					
			Unit = Running metre					
			Taking output = 10metres					
			i) Excavation for foundation (6 Nos)6 x 0.6 x 0.6 x 0.6	cum	1.296	248.00	321.41	Item No. 3.13
			ii) Foundation concrete M-15 grade PCC 6 x 0.6 x 0.6 x 0.3	cum	0.648	5690.00	3687.12	Item 12.8 (A)
			iii) Painting of pipe	sqm	4.710	56.00	263.76	Item 8.9
			iv) Painting of channel section 6 nos,1.8 metres each 0.2 x 1.8 x 6 = 2.16	sqm	2.160	56.00	120.96	Item 8.9
			a) Labour (For fixing at site)					
			Mate	day	0.010	275.00	2.75	L-12
			Mazdoor	day	0.250	245.00	61.25	L-13
			Plumber	day	0.010	275.00	2.75	L-02
			b) Material					
			Steel pipe 50 mm external dia as per IS:1239	metre	30.000	55.00	1650.00	M-175
			Medium weight steel channel (ISMC series) 100 mm x 50 mm,10.8 metres length @ 9.2 kg per metre	kg	99.360	34.00	3378.24	M-179 /1000
			Add for drilling holes @ 2 per cent of cost of channels				67.56	
			c) Machinery					
			Tractor-trolley	hour	0.040	280.00	11.20	P&M-053
			d) Overhead charges @ 10%				955.58	
			e) Contractor's profit @ 10%				1051.14	
			Cost for 10 metre				11573.72	
			Rate per metre				1157.37	
						say	*1157.00*	
8.21	808		Tubular Steel Railing on Precast RCC Posts, 1.2 m High Above Ground Level					
			Providing, fencing and erecting 50 mm dia painted steel pipe railing in 3 rows on precast M20 grade RCC vertical posts1.8 metres high (1.2 m above GL) with 3 holes 50 mm dia for pipe, fixed 2 metres centre to, complete as per approved drawing					
			Unit = Running metre					
			Taking output = 10metres					
			i) Excavation for foundation (6 Nos)6 x 0.6 x 0.6 x 0.6	cum	1.296	248.00	321.41	Item No. 3.13
			ii) Foundation concrete M - 15 grade PCC 6 x 0.6 x 0.6 x 0.3	cum	0.648	5690.00	3687.12	Item 12.8 (A)
			iii) RCC M - 20 for pre cast posts 6 nos of 1.8 metres each	cum	0.320	6203.00	1984.96	Item 14.1(A)
			iv) Painting of pipe	sqm	4.710	56.00	263.76	Item 8.9
			a) Labour					
			Mate	day	0.014	275.00	3.85	L-12
			Mazdoor	day	0.350	245.00	85.75	L-13
			Plumber	day	0.010	275.00	2.75	L-02
			b) Material					
			Steel pipe 50 mm dia as per IS:1239	metre	30.000	55.00	1650.00	M-175
			c) Machinery					
			Tractor-trolley	hour	0.250	280.00	70.00	P&M-053
							181.24	
							199.36	
			Cost for 10 metre				8450.19	
			Rate per metre				845.02	
						say	*845.00*	
8.22	809		Reinforced Cement Concrete Crash Barrier					
			Provision of an Reinforced cement concrete crash barrier at the edges of the road, approaches to bridge structures and medians, constructed with M-20 grade concrete with HYSD reinforcement conforming to IRC:21 and dowel bars 25 mm dia, 450 mm long at expansion joints filled with pre-moulded asphalt filler board, keyed to the structure on which it is built and installed as per design given in the enclosure to MOST circular No. RW/NH - 33022/1/94-DO III dated 24 June 1994 as per dimensions in the approved drawing and at locations directed by the Engineer, all as specified					
			Unit = Linear metre					
			Taking output = 10 m					
		(i)	a) M 20 grade concrete					
			M 20 grade concrete	cum	3.000	7085.00	21255.00	Item 14.1(A)
			b) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			c) Material					
			HYSD steel reinforcement including dowel bars	tonne	0.280	49198.00	13775.44	M-082
			Pre-moulded asphalt filler board	sqm	0.320	215.00	68.80	M-144
			d) Overhead charges @ 10%				1410.02	
			e) Contractor's profit @ 10%				1551.03	
			Cost for 10 metre				38316.29	
			Rate per metre				3831.63	
						say	*3832.00*	
		Note	i) Excavation and backfilling are incidental to work and not to be measured separately.					
			ii) Rate for RCC M 20 may be taken from chapter on super structure.					
8.22 A	809		Reinforced Cement Concrete Crash Barrier					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Provision of an Reinforced cement concrete crash barrier at the edges of the road, approaches to bridge structures and medians, constructed with M-40 grade concrete with HYSD reinforcement conforming to IRC:21 and dowel bars 25 mm dia, 450 mm long at expansion joints filled with pre-moulded asphalt filler board, keyed to the structure on which it is built and installed as per design given in the enclosure to MOST circular No. RW/NH - 33022/1/94-DO III dated 24 June 1994 as per dimensions in the approved drawing and at locations directed by the Engineer, all as specified					
			Unit = Linear metre					
			Taking output = 10 m					
		(i)	a) M 40 grade concrete					
			M 40 grade concrete	cum	3.000	8387.00	25161.00	Item 14.1(A)
			b) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			c) Material					
			HYSD steel reinforcement including dowel bars	tonne	0.280	49198.00	13775.44	M-082
			Pre-moulded asphalt filler board	sqm	0.320	215.00	68.80	M-144
			d) Overhead charges @ 10%				1410.02	
			e) Contractor's profit @ 10%				1551.03	
			Cost for 10 metre				42222.29	
			Rate per metre				4222.23	
						say	*4222.00*	
		Note	i) Excavation and backfilling are incidental to work and not to be measured separately.					
			ii) Rate for RCC M 40 may be taken from chapter on super structure.					
8.22 B	809		Reinforced Cement Concrete Crash Barrier with friction slab					
			Provision of an Reinforced cement concrete crash barrier at the edges of the road, approaches to bridge structures and medians, constructed with M-40 grade concrete with HYSD reinforcement conforming to IRC:21 and dowel bars 25 mm dia, 450 mm long at expansion joints filled with pre-moulded asphalt filler board, keyed to the structure on which it is built and installed as per design given in the enclosure to MOST circular No. RW/NH - 33022/1/94-DO III dated 24 June 1994 as per dimensions in the approved drawing and at locations directed by the Engineer, all as specified					
			Unit = Linear metre					
			Taking output = 10 m					
		(i)	a) M 40 grade concrete					
			M 40 grade concrete	cum	6.000	6353.52	38121.12	Item 14.1(A)
			b) Material					
			HYSD steel reinforcement including dowel bars	tonne	0.715	54841.00	39211.32	M-082
			Pre-moulded asphalt filler board	sqm	0.320	215.00	68.80	M-144
			d) Overhead charges @ 10%				3928.01	
			e) Contractor's profit @ 10%				4320.81	
			Cost for 10 metre				85650.06	
			Rate per metre				8565.01	
						say	*8565.00*	
		Note	i) Excavation and backfilling are incidental to work and not to be measured separately.					
			ii) Rate for RCC M 40 may be taken from chapter on super structure.					
8.23	810		Metal Beam Crash Barrier					
	A		Type - A, "W" : Metal Beam Crash Barrier					
			Providing and erecting a "W" metal beam crash barrier comprising of 3 mm thick corrugated sheet metal beam rail, 70 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 1.8 m high, 1.1 m below ground/road level, all steel parts and fitments to be galvanised by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a spacer of channel section 150 x 75 x 5 mm, 330 mm long complete as per clause 810					
			Unit = Running metre					
			Taking output = 4.5 metre length					
			a) Labour					
			Mate	day	0.060	275.00	16.50	L-12
			Blacksmith	day	0.500	245.00	122.50	L-02
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.100	280.00	28.00	P&M-053
			c) Material					
			Corrugated sheet,3 mm thick, "W" beam section railing,4.5 m in length	kg	41.210	45.00	1854.45	M-179 /1000
			Channel post 150 x 75 x 5 mm,1.8 m long,3 Nos @ 16.4 kg per metre	kg	88.560	35.00	3099.60	M-179 /1000
			Spacer 150 x 75 x 5 mm channel 0.33 m long,3 Nos @ 16.4 kg per metre	kg	16.240	34.00	552.16	M-179 /1000
			Nuts and bolts	kg	20.000	37.00	740.00	M-130
			Add 25 per cent of the cost of material for fabrication, nuts, bolts and washers etc.)				1561.55	
			d) Overhead charges @ 10%				821.98	
			e) Contractor's profit @ 10%				904.17	
			Cost for 4.5 metre				9945.91	
			Rate per metre				2210.20	
						say	*2210.00*	
8.23		B	Type - B, "THRIE" : Metal Beam Crash Barrier					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Providing and erecting a "Thrie" metal beam crash barrier comprising of 3 mm thick corrugated sheet metal beam rail, 85 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 2 m high with 1.15 m below ground level, all steel parts and fitments to be galvanised by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a space of channel section 150 x 75 x 5 mm, 546 mm long complete as per clause 810					
			Unit = Running metre					
			Taking output = 4.5 metre length					
			a) Labour					
			Mate	day	0.060	275.00	16.50	L-12
			Blacksmith	day	0.500	245.00	122.50	L-02
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Tractor-trolley	hour	0.100	280.00	28.00	P&M-053
			c) Material					
			Corrugated sheet,3 mm thick, "Thrie" beam section railing,4.5 m in length	kg	72.940	45.00	3282.30	M-088
			Channel post 150 x 75 x 5 mm, 2 m long,3 Nos @ 16.4 kg per metre	kg	98.400	35.00	3444.00	M-179 /1000
			Spacer 150 x 75 x 5 mm channel 0.546 m long,3 Nos	kg	26.860	34.00	913.24	M-179 /1000
			Nuts and bolts	kg	30.000	37.00	1110.00	M-130
			Add 15 per cent of the cost of material for fabrication, nuts, bolts and washers etc.)				1312.43	
			d) Overhead charges @ 10%				1047.40	
			e) Contractor's profit @ 10%				1152.14	
			Cost for 4.5 metre				12673.50	
			Rate per metre				2816.33	
						say	*2816.00*	
		Note	In the case of median crash barrier, 'W' metal beam or thrie beam section should be provided on both sides of the vertical posts fixed in the median. Extra provision for metal beam railing and spacer is required to be made when fixed in the median depending on approved design.					
8.24	811		Road Traffic Signals electrically operated					
		Note	Since it is a ready made item commercially produced and erected by specialised firm in the electrical and electronic field, rate may be taken based on market enquiry from firms specialised in this field and ISI certified for the approved design and drawing.					
8.25	Suggest ive		Flexible Crash Barrier, Wire Rope Safety Barrier					
			Providing and erecting a wire rope safety barrier with vertical posts of medium weight RS Joist (ISMB series) 100 mm x 75 mm (11.50 kg/m), 1.50 m long 0.85 m above ground and 0.65 m below ground level, split at the bottom for better grip, embedded in M 15 grade cement concrete 450 x 450 x 450 mm, 1.50 m center to center and with 4 horizontal steel wire rope 40 mm dia and anchored at terminal posts 15 m apart. Terminal post to be embedded in M 15 grade cement concrete foundation 2400 x 450 x 900 mm (depth), strengthened by a strut of RS joist 100 x 75 mm, 2 m long at 450 inclination and a tie 100 x 8 mm, 1.50 m long at the bottom, all embedded in foundation concrete as per approved design and drawing, rate excluding excavation and cement concrete					
			Unit = Running metre					
			Taking output = 15 metre					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			Blacksmith	day	1.000	245.00	245.00	L-02
			b) Material					
			i) RS Joist 100 x 75 mm - 16.5 m @ 11.5 kg per metre	kg	190.000	34.00	6460.00	M-179 /1000
			ii) Struts - 2 Nos. for terminal posts,2 m long each 2 x 2 x 11.50	kg	46.000	34.00	1564.00	M-179 /1000
			iii) Tie 2 Nos. of 8 mm steel plate,1.5 sqm each for terminal posts @ 62.80 kg/sqm (2 x 1.5)	kg	188.400	45.00	8478.00	M-179 /1000
			iv) Steel wire rope 40 mm, including 7.50 per cent extra for fixing at ends 15 x 4 x 1.075 @ 1 kg per m	kg	65.000	45.00	2925.00	M-177
			Add 5 per cent of cost of material for drilling, gripping, fixing, fabrication and welding consumables				971.35	
			c) Painting					
			Applying 2 coats of painting on exposed surface	sqm	16.500	56.00	924.00	Item 8.9
			d) Machinery					
			Tractor-trolley	hour	0.250	280.00	70.00	P&M-053
			d) Overhead charges @ 10%				2123.64	
			e) Contractor's profit @ 10%				2336.00	
			Cost for 15 m				26619.98	
			Rate per m				1774.67	
						say	*1775.00*	
		Note	The items of excavations and cement concrete works will be measured and included separately as per the approved designs and drawings.					
8.26	Suggest ive		Anti-Glare Devices in Median					
		A	Plantation					
			Plantation of shrubs and plants of approved species in the median. apart from cutting off glare from vehicle coming from opposite direction, these plants provide a pleasant envoirenment and are eco-friendly. The rate for this item is available in the chapter 11 on horticulture.					
		B	Anti-glare screen with 25 mm steel pipe framework fixed with circular and rectangular vans					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Providing and erecting an anti - glare screen with 25 mm dia vertical pipes fabricated and framed in the form of panels of one metre length and 1.75 metre height fixed with circular vane 250 mm dia at top and rectangular vane 600 x 300 mm at the middle, made out of steel sheet of 3 mm thickness, end vertical pipes of the panel made larger for embedding in foundation concrete, applying 2 coats of paint on all exposed surfaces, all as per approved design and drawings.					
			Unit = Running metre					
			Taking output = one metre					
			a) Labour					
			Mate	day	0.004	275.00	1.10	L-12
			Mazdoor	day	0.100	245.00	24.50	L-13
			b) Material					
			i) 25 mm steel pipe	metre	16.000	200.00	3200.00	M-174
			ii) MS sheet for 600 x 300 x 3 mm rectangular vane, one number @ 24kg/sqm	kg	4.320	34.00	146.88	M-179 /1000
			iii) MS sheet for 250 mm dia circular vane 3 mm thick,4 numbers @ 24 kg/sqm	kg	4.800	34.00	163.20	M-179 /1000
			Add 5 per cent cost of material for fabrication, welding, bending, nuts, bolts etc				175.50	
			c) Painting					
			Applying 2 coats of painting on exposed surface	sqm	1.830	56.00	102.48	Item 8.9
			d) Overhead charges @ 10%				371.12	
			e) Contractor's profit @ 10%				408.23	
			Rate per metre				4593.01	
						say	*4593.00*	
		Note	The items of excavation and cement concrete as per approved design to be measured and paid separately					
8.26		C	Anti-glare screen with rectangular vane of MS sheet					
			Providing and erecting anti - glare screen with rectangular vanes of size 750 x 500 mm made from MS sheet, 3 mm thick and fixed on MS angle 50 x 50 x 6 mm at an angle of 450 to the direction of flow of traffic, 1.5 m center to center, top edge of the screen 1.75 m above ground level, vertical post firmly embedded in M-15 cement concrete foundation 0.60 m below ground level, applying 2 coats of paint on exposed faces, all complete as per approved design and drawings					
			Unit = Running metre					
			Taking output = 1.50 metre					
			a) Labour					
			Mate	day	0.004	275.00	1.10	L-12
			Mazdoor	day	0.100	245.00	24.50	L-13
			b) Material					
			i) Angle iron post,50 x 50 x 6 mm, length 2.35 m	kg	10.580	34.00	359.72	M-179 /1000
			ii) MS sheet 3 mm thick @ 24 kg/sqm	kg	9.000	34.00	306.00	M-179 /1000
			Add 5 per cent of cost of material for fabrication, nuts, bolts etc				33.29	
			c) Machinery					
			Tractor-trolley	hour	0.100	280.00	28.00	P&M-053
			d) Painting					
			Applying 2 coats of painting	sqm	0.850	56.00	47.60	Item 8.9
			e) Overhead charges @ 10%				75.26	
			f) Contractor's profit @ 10%				82.79	
			Cost for 1.5 m				958.25	
			Rate per metre				638.84	
						say	*639.00*	
		Note	The items of excavation and cement concrete as per approved design to be measured and paid separately. Rate of painting has been analysed separately in this chapter.					
8.27	Suggestive		Street Lighting					
			Providing and erecting street light mounted on a steel circular hollow pole of standard specifications for street lighting, 9 m high spaced 40 m apart, 1.8 m overhang on both sides if fixed in the median and on one side if fixed on the footpath, fitted with sodium vapour lamp and fixed firmly in concrete foundation.					
			Unit = Each					
			Taking output = one light					
			a) Labour					
			Mate	day	0.030	275.00	8.25	L-12
			Mazdoor	day	0.500	245.00	122.50	L-13
			Electrician	day	0.250	250.00	62.50	L-02
			b) Material					
			i) Steel circular hollow pole of standard specification for street lighting to mount light at 9 m height above road level	each	1.000	4500.00	4500.00	M-171
			ii) Sodium vapour lamp	each	1.000	1200.00	1200.00	M-168
			Add 5 per cent of cost of material for holder, electric cable, insulation, ladder, scaffolding etc				285.00	
			c) Painting					
			For Fixing in Median					
			Providing two coats of alluminium paint over steel circular hollow pipe with overhang on both sides	sqm	5.750	24.00	138.00	Item 8.9
			For fixing in Footpath					
			Providing two coats of alluminium paint over steel circular hollow pipe with overhang on one side	sqm	4.630	24.00	111.12	Item 8.9
		(i)	For Fixing in Median					
			d) Overhead charges @ 0.15 on (a+b)				926.74	
			e) Contractor's profit @ 0.1 on (a+b+d)				710.50	
			Rate per light for fixing in Median= a+b+c+d+e				7953.49	
						say	*7953.00*	
		(ii)	For fixing in Footpath					
			Rate per light for Fixing in Footpath = a+b+c+d+e				7926.61	
						say	*7927.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		Note	The items of excavation and cement concrete foundation will be measured and included separately in the estimate as per approved design and drawing. The rate for painting has been analysed in this chapter.					
8.28	Suggest ive		Lighting on Bridges					
			Providing and fixing lighting on bridges, mounted on steel hollow circular poles of standard specifications, 5 m high fixed on parapets with cement concrete, 20 m apart and fitted with sodium vapour lamp					
			Unit = Each					
			Taking output = one light					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor	day	0.400	245.00	98.00	L-13
			Electrician	day	0.200	250.00	50.00	L-02
			b) Material					
			i) Steel circular hollow pole of standard specification for street lighting to mount light at 5 m above deck level	each	1.000	4500.00	4500.00	M-170
			ii) Sodium vapour lamp 70 watt	each	1.000	1200.00	1200.00	M-168
			Add 1 per cent of cost of material for holder, electric cable, insulation, ladder, scaffolding etc				57.00	
			c) Painting					
			Providing two coats of alluminium paint over steel circular hollow pipe	sqm	2.760	24.00	66.24	Item 8.9
			d) Overhead charges @ 0.15 on (a+b)				886.58	
			e) Contractor's profit @ 0.1 on (a+b+d)				679.71	
			Rate per light = a+b+c+d+e				7543.02	
						say	*7543.00*	
		Note	The items of cement concrete to be measured and paid separately as per approved design. The rate for painting has already been analysed in this chapter.					
8.29	Suggest ive		Cable Duct Across the Road					
			Providing and laying of a reinforced cement concrete pipe duct, 300 mm dia, across the road (new construction), extending from drain to drain in cuts and toe of slope to toe of slope in fills, constructing head walls at both ends, providing a minimum fill of granular material over top and sides of RCC pipe as per IRC:98-1997, bedded on a 0.3 m thick layer of granular material free of rock pieces, outer to outer distance of pipe at least half dia of pipe subject to minimum 450 mm in case of double and triple row ducts, joints to be made leak proof, invert level of duct to be above higher than ground level to prevent entry of water and dirt, all as per IRC: 98 - 1997 and approved drawings.					
		(i)	Single row for one utility service					
			Unit = Running metre					
			Taking output = 20metres					
			a) Random Rubble masonry/Brick masonry in cement mortar 1:6 for head wall both side	cum	2.360	4004.00	9449.44	Item 12.7 (Addl) B)
			b) Labour					
			Mate	day	0.050	275.00	13.75	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			Mazdoor skilled	day	0.250	245.00	61.25	L-15
			c) Material					
			Reinforced Cement Concrete pipe 450 mm dia	metre	20.000	2040.00	40800.00	M-151
			Granular soil with PI less than 6 for bedding and sides of pipe (0.6 x 0.6 x 20 m)	cum	7.200	457.00	3290.40	M-009
			Collar for joints 300 mm dia	each	9.000	50.00	450.00	M-083
			Cement mortar 1:2 for joints	cum	0.020	6439.00	128.78	Item 12.6 (B)
			d) Machinery					
			Tractor-trolley	hour	0.500	280.00	140.00	P&M-053
			e) Overhead charges @ 0.15 on (b+c+d)				6769.38	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				5189.86	
			Cost for 20 metre = a+b+c+d+e+f				66537.85	
			Rate per metre = (a+b+c+d+e+f)/20				3326.89	
						say	*3327.00*	
8.29		(ii)	Double row for two utility services					
			Unit = Running metre					
			Taking output = 20metres					
			a) Random Rubble brick/Brick masonry in cement mortar 1:6 for head wall both sides.	cum	3.370	1719.00	5793.03	Item 12.7 (Addl) B)
			b) Labour					
			Mate	day	0.050	275.00	13.75	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			Mazdoor skilled	day	0.250	245.00	61.25	L-15
			c) Material					
			Reinforced Cement Concrete pipe 300 mm dia	metre	40.000	500.00	20000.00	M-151
			Granular soil with PI less than 6 for bedding and sides of pipe (0.6 x 0.6 x 40 m)	cum	14.400	130.00	1872.00	M-009
			Collar for joints 300 mm dia	each	18.000	300.00	5400.00	M-083
			Cement mortar 1:2 for joints	cum	0.040	6439.00	257.56	Item 12.6 (B)
			d) Machinery					
			Tractor-trolley	hour	1.000	280.00	280.00	P&M-053
			e) Overhead charges @ 0.15 on (b+c+d)				4256.18	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				3263.07	
			Cost for 20 metre = a+b+c+d+e+f				41686.85	
			Rate per metre = (a+b+c+d+e+f)/20				2084.34	
						say	*2084.00*	
8.29		(iii)	Triple rRow for three utility services					
			Unit = Running metre					
			Taking output = 20metres					
			a) Random Rubble brick/Brick masonry in cement mortar 1:6 for head wall both sides.	cum	4.380	1719.00	7529.22	Item 12.7 (Addl) B)
			b) Labour					
			Mate	day	0.160	275.00	44.00	L-12

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mazdoor	day	3.000	245.00	735.00	L-13
			Mazdoor skilled	day	1.000	245.00	245.00	L-15
			c) Material					
			Reinforced Cement Concrete pipe 300 mm dia	metre	60.000	500.00	30000.00	M-151
			Granular soil with PI less than 6 for bedding and sides of pipe (0.6 x 0.6 x 60 m)	cum	21.600	130.00	2808.00	M-009
			Collar for joints 300 mm dia	each	27.000	300.00	8100.00	M-083
			Cement mortar 1:2 for joints	cum	0.060	6439.00	386.34	Item 12.6 (B)
			d) Machinery					
			Tractor-trolley	hour	1.500	280.00	420.00	P&M-053
			e) Overhead charges @ 0.15 on (b+c+d)				6410.75	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				4914.91	
			Cost for 20 metre = a+b+c+d+e+f				61593.22	
			Rate per metre = (a+b+c+d+e+f)/20				3079.66	
						say	*3080.00*	
		Note	1.Inspection chamber at both ends is the responsibility of the agency who is laying the duct. Hence not included.					
			2.The rates for stone masonry / brick masonry and cement mortar to be adopted from respective clauses.					
8.30	Suggestive		Highway Patrolling and Traffic Aid Post					
			It is proposed to locate one Traffic Aid Post every 50-60 km of the highway.					
			The organisation and financial aspect are required to be finalised in consultation with administrative and traffic authorities .					
8.31	Suggestive		Items Related to Underpass/ Subway/ Overhead Bridge/ Overhead Foot Bridge					
			The items involved for underpass/ subway/ overhead bridge/ overhead foot bridge are earthwork, plain cement concrete, plastering, painting, information sign etc. The rates for these items are available in respective chapters which can be adopted for the quantities derived from the approved designs and drawings					
8.32	Suggestive		Traffic Control System and Communication System					
			Providing a traffic control centre and communication system including telecommunication facilities and related accessories, CCTV, radar, vehicle detection camera, central computer system					
			These are specialised item of telecommunication system and are the commercial products. The designer is required to contact the manufacturers to ascertain market prices. In case of civil works required to be executed for these installations, pricing may be done as per rates in relevant chapters for quantities derived as per approved design and drawing.					
			As regards the locations where such devices are required to be installed, the traffic control authority should be consulted to finalise the location					
8.33	Suggestive		Gantry Mounted Variable Message Sign Board					
			Providing and erecting gantry mounted variable message sign board electronically operated capable of flashing the desired message over a designed support system of aluminium alloy or galvanised steel, erected as per approved design and drawings and with lateral clearance as per clause 802.3					
		(i)	Gantry Support System					
			Unit = tonne					
			Taking output=1 tonne					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			Blacksmith	day	1.000	245.00	245.00	L-02
			b) Material					
			Alluminium alloy/galvanised steel including 5 per cent wastage	tonne	1.050	46000.00	48300.00	M-060
			Add 15 per cent of cost of material for fabrication and erection.				7245.00	
			Add 1 per cent of cost of material for nuts, bolts and welding				483.00	
			c) Machinery					
			Truck 10 tonne	hour	1.000	240.00	240.00	P&M-057
			d) Overhead charges @ 0.15 on (a+b+c)				8555.40	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				6559.14	
			Rate per tonne = a+b+c+d+e				72150.54	
						say	*72151.00*	
8.33		(ii)	Message Display					
			Message display board 6 sqm electronically operated with complete electronic fitments for flashing the pre-determined messages.					
			This is a specilised commercial product and the lumpsum rate including erection at site is required to be as certained from the market and including in the rate analysis. The size of the board will vary depending upon specific location.					
			The rate for the gantry mounted variable sign would be the addition of cost of gantry support system as per approved design determined at (i) above and the cost of message display board as certained from the market at (ii) above					
8.34	Suggestive		Traffic Impact Attenuators at Abutments and Piers					
		A	With Scrap Tyres					
			Provision and installation of traffic attenuators at abutment/pier of flyovers bridges using scrap tyres of size 100 x 20 retrieved from trucks laid in 2 rows and 4 tiers, one above the other and tied with 20 mm wire rope as per approved design and drawings.					
			Unit = sqm					
			Taking output = 20sqm					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	1.500	245.00	367.50	L-13

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Blacksmith	day	0.250	245.00	61.25	L-02
			b) Material					
			Scrap tyres of size 900 x 20	each	80.000	200.00	16000.00	M-161
			20 mm steel wire rope	kg	150.000	38.00	5700.00	M-176
			Add 1 per cent of cost of wire rope for clamps etc.				57.00	
			c) Machinery					
			Tractor-trolley	hour	3.000	280.00	840.00	P&M-053
			d) Overhead charges @ 0.15 on (a+b+c)				3457.16	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				2650.49	
			Cost for 20 sqm = a+b+c+d+e				29155.40	
			Rate per sqm = (a+b+c+d+e)/20				1457.77	
						say	*1458.00*	
8.34		B	Using Plastic/Steel Barrel, Filled with Sand					
			Provision and installation of traffic impact attenuator at abutment/pier of flyovers bridges using plastic/steel barrels 0.60 m dia and 1.0 m in height, filled with sand in three rows and tied with20 mm steel wire rope as per approved design and drawings					
			Unit = sqm					
			Taking output = 20sqm					
			a) Labour					
			Mate	day	0.130	275.00	35.75	L-12
			Mazdoor	day	3.000	245.00	735.00	L-13
			Blacksmith	day	0.250	245.00	61.25	L-02
			b) Material					
			Plastic barrels	each	50.000			
			or					
			Steel barrels	each	50.000	25.00	1250.00	M-172
			Sand	cum	8.000	1184.68	9477.44	M-004
			20 mm steel wire rope	kg	15.000	38.00	570.00	M-176
			Add 1 per cent of cost of wire rope for clamps etc.				5.70	
			c) Machinery					
			Tractor-trolley	hour	2.000	280.00	560.00	P&M-053
			d) Overhead charges @ 0.15 on (a+b+c)				1904.27	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				1459.94	
			Cost for 20 sqm = a+b+c+d+e				16059.35	
			Rate per sqm = (a+b+c+d+e)/20				802.97	
						say	*803.00*	
8.34		C	With HI - DRO cell Sandwich (Patented)					
			(In this patented HI - DRO cell system, water gets discharged from plastic tubes on impact over a pre-determined time, thus absorbing the energy)					
			Providing and installing a patentend HI - DRO cell system as a traffic impact attenuators, using plastic tubes 50 cm dia, 1.2 m in height, 25 mm opening at the top, placed in three rows, filled with water and tied with a 20 mm steel wire rope					
			Unit = sqm					
			Taking output = 10sqm					
			a) Labour					
			Mate	day	0.100	275.00	27.50	L-12
			Mazdoor	day	2.500	245.00	612.50	L-13
			b) Material					
			Plastic tubes 50 cm dia,1.2 m high	each	40.000	25.00	1000.00	M-139
			Cost of water	KL	12.000	30.00	360.00	M-189
			20 mm steel wire rope	kg	100.000	38.00	3800.00	M-176
			Add 1 per cent of cost of wire rope for clamps etc.				38.00	
			c) Machinery					
			Tractor-trolley	hour	2.000	280.00	560.00	P&M-053
			Water tanker6 KL capacity	hour	2.000	374.00	748.00	P&M-060
			d) Overhead charges @ 0.15 on (a+b+c)				1071.90	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				821.79	
			Cost for 10 sqm = a+b+c+d+e				9039.69	
			Rate per sqm = (a+b+c+d+e)/10				903.97	
						say	*904.00*	
8.35	Suggestive		Road Markers/Road Stud with Lense Reflector					
			Providing and fixing of road stud 100x 100 mm, die-cast in aluminium, resistant to corrosive effect of salt and grit, fitted with lense reflectors, installed in concrete or asphaltic surface by drilling hole 30 mm upto a depth of 60 mm and bedded in a suitable bituminous grout or epoxy mortar, all as per BS 873 part 4:1973					
			Unit = Nos					
			Taking output = 50Nos					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Material					
			Aluminium studs 100 x 100 mm fitted with lense reflectors	each	50.000	200.00	10000.00	M-062
			Add 10 per cent of cost of material for fixing and installation				1000.00	
			c) Overhead charges @ 0.15 on (a+b)				1688.40	
			d) Contractor's profit @ 0.1 on (a+b+c)				1294.44	
			Cost for 50 studs = a+b+c+d				14238.84	
			Rate per studs = (a+b+c+d)/50				284.78	
						say	*285.00*	
8.36	Suggestive		Traffic Cone					
			Provision of red fluorescent with white reflective sleeve traffic cone made of low density polyethylene (LDPE) material with a square base of 390 x 390 x 35 mm and a height of 770 mm, 4 kg in weight, placed at 1.5 m interval, all as per BS 873					
			Unit = Running metre					
			Taking output = 68 Nos.					
			a) Labour					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor	day	0.500	245.00	122.50	L-13
			b) Material					
			Traffic cones with 150 mm reflective sleeve	each	68.000	400.00	27200.00	M-186
			c) Machinery					
			Tractor-trolley	hour	0.100	280.00	28.00	P&M-053
			d) Overhead charges @ 0.15 on (a+b+c)				4103.40	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				3145.94	
			Cost for 68 Nos. = a+b+c+d+e				34605.34	
			Rate per metre = (a+b+c+d+e)/68				508.90	
						say	*509.00*	
8.37	Suggestive		Roadside Amenities					
		A	Rest areas					
			Providing plainly furnished accommodation for rest rooms, dormitories, restaurants, stalls, shops, petrol pump, telephone booth, first aid room, traffic aid post, police assistance booth, including electricity, toilet and sewerage system					
			Pricing may be done based on current plinth area rates approved by PWD/CPWD/MES for a particular zone. Area is required to be assessed for specific location as per actual site conditions					
		B	Parking areas and bus laybyes for trucks, buses and light vehicles					
			Pricing of parking areas may be done for the quantities of various items based on the approved dimensions and pavement design for a particular terrain and soil. Rates for items may be from respective chapters.					
		C	Lawn					
			Providing a lawn planted with grass and its maintenance					
			Pricing of lawn may be done as per rates given in the chapter on horticulture for the quantities as per approved dimensions in the drawings					
8.38	Suggestive		Rumble Strips					
			Provision of 15 nos rumble strips covered with premix bituminous carpet, 15-20 mm high at center, 250 mm wide placed at 1 m center to center at approved locations to control speed, marked with white strips of road marking paint.					
			Unit = sqm					
			Taking output = 100 sqm (including gaps)					
			The rate per sqm of premix carpet and road marking may be adopted from chapter 5 & 8 respectively for the quantities calculated from approved drawings					
8.39	Suggestive		Policeman Umbrella					
			Provision of a 2 m high (floor to roof) umbrella for traffic policeman at road crossings, where necessary, installed on a raised platform, built on a central support of a steel pipe 100 mm dia, roof made of 25 mm dia steel pipe to provide covered area of 3 sqm, roofed with CGI sheets, all steel parts to be given 2 coats of paint					
			Unit = each					
			Taking output = one number					
			Earthwork	cum	Quantities of these items to be calculated as per approved design and cost added as per rates of these items given in chapter 3 and 13			
			Cement Concrete	cum				
			brick masonry or	cum				
			stone masonry	cum				
			Painting	sqm	2.500			
			a) Labour					
			Mate	day	0.090			
			Mazdoor	day	1.000			
			Blacksmith	day	1.000			
			Welder	day	0.250			
			b) Material					
			Steel pipe 100 mm dia	metre	3.500			
			Steel pipe 25 mm dia	metre	10.000			
			CGI sheets	kg	8.000			
			Add 25 per cent of cost of material for fabrication					
			Add 2 per cent of cost of material for welding consumables, J-hooks, washers etc.					
			c) Machinery					
			Tractor-trolley	hour	0.500			
			d) Overheads @ per cent on (a+b+c)					
			e) Contractors Profit@ per cent on (a+b+c+d)					
			Rate per policeman umbrella = a+b+c+d+e					
8.40	suggestive		High Mast Pole Lighting at Interchanges and Flyovers					
			Providing and erecting a high mast pole lighting with 30 m high hot dip galvanised mast designed to withstand forces exerted with wind speeds of 180 km per hour with 3 seconds gust, as per IS:875 (Part 3) - 1978, fitted with a base flange, door at the base of mast with heavy duty internal lock, lantern carriage, suitable winching arrangement for safe working load of 750 kg and high powered electrically driven power tools for raising and lowering of lantern carriage, flexible 8 core electric cable, lightening conductor, earthing terminal, and fixing 2 nos aviation obstruction lights on top of the mast, all complete as per approved design and drawings					
			This is a specialised work and is generally done by firms who specialise in such jobs. The detailed designs and estimates are submitted by the firms along with their tender for checks by the Department. The cost of this work is required to be worked out based on approved design, drawings and estimate of the lowest tender. A separate contract for this work is concluded as the contractors for road and bridge works generally donot undertake such jobs.					
8.41			Toll Plaza					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			The construction, operation and maintenance of Toll Plaza can be broken into separate items of work as under based on the approved design and drawings:-					
			a) Provision of toll collection service lane to separate different categories of vehicles for purpose of toll collection. This involves considerable increase in carriage way width.					
			b) Provision of 2.5 m wide separators for different toll collection service lanes for safety					
			c) Toll booths with integrated roof cover					
			d) Barrier gates for individual lanes					
			e) Provision of building to provide facility to toll plaza personnel					
			f) Toll plaza office equipment and furniture					
			g) Water supply, electricity, sanitation, septic-tank system and drainage					
			h) Telephone, intercomes, wireless communication system					
			i) High mast lighting					
			j) Pavement marking					
			k) Overhead signs					
			l) Fixed message signs (Advance)					
			m) Variable message signs					
			n) Traffic cones and pylons					
			o) First aid post					
			p) Traffic aid post and security					
			The quantities for the above mentioned items may be calculated from the approved design and drawings and their rates adopted from respective chapters of the Standard Data Book					
8.42			Safety Devices and Signs in Construction Zones					
			Provision and fixing of traffic signs for limited period at suitable locations in construction zone comprising of warning zone, approach transition zone, working zone and terminal transition zone with a minimum distance of 60 cm from the edge of the kerb in case of kerbed roads and 2 to 3 m from the edge of the carriageway in case of un-kerbed roads, the bottom edge of the lowest sign plate to be not less than 2 m above the road level, fixed on 60 mm x 60 mm x 6 mm angle iron post, founded and installed as per approved design and drawings, removed and disposed of after completion of construction work, all as per IRC:SP:55-2001					
			Unit = each					
			Taking output = one sign post					
			Following types of signs are required to be fixed in construction zones for safety of traffic					
			a) Diversion one km ahead					
			b) Traffic sign ahead					
			c) Road ahead closed					
			d) Men at work					
			e) Road narrow					
			f) Single file traffic					
			g) Right lane diverted					
			h) Left lane diverted					
			i) Right lane closed					
			j) Left lane closed					
			k) Median closed					
			l) Diversion to other carriageway					
			m) Traffic signal ahead					
			n) Two way traffic					
			o) Un - even road					
			p) Slippery road					
			q) Loose chippings					
			r) Dual carriageway ends					
			s) Diversion					
			t) Do not enter					
			u) Road closed					
			v) Stop					
			w) Slow					
			x) One way					
			y) Give way					
			z) Overtaking prohibited					
			aa) Speed limit					
			bb) Weight limit					
			cc) Height and length limit					
			dd) No stopping or standing					
			ee) Any other warning or regulatory safety sign as per site requirement and consistent with IRC:SP:55-2001 and IRC:67					
			The rate for traffic signs are already worked out and given elsewhere in this chapter. The same may be adopted.					
8.43	suggesti ve		Portable Barricade in Construction Zone					
			Installation of a steel portable barricade with horizontal rail 300 mm wide, 2.5 m in length fitted on a 'A' frame made with 45 x 45 x 5 mm angle iron section, 1.5 m in height, horizontal rail painted (2 coats) with yellow and white stripes, 150 mm in width at an angle of 450, 'A' frame painted with 2 coats of yellow paint, complete as per IRC:SP:55-2001					
			Unit = each					
			Taking output = one steel portable barricade					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor	day	0.250	245.00	61.25	L-13
			Painter	day	0.500	250.00	125.00	L-18
			Welder	day	0.250	250.00	62.50	L-02
			b) Material					
			Angle iron 45 x 45 x 5 mm	kg	25.000	45.00	1125.00	M-179 /1000

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			MS sheet 300 mm wide,2.5 m long and 2.6 mm thick	kg	15.000	34.00	510.00	M-179 /1000
			Paint	litre	0.500	75.00	37.50	M-131
			Add 2 per cent of cost of steel for welding consumables, nuts & bolts and drilling holes				32.70	
			c) Overhead charges @ 0.15 on (a+b)				293.92	
			d) Contractor's profit @ 0.1 on (a+b+c)				225.34	
			Rate per barricade = a+b+c+d				2478.70	
						say	2479.00	
8.44	suggestive		Permanent Type Barricade in Construction Zone					
		A	With steel components					
			Construction of a permanent type barricade made of steel components, 1.5 m high from road level, fitted with 3 horizontal rails 200 mm wide and 4 m long on 50 x 50 x 5 mm angle iron vertical support, painted with yellow and white strips, 150 mm in width at an angle of450, complete as per IRC:SP:55-2001					
			Unit = each					
			Taking output = one barricade					
			a) Labour					
			Mate	day	0.050	275.00	13.75	L-12
			Mazdoor	day	0.300	245.00	73.50	L-13
			Painter	day	0.600	250.00	150.00	L-18
			Welder	day	0.300	250.00	75.00	L-02
			b) Material					
			Angle iron 50 x 50 x 5 mm,2 m long,2 Nos.	kg	15.000	45.00	675.00	M-179 /1000
			MS sheet of 12 SWG,3 Nos of 200 mm width and 4 m length	kg	50.000	34.00	1700.00	M-179 /1000
			Paint	litre	1.000	75.00	75.00	M-131
			Add 1 per cent of cost of steel for welding consumables, nuts & bolts and drilling holes				47.50	
			c) Overhead charges @ 0.15 on (a+b)				421.46	
			d) Contractor's profit @ 0.1 on (a+b+c)				323.12	
			Rate per barricade = a+b+c+d				3554.33	
						say	3554.00	
8.44		B	With wooden components					
			Construction of a permanent type barricade made of wooden components, 1.5 m high from road level, fitted with 3 horizontal planks 200 mm wide and 3.66 m long on 100 x 100mm wooden vertical post, painted with yellow and white strips, 150 mm in width at an angle of450, complete as per IRC:SP:55-2001					
			Unit = each					
			Taking output = one barricade					
			a) Labour					
			Mate	day	0.050	150.00	7.50	L-12
			Mazdoor	day	0.300	100.00	30.00	L-13
			Painter	day	0.600	150.00	90.00	L-18
			Carpenter	day	0.600	150.00	90.00	L-04
			b) Material					
			Timber	cum	0.180	input	#VALUE!	M-185
			Add 1 per cent of cost of timber for nuts & bolts, nails, etc.				#VALUE!	
			c) Overhead charges @ 0.15 on (a+b)				#VALUE!	
			d) Contractor's profit @ 0.1 on (a+b+c)				#VALUE!	
			Rate per barricade = a+b+c+d				#VALUE!	
						say	#VALUE!	
8.44		C	With bricks					
			Construction of a permanent type barricade made with brick work in mud mortar, 1.5 m high, 4 m long, 600 mm thick, plastered with cement mortar 1:6, painted with yellow and white strips					
			Unit = each					
			Taking output = one barricade					
			a) Labour					
			Mate	day	0.240	275.00	66.00	L-12
			Mazdoor	day	3.000	245.00	735.00	L-13
			Painter	day	1.000	250.00	250.00	L-18
			Mason	day	2.000	245.00	490.00	L-11
			b) Material					
			Brick	each	1800.000	6.50	11700.00	M-079
			Cement	kg	22.000	7.60	167.16	M-081 /1000
			Sand	cum	0.090	1184.68	106.62	M-005
			Paint	litre	1.250	75.00	93.75	M-131
			c) Overhead charges @ 0.15 on (a+b)				2041.28	
			d) Contractor's profit @ 0.1 on (a+b+c)				1564.98	
			Rate per barricade = a+b+c+d				17214.79	
						say	17215.00	
8.45	suggestive		Drum Delineator in Construction Zone					
			Provision of metal drum/empty bitumen drum delineator, 300 mm in diameter, 800 mm high, filled with earth for stability, painted in circumferential strips of alternate black and white 100 mm wide fitted with reflectors 3 Nos of 7.5 cm dia, all as per IRC:SP:55-2001					
			Unit = each					
			Taking output = one drum delineator					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Mazdoor	day	0.250	245.00	61.25	L-13
			Painter	day	0.250	250.00	62.50	L-18
			b) Material					
			Steel drum 300 mm dia 1.2 m high/empty bitumen drum	each	1.000	600.00	600.00	M-172
			Paint	litre	0.500	75.00	37.50	M-131
			c) Overhead charges @ 0.15 on (a+b)				115.01	
			d) Contractor's profit @ 0.1 on (a+b+c)				88.18	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Rate per drum delineator = a+b+c+d				969.94	
						say	*970.00*	
8.46	suggesti ve		Flagman					
			Positioning of a smart flagman with a yellow vest and a yellow cap and a red flag 600 x 600 mm securely fastened to a staff 1 m in length for guiding the traffic					
			Unit = each					
			Taking output = one flagman					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Material					
			Flag of red color cloth 600 x 600 mm	each	1.000	20.00	20.00	M-099
			Wooden staff for fastening of flag 25 mm dia, one m long	each	1.000	5.00	5.00	M-196
			c) Overhead charges @ 0.15 on (a+b)				42.15	
			d) Contractor's profit @ 0.1 on (a+b+c)				32.32	
			Rate per flagman = a+b+c+d				355.47	
						say	*355.00*	

CHAPTER-9
PIPE CULVERTS

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
9.1	408		PCC 1:3:6 in Foundation					
			Plain cement concrete 1:3:6 mix with crushed stone aggregate 40 mm nominal size mechanically mixed, placed in foundation and compacted by vibration including curing for 14 days.					
			Unit = cum					
			Taking output = 15 cum					
			a) Labour					
			Mate	day	0.640	275.00	176.00	L-12
			Mason	day	1.000	245.00	245.00	L-11
			Mazdoor	day	15.000	245.00	3675.00	L-13
			b) Material					
			40mm Aggregate at site	cum	13.800	974.52	13448.38	M-055
			Sand at site	cum	6.900	1184.68	8174.29	M-005
			Cement at site	tonne	3.300	7598.00	25073.40	M-081
			Cost of water	KL	18.000	30.00	540.00	M-189
			c) Machinery					
			Concrete mixer0.4/ 0.28 cum	hour	6.000	172.00	1032.00	P&M-009
			Generator set 33 KVA	hour	6.000	264.00	1584.00	P&M-079
			Water tanker6 KL capacity	hour	3.000	374.00	1122.00	P&M-060
			d) Overhead charges @ 10%				5507.01	
			e) Contractor's profit @ 10%				6057.71	
			Cost for 15 cum				66634.78	
			Rate per cum				4442.32	
						say	*4442.00*	
		Note	Vibrator is a part of minor T & P which is already included in overhead charges of the contractor.					
9.2	2900		Laying Reinforced Cement Concrete Pipe NP4 / Prestressed Concrete Pipe on First Class Bedding in Single Row .					
			Laying Reinforced cement concrete pipe NP4/prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .					
			Unit = metre					
			Taking output = 12.5 metres (5 pipes of 2.5 m length each)					
		A	1000 mm dia					
			a) Labour					
			Mate	day	0.180	275.00	49.50	L-12
			Mason	day	0.500	245.00	122.50	L-11
			Mazdoor	day	4.000	245.00	980.00	L-13
			b) Material					
			Sand at site	cum	0.070	1184.68	82.93	M-005
			Cement at site	tonne	0.050	7598.00	379.90	M-081
			RCC pipe NP-4 /prestressed concrete pipe including collar at site	metre	12.500	4540.00	56750.00	M-149
			Granular material passing 5.6 mm sieve for bedding	cum	4.500	112.00	504.00	M-009
			c) Overhead charges @ 10%				5886.88	
			d) Contractor's profit @ 10%				6475.57	
			Cost for 12.5 metres				71231.28	
			Rate per metre				5698.50	
						say	*5699.00*	
		Note	1. In case of cement craddle bedding, quantity of PCC M15 is to be calculated as per design and priced separately and added .					
			2. The rate analysis does not include excavation, cement /masonry works in head walls, backfilling, protection works and parapet walls. The same are to be calculated as per approved design and drawings and priced separately on rates available under respective sections					
9.2		B	1200 mm dia					
			a) Labour					
			Mate	day	0.280	275.00	77.00	L-12
			Mason	day	1.000	245.00	245.00	L-11
			Mazdoor	day	6.000	245.00	1470.00	L-13
			b) Material					
			Sand at site	cum	0.090	1184.68	106.62	M-005
			Cement at site	tonne	0.070	7598.00	531.86	M-081
			RCC pipe NP-4/prestressed concrete pipe including collar at site	metre	12.500	5340.00	66750.00	M-150
			Granular material passing 5-6 mm sieve for class bedding	cum	5.000	112.00	560.00	M-009
			c) Overhead charges @ 10%				6974.05	
			d) Contractor's profit @ 10%				7671.45	
			Cost for 12.5 metres				84385.98	
			Rate per metre				6750.88	
						say	*6751.00*	
		Note	1. In case of cement craddle bedding, quantity of PCC M15 is to be calculated as per design and priced separately and added .					
			2. The rate analysis does not include excavation, cement /masonry works in head walls, backfilling, protection works and parapet walls. The same are to be calculated as per approved design and drawings and priced separately on rates available under respective sections					
9.3	2900		Laying Reinforced Cement Concrete Pipe NP4 / Prestressed Concrete Pipe on First Class Bedding in Double Row .					
			Laying Reinforced cement concrete pipe NP4 / prestressed concrete pipe for culverts on first class bedding of granular material in double row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .					
			Unit = metre					
			Taking output = 12.5 metres (10 pipes of 2.5 m length each in two rows.)					
		A	1000 mm dia					
			a) Labour					
			Mate	day	0.360	275.00	99.00	L-12
			Mason	day	1.000	245.00	245.00	L-11
			Mazdoor	day	8.000	245.00	1960.00	L-13
			b) Material					
			Sand at site	cum	0.140	1184.68	165.86	M-005
			Cement at site	tonne	0.100	7598.00	759.80	M-081

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			RCC pipe NP-4/prestressed concrete pipe including collar at site	metre	25.000	4540.00	113500.00	M-149
			Granular material passing 5.6 mm sieve for bedding	cum	12.500	112.00	1400.00	M-009
			c) Overhead charges @ 10%				11812.97	
			d) Contractor's profit @ 10%				12994.26	
			Cost for 12.5 metres				142936.88	
			Rate per metre				11434.95	
		Note	1. In case of cement craddle bedding, quantity of PCC M15 is to be calculated as per design and priced separately and added .			*say*	*11435.00*	
			2. The rate analysis does not include excavation, cement /masonry works in head walls, backfilling, protection works and parapet walls. The same are to be calculated as per approved design and drawings and priced separately on rates available under respective sections					
9.3		B	1200 mm dia					
			a) Labour					
			Mate	day	0.560	275.00	154.00	L-12
			Mason	day	2.000	245.00	490.00	L-11
			Mazdoor	day	12.000	245.00	2940.00	L-13
			b) Material					
			Sand at site	cum	0.180	1184.68	213.24	M-005
			Cement at site	tonne	0.140	7598.00	1063.72	M-081
			RCC pipe NP-4 /prestressed concrete pipe including collar at site	metre	25.000	5340.00	133500.00	M-150
			Granular material passing 5-6 mm sieve for class bedding	cum	13.750	112.00	1540.00	M-009
			c) Overhead charges @ 10%				13990.10	
			d) Contractor's profit @ 10%				15389.11	
			Cost for 12.5 metres				169280.16	
			Rate per metre				13542.41	
		Note	1. In case of cement craddle bedding, quantity of PCC M15 is to be calculated as per design and priced separately and added .			*say*	*13542.00*	
			2. The rate analysis does not include excavation, cement /masonry works in head walls, backfilling, protection works and parapet walls. The same are to be calculated as per approved design and drawings and priced separately on rates available under respective sections					

CHAPTER- 10								
MAINTENANCE OF ROADS								
Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
10.1	3002		Restoration of Rain Cuts					
			Restoration of rain cuts with soil, moorum, gravel or a mixture of these, clearing the loose soil, benching for 300 mm width, laying fresh material in layers not exceeding 250 mm and compacting with plate compactor or power rammers to restore the original alignment, levels and slopes					
			Unit = cum					
			Taking output = 10 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Excavator1.0 cum bucket capacity @ 60 cum per hour	hour	0.130	1008.00	131.04	P&M-026
			Tipper (L is average lead in km for borrow earth)	tonne.km	12.000	1.90	22.80	Lead =5 km & P&M-058
			Add 10 per cent of cost of carriage towards loading and unloading charges.				2.28	
			Plate compactor	hour	0.500	250.00	125.00	P&M-086
			c) Overhead charges @ 10%				79.31	
			d) Contractor's profit @ 10%				87.24	
			Cost for 10 cum				959.68	
			Rate per cum				95.97	
						say	*96.00*	
		Note	Only 75 per cent of fresh material has been provided as 25 per cent can be retrieved at site from earth that is flown down the slope in the form of slurry and deposited at the foot of there in cuts					
10.2	3003		Maintenance of Earthen Shoulder (filling with fresh soil)					
			Making up loss of material/ irregularities on shoulder to the design level by adding fresh approved soil and compacting it with appropriate equipment.					
			Unit = sqm					
			Taking output = 100 sqm					
			Assuming average thickness of filling to be 150 mm					
			Quantity of fresh material = 15 cum					
			a) Labour					
			Mate	day	0.180	275.00	49.50	L-12
			Mazdoor	day	4.500	245.00	1102.50	L-13
			b) Machinery					
			Excavator1.0 cum bucket capacity @ 60 cum per hour	hour	0.250	1008.00	252.00	P&M-026
			Tipper (L is average lead in km for borrow earth)	tonne.km	24.000	1.90	45.60	Lead =5 km & P&M-058
			Add 10 per cent of cost of transportation to cover cost of loading and unloading				4.56	
			Plate compactor @ 25 sqm per hour	hour	12.000	250.00	3000.00	P&M-086
			c) Overhead charges @ 10%				445.42	
			d) Contractor's profit @ 10%				489.96	
			Cost for 100 sqm				5389.53	
			Rate per sqm				53.90	
						say	*54.00*	
10.3	3003		Maintenance of Earth Shoulder (stripping excess soil)					
			Stripping excess soil from the shoulder surface to achieve the approved level and compacting with plate compactor					
			Unit = sqm					
			Taking output = 100 sqm					
			Assuming average depth of stripping as 75 mm					
			Quantity of earth cutting involved = 7.5 cum					
			a) Labour					
			Mate	day	0.100	275.00	27.50	L-12
			Mazdoor	day	2.500	245.00	612.50	L-13
			b) Machinery					
			Plate compactor @ 25 sqm per hour	hour	4.000	250.00	1000.00	P&M-086
			c) Overhead charges @ 10%				164.00	
			d) Contractor's profit @ 10%				180.40	
			Cost for 100 sqm				1984.40	
			Rate per sqm on				19.84	
						say	*20.00*	
		Note	The earth stripped from earthen shoulders to be dumped on the side slopes locally for disposal.					
10.4	3004.2		Filling Pot-holes and Patch Repairs with open-Graded Premix surfacing, 20mm.					
			Removal of all failed material, trimming of completed excavation to provide firm vertical faces, cleaning of surface, painting of tack coat on the sides and base of excavation as per clause 503, back filling the pot holes with hot bituminous material as per clause 511, compacting, trimming and finishing the surface to form a smooth continuous surface, all as per clause 3004.2					
			Unit = Sqm					
			Taking out put = 10250 sqm (205 cum)(405 tonne)					
			a) Labour					
			Mate	Day	3.760	275.00	1034.00	L-12
			Mazdoor	Day	90.000	245.00	22050.00	L-13
			Mazdoor skilled	Day	4.000	245.00	980.00	L-15
			b) Machinery					
			Air compressor 250 cfm	hour	6.000	257.00	1542.00	P&M-001
			HMP 100-110 TPH Capacity	hour	6.000	12280.00	73680.00	P&M-021
			Tipper 10 tonnes capacity	hour	45.000	225.00	10125.00	P&M-048
			Smooth wheeled roller 8-10 tonnes	hour	12.000	386.00	4632.00	P&M-044
			c) Material					
			Crushed stone aggregates nominal size 13.2mm	cum	184.500	774.52	142898.94	M-052
			Crushed stone aggregates nominal size 11.2mm	cum	92.250	774.52	71449.47	M-051
			Bitumen 80/100	tonne	14.970	50351.34	753759.48	M-075
			Bitumen emulsion for tack coat including vertical sides of pot hole.	tonne	2.460	31532.50	77569.95	M-077
			d) Overhead charges @ 10%				115972.08	
			e) Contractor's profit @ 10%				127569.29	
			Cost for 10250 sqm				1403262.22	
			Rate per sqm				136.90	
						say	*137.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
10.5	3004.2		Filling Pot-holes and Patch Repairs with Bituminous concrete, 40mm.					
			Removal of all failed material, trimming of completed excavation to provide firm vertical faces, cleaning of surface, painting of tack coat on the sides and base of excavation as per clause 503, back filling the pot holes with hot bituminous material as per clause 504, compacting, trimming and finishing the surface to form a smooth continuous surface, all as per clause 3004.2					
			Unit = Sqm					
			Taking out put = 4900 sqm (196 cum)(450 Tonnes)					
			a) Labour					
			Mate	Day	2.920	275.00	803.00	L-12
			Mazdoor	Day	70.000	245.00	17150.00	L-13
			Mazdoor skilled	Day	3.000	245.00	735.00	L-15
			b) Machinery					
			Air compressor 250 cfm	hour	6.000	257.00	1542.00	P&M-001
			HMP 100-110 TPH Capacity	hour	6.000	12280.00	73680.00	P&M-022
			Tipper 10 tonnes capacity	hour	45.000	225.00	10125.00	P&M-048
			Smooth wheeled roller 8-10 tonnes	hour	12.000	386.00	4632.00	P&M-044
			c) Material					
			I) Bitumen	tonne	22.500	50351.34	1132905.04	M-075
			ii) Bitumen emulsion for tack coat .	tonne	1.180	31532.50	37208.35	M-077
			iii) Aggregates					
			Grading I - 19mm(Nominal size)					
			20-10mm 35 per cent	cum	99.750	874.52	87233.37	M-051,M-052,M-053 and M-054
			10-5 mm 23 per cent	cum	65.550	774.52	50769.79	M-025
			5mm and below40 per cent	cum	114.000	687.02	78320.28	M-021,M-022 and M-024
			Add 5 per cent for wastage				10816.17	
			or					
			Grading-II 13mm (Nominal size)					
			13.2-10 mm 30 per cent	cum	85.500	774.52	66221.46	M-051 and M-052
			10-5 mm 25 per cent	cum	71.250	774.52	55184.55	M-025
			5 mm and Below43 per cent	cum	122.550	687.02	84194.30	M-021,M-022 and M-024
			Filler 2 per cent	tonne	9.000	7598.00	68382.00	M-188
			Add 5 per cent for wastage				13699.12	
			Any one of the above alternatives of aggregate i.e. 19mm or 13mm nominal size may be adopted as per approved design.					
10.5		(i)	for grading I Material					
			d) Overhead charges @ 10%				150592.00	
			e) Contractor's profit @ 10%				165651.20	
			Cost for 4900 cum				1822163.19	
			Rate per cum				371.87	
						say	*372.00*	
10.5		(ii)	for grading II Material					
			d) Overhead charges @ 10%				156646.18	
			e) Contractor's profit @ 10%				172310.80	
			Cost for 4900 cum				1895418.80	
			Rate per cum				386.82	
						say	*387.00*	
		Note	For detailed working of quantities of aggregates, refer item 5.8 of chapter 5					
10.6	3004.3.3		Crack Filling					
			Filling of crack using slow - curing bitumen emulsion and applying crusher dust in case crack are wider than 3mm.					
			Unit = Running Meter					
			Taking out put = 500m					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Material					
			Slow-curing bitumen emulsion	Kg	33.000	31.53	1040.57	M-077
			Stone crusher dust	cum	0.020	599.52	11.99	M-021
			c) Overhead charges @ 10%				130.86	
			d) Contractor's profit @ 10%				143.94	
			Cost for 500sqm				1583.36	
			Rate per meter				3.17	
						say	*3.00*	
10.7	3004.4		Dusting					
			Applying crusher dust to areas of road where bleeding of excess bitumen has occurred.					
			Unit = Sqm					
			Taking output = 3500 sqm					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Material					
			Stone crusher dust finer than 3mm with not more than 10 per cent passing 0.075 sieve.	cum	6.250	599.52	3747.00	M-021
			c) Overhead charges @ 10%				425.90	
			d) Contractor's profit @ 10%				468.49	
			Cost for 3500sqm				5153.39	
			Rate per meter				1.47	
						say	*1.47*	
10.8	(A) 3004.3.2		Fog Seal	sqm			18.00	Item 5.17
	(B) 3004.3.4		Crack Prevention courses.					
		(i)	Stress Absorbing Membrane (SAM) crack width less than 6 mm	sqm			33.00	Item 5.21 Case-I

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		(ii)	Stress Absorbing Membrane (SAM) with crack width 6 mm to 9 mm	sqm			38.00	Item 5.21 Case-II
		(iii)	Stress Absorbing Membrane (SAM) crack width above 9 mm and cracked area above 50 per cent	sqm			50.00	Item 5.21 Case-IV
		(iv)	Bitumen Impregnated Geotextile	sqm			130.00	Item 5.21 Case-IV
10.8	(C) 3004.5		Slurry Seal					
		(i)	5 mm thickness	sqm			30.00	Item 5.15 Case-I
		(ii)	3 mm thickness	sqm			20.00	Item 5.15 Case-II
		(iii)	1.5 mm thickness	sqm			12.00	Item 5.15 Case-III
10.8	(D) 3004.6		Surface Dressing for maintenance works.					
		(i)	19 mm nominal chipping size	sqm			40.00	Item 5.9 Case-I
		(ii)	13 mm nominal size chipping	sqm			33.00	Item 5.9 Case-II
			The above mentioned items have already been included in chapter 5.					
10.9	3005.1		Repair of Joint Grooves with Epoxy Mortar					
			Repair of spalled joint grooves of contraction joints, longitudinal joints and expansion joints in concrete pavements using epoxy mortar or epoxy concrete					
			Unit = running metre					
			Taking output = 10 metres					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	0.500	245.00	122.50	L-13
			Chiseller	day	0.500	275.00	137.50	L-05
			b) Material					
			Epoxy primer	kg	2.500	250.00	625.00	M-097
			Epoxy compound with accessories for preparing epoxy mortar	kg	10.000	375.00	3750.00	M-095
			c) Machinery					
			Air compressor 250 cfm for cleaning	hour	0.050	257.00	12.85	P&M-001
			d) Overhead charges @ 10%				465.89	
			e) Contractor's profit @ 10%				512.47	
			Cost for 10 metres				5637.21	
			Rate per metre				563.72	
						say	*564.00*	
10.10	3005.2		Repair of old Joints Sealant					
			Removal of existing sealant and re sealing of contraction, longitudinal or expansion joints in concrete pavement with fresh sealant material					
			Unit = running metre					
			Taking output = 10 metres					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	0.500	245.00	122.50	L-13
			b) Material					
			Primer	kg	0.250	110.00	27.50	M-146
			Sealant	kg	1.000	50.00	50.00	M-120
			c) Machinery					
			Air compressor 250 cfm for cleaning	hour	0.050	257.00	12.85	P&M-001
			d) Overhead charges @ 10%				22.39	
			e) Contractor's profit @ 10%				24.62	
			Cost for 10 metres				270.86	
			Rate per metre				27.09	
						say	*27.00*	
10.11	3000		Hill Side Drain Clearance					
			Removal of earth from the choked hill side drain and disposing it on the valley side manually					
			Unit = running metre					
			Taking output = 10 metres					
			Assuming muck causing choking of drain to be 0.2 cum per metre, quantity of earth to be removed for 10 metres = 2 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Overhead charges @ 10%				26.70	
			c) Contractor's profit @ 10%				29.37	
			Cost for 10 metres				323.07	
			Rate per metre				32.31	
						say	*32.00*	
10.12	3000		Land Slide Clearance in soil					
			Clearance of land slides in soil and ordinary rock by a bull-dozer D 80 A-12, 180 HP and disposal of the same on the valley side					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Dozer 180 HP @ 60 cum per hour	hour	1.670	2640.00	4408.80	P&M-014
			c) Overhead charges @ 10%				466.48	
			d) Contractor's profit @ 10%				513.13	
			Cost for 100 cum				5644.41	
			Rate per cum				56.44	
						say	*56.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		Note	Land Slide clearance involves pushing of loose earth slided on the road surface from hill face on the valley side. Since no cutting of original ground is involved, the output of dozer has been taken as 60 cum per hour for soil, ordinary rock and blasted hard rock. However, if there are objection to disposing of earth on valley side, additional resources for its disposal shall be considered as per site conditions.					
10.13	3000		Landslide Clearance in Hard Rock Requiring Blasting					
			Clearing of land slide in hard rock requiring blasting for 50 per cent of the boulders and disposal of the same on the valley side.					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.090	275.00	24.75	L-12
			Mazdoor	day	1.500	245.00	367.50	L-13
			Driller	day	0.750	245.00	183.75	L-06
			Blaster	day	0.070	250.00	17.50	L-03
			b) Machinery					
			Dozer D 80 A-12,180 HP @ 60 cum per hour	hour	1.670	2640.00	4408.80	P&M-014
			Air compressor 250 cfm with two jack hammer	hour	2.500	257.00	642.50	P&M-001
			c) Materials					
			Gelatine 80 per cent @ 35 kg per 100 cum	kg	17.500	102.00	1785.00	M-104
			Electric Detonators @ 1 Detonator for 2 Gelatine sticks of 125 gms each	each	70.000	6.12	428.40	M-094 /100
			c) Overhead charges @ 10%				785.82	
			d) Contractor's profit @ 10%				864.40	
			Cost for 100 cum				9508.42	
			Rate per cum				95.08	
						say	*95.00*	
		Note	Credit for the rock if found acceptable as construction material shall be afforded					
10.14	3000		Snow Clearance on Roads with Dozer					
			Snow clearance from road surface by a bull- dozer 165 Hp and disposing it on the valley side					
			Unit = cum					
			Taking output = 5000 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Dozer D 80 A-12,180 HP @ 850 cum per hour	hour	5.880	2640.00	15523.20	P&M-014
			c) Overhead charges @ 10%				1603.52	
			d) Contractor's profit @ 10%				1763.87	
			Cost for 5000 cum				19402.59	
			Rate per cum				3.88	
						say	*4.00*	
		Note	i) Labour provided will not be cutting the snow. They will be guiding the dozer operator on the alignment of the road as entire surface gets covered with snow and the edges of the road are not visible and for changing the blade angle. Also they will keep a watch on the hill side for any eventuality of avalanches, slide etc					
10.15	3000		Snow Clearance on Roads with Snow Blowers					
			Snow clearance from road surface by a snow blower and disposing on the valley side.					
			Unit = cum					
			Taking output = 3600 cum					
			a) Labour					
			Mate	day	0.080	275.00	22.00	L-12
			Mazdoor	day	2.000	245.00	490.00	L-13
			b) Machinery					
			Snow blower equipment 140 HP @ 600 cum per hour	hour	6.000	200.00	1200.00	P&M-087
			c) Overhead charges @ 10%				171.20	
			d) Contractor's profit @ 10%				188.32	
			Cost for 3600 cum				2071.52	
			Rate per cum				0.58	
						say	*0.58*	

CHAPTER-11
HORTICULTURE

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
11.1	307		Spreading of Sludge Farm Yard Manure or/and good Earth					
			Spreading of sludge farm yard manure or/ and good earth in required thickness (cost of sludge, farm yard manure or/and good earth to be paid for separately)					
			Unit = cum					
			Taking output = 15 cum					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Overhead charges @ 10%				25.60	
			c) Contractor's profit @ 10%				28.16	
			Cost for 15 cum				309.76	
			Rate per cum				20.65	
						say	*21.00*	
11.2	307		Grassing with ' Doobs' Grass					
			Grassing with 'Doobs' grass including watering and maintenance of the lawn for 30 days or more till the grass forms a thick lawn free from weeds and fit for moving including supplying good earth if needed					
			Unit = sqm					
			Taking output = 100 sqm					
		(i)	In rows 15 cm apart in either direction					
			a) Labour					
			Mate	day	0.170	275.00	46.75	L-12
			Mazdoor for grassing	day	0.750	245.00	183.75	L-13
			Mazdoor for maintenance for 30 days	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Water tanker6 KL capacity	hour	0.500	374.00	187.00	P&M-060
			c) Material					
			Doob grass	kg	100.000	30.00	3000.00	M-112
			d) Overhead charges @ 10%				366.25	
			e) Contractor's profit @ 10%				402.88	
			Cost for 100 sqm				4431.63	
			Rate per sqm				44.32	
						say	*44.00*	
11.2		(ii)	In rows 7.5 cm apart in either direction					
			a) Labour					
			Mate	day	0.220	275.00	60.50	L-12
			Mazdoor for grassing.	day	1.250	245.00	306.25	L-13
			for maintenance for 30 days	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Water tanker6 KL capacity	hour	0.750	374.00	280.50	P&M-060
			c) Material					
			Doob grass	kg	200.000	30.00	6000.00	M-112
			d) Overhead charges @ 10%				689.23	
			e) Contractor's profit @ 10%				758.15	
			Cost for 100 sqm				8339.62	
			Rate per sqm				83.40	
						say	*83.00*	
		Note	In the case of horticulture one mate has been provided for every 10 mazdoors as maintenance of grass and plants require more care.					
11.3	307		Making Lawns including Ploughing and Dragging with 'Swagha' Breaking of Clod					
			Making lawns including ploughing and breaking of clod, removal of rubbish, dressing and supplying doobs grass roots and planting at 15 cm apart, including supplying and spreading of farm yard manure at rate of 0.18 cum per 100 sqm					
			Unit = sqm					
			Taking output = 100 sqm					
			a) Labour					
			Mate	day	0.150	275.00	41.25	L-12
			Mazdoor for preparation of ground	day	0.500	245.00	122.50	L-13
			Mali for fetching doobs grass roots and grassing at 15 cm apart	day	1.000	245.00	245.00	L-09
			b) Machinery					
			Water tanker6 KL capacity	hour	0.500	374.00	187.00	P&M-060
			Tractor with tiller	hour	0.010	280.00	2.80	P&M-053
			c) Material					
			Supply of farm yard manure at site of work	cum	0.180	110.00	19.80	M-167
			Fine grass	kg	100.000	7.00	700.00	M-113
			d) Overhead charges @ 10%				131.84	
			e) Contractor's profit @ 10%				145.02	
			Cost for 100 sqm				1595.20	
			Rate per sqm				15.95	
						say	*16.00*	
11.4	307		Maintenance of Lawns or Turfing of Slopes					
			Maintenance of lawns or Turfing of slopes (rough grassing) for a period of one year including watering etc					
			Unit = sqm					
			Taking output = 100 sqm					
			a) Labour					
			Mali	day	10.000	275.00	2750.00	L-09
			b) Machinery					
			Water tanker6 KL capacity	hour	15.000	374.00	5610.00	P&M-060
			c) Material					
			Cost of water	KL	90.000	30.00	2700.00	M-189
			d) Overhead charges @ 10%				1106.00	
			e) Contractor's profit @ 10%				1216.60	
			Cost for 100 sqm				13382.60	
			Rate per sqm				133.83	
						say	*134.00*	
11.5	307		Turfing Lawns with Fine Grassing including Ploughing, Dressing					
			Turfing lawns with fine grassing including ploughing, dressing including breaking of clods, removal of rubbish, dressing and supplying doobs grass roots at 10 cm apart, including supplying and spreading of farm yard manure at rate of0.6 cum per 100 sqm					
			Unit = sqm					
			Taking output = 100 sqm					
			a) Labour					
			Mate	day	0.250	275.00	68.75	L-12

			Spreading of sludge farm yard manure or/ and good earth in required thickness (cost of sludge, farm yard manure or/and good earth to be paid for separately)					
			Mazdoor for preparation of ground	day	1.000	245.00	245.00	L-13
			Mali for fetching doobs grass roots hedges and grassing at 10 cm apart	day	1.500	245.00	367.50	L-09
			b) Machinery					
			Water tanker6 KL capacity	hour	0.500	374.00	187.00	P&M-060
			Tractor with tiller	hour	0.010	280.00	2.80	P&M-053
			c) Material					
			Supply of farm yard manure at site of work @ 0.6 cum per 100 sqm	cum	0.600	110.00	66.00	M-167
			Fine grass	kg	100.000	7.00	700.00	M-113
			d) Overhead charges @ 10%				163.71	
			e) Contractor's profit @ 10%				180.08	
			Cost for 100 sqm				1980.83	
			Rate per sqm				19.81	
						say	*20.00*	
11.6	307		Maintenance of Lawns with Fine Grassing for the First Year					
			Maintenance of lawns with fine grassing for the first year including watering etc					
			Unit = sqm					
			Taking output = 100 sqm					
			a) Labour					
			Mali	day	10.000	245.00	2450.00	L-09
			b) Machinery					
			Water tanker6 KL capacity	hour	20.000	374.00	7480.00	P&M-060
			c) Material					
			Cost of water	KL	60.000	30.00	1800.00	M-189
			d) Overhead charges @ 10%				1173.00	
			e) Contractor's profit @ 10%				1290.30	
			Cost for 100 sqm				14193.30	
			Rate per sqm				141.93	
						say	*142.00*	
11.7	307		Planting and Maintaining of Permanent Hedges					
		(a)	Planting permanent hedges including digging of trenches					
			Planting permanent hedges including digging of trenches, 60 cm wide and 45 cm deep, refilling the excavated earth mixed with farmyard manure, supplied at the rate of 4.65 cum per 100 metres and supplying and planting hedge plants at 30 cm apart					
			Unit = Running metre					
			Taking output = 100metre					
			a) Labour					
			Mate	day	1.400	275.00	385.00	L-12
			Mazdoor for digging of trench 60 cm wide and 45 cm deep	day	10.000	245.00	2450.00	L-13
			Mazdoor for refilling the excavated earth mixed with cow dung, preparation of ground and digging of plant, from the nursery carriage to site and planting in position	day	4.000	245.00	980.00	L-13
			b) Machinery					
			Water tanker6 KL capacity	hour	0.500	374.00	187.00	P&M-060
			c) Material					
			Cost of hedge plants 2 rows at 30 cm apart	each	680.000	3.00	2040.00	M-116
			Supply of farm yard manure at site of work	cum	4.670	110.00	513.70	M-167
			Pesticide	kg	0.250	200.00	50.00	M-136
			Cost of water	KL	3.000	30.00	90.00	M-189
			d) Overhead charges @ 10%				669.57	
			e) Contractor's profit @ 10%				736.53	
			Cost for 100 metres				8101.80	
			Rate per metre				81.02	
						say	*81.00*	
		(b)	Maintenance of hedge for one year					
			Unit = Running metre					
			Taking output = 100 m					
			a) Labour					
			Mate	day	3.000	275.00	825.00	L-12
			Mazdoor	day	30.000	245.00	7350.00	L-13
			b) Machinery					
			Water tanker6 KL capacity	hour	5.000	374.00	1870.00	P&M-060
			c) Material					
			Manure sludge/Farm yard manure	cum	2.000	110.00	220.00	M-167
			Pesticide	kg	0.500	200.00	100.00	M-136
			Cost of water	KL	30.000	30.00	900.00	M-189
			Cost of hedge plants @ 10 per cent casualty	each	68.000	3.00	204.00	M-116
			d) Overhead charges @ 10%				1146.90	
			e) Contractor's profit @ 10%				1261.59	
			Cost for 100 metres				13877.49	
			Rate per metre				138.77	
						say	*139.00*	
11.8	307		Planting and Maintaining of Flowering Plants and Shrubs					
		(a)	Planting flowering plants and shrubs in central verge					
			Unit = Running metres 200 plants and 800 shrubs in two rows in one km length of road where width of verge is 3m and above.					
			Taking output = 1000 metres					
			a) Labour					
			Mate	day	1.200	275.00	330.00	L-12
			Mazdoor	day	12.000	245.00	2940.00	L-13
			b) Machinery					
			Water tanker6 KL capacity	hour	6.000	374.00	2244.00	P&M-060
			c) Material					
			Plants	each	200.000	2.50	500.00	M-100
			Shrubs	each	800.000	2.00	1600.00	M-166
			Manure sludge/Farm yard manure	cum	63.640	110.00	7000.40	M-167

			Spreading of sludge farm yard manure or/ and good earth in required thickness (cost of sludge, farm yard manure or/and good earth to be paid for separately)					
			Pesticide	kg	0.500	200.00	100.00	M-136
			Cost of water	KL	36.000	30.00	1080.00	M-189
			d) Overhead charges @ 10%				1579.44	
			e) Contractor's profit @ 10%				1737.38	
			Rate per Km				19111.22	
						say	*19111.00*	
11.8		(b)	Maintenance of flowering plants and shrubs in central verge for one year					
			Unit = km					
			Taking output = one km					
			a) Labour					
			Mate	day	36.000	275.00	9900.00	L-12
			Mazdoor	day	365.000	245.00	89425.00	L-13
			b) Machinery					
			Water tanker6 KL capacity	hour	90.000	374.00	33660.00	P&M-060
			c) Material					
			Manure Sludge / farm yard manure at site	cum	10.000	110.00	1100.00	M-167
			Cost of water	KL	180.000	30.00	5400.00	M-189
			Replacement of casualties @ 10 per cent					
			Plants	each	20.000	2.50	50.00	M-100
			Shrubs	each	80.000	2.00	160.00	M-166
			Pesticides	kg	1.500	200.00	300.00	M-136
			d) Overhead charges @ 10%				13999.50	
			e) Contractor's profit @ 10%				15399.45	
			Rate per Km for one year				169393.95	
						say	*169394.00*	
11.9	307		Planting of Trees and their Maintenance for one Year					
			Planting of trees by the road side (Avenue trees) in 0.60 m dia holes, 1 m deep dug in the ground, mixing the soil with decayed farm yard/sludge manure, planting the saplings, backfilling the trench, watering, fixing the tree guard and maintaining the plants for one year					
			Unit = Each					
			Taking output = 10 trees					
			a) Labour					
			Mate	day	1.700	275.00	467.50	L-12
			Mazdoor for planting	day	2.000	245.00	490.00	L-13
			Mazdoor for maintenance for one year	day	15.000	245.00	3675.00	L-13
			b) Machinery					
			Water tanker6 KL capacity	hour	2.000	374.00	748.00	P&M-060
			c) Material					
			Sapling 2 m high 25 mm dia	each	10.000	10.00	100.00	M-160
			Farm yard manure	cum	0.940	110.00	103.40	M-167
			Pesticide	kg	0.500	200.00	100.00	M-136
			Cost of water	KL	12.000	30.00	360.00	M-189
			d) Overhead charges @ 10%				604.39	
			e) Contractor's profit @ 10%				664.83	
			Cost for 10 trees				7313.12	
			Rate per trees				731.31	
						say	*731.00*	
11.10	308		Renovation Lawns including, Weeding, Forking the Ground, Top Dressing with Forked Soil					
			Renovation lawns including, weeding, forking the ground, top dressing with forked soil, watering and maintenance the lawns, for 30 days or more, till the grass forms a thick lawn, free from weeds, and fit for moving and disposal of rubbish as directed, including supplying good earth, if needed but excluding the cost of well decayed farm yard manure					
			Unit = sqm					
			Taking output = 100 sqm					
			a) Labour					
			Mate	day	0.120	275.00	33.00	L-12
			Mazdoor	day	3.000	245.00	735.00	L-13
			b) Machinery					
			Water tanker6 KL capacity	hour	0.500	374.00	187.00	P&M-060
			c) Material					
			Cost of water	KL	3.000	30.00	90.00	M-189
			d) Overhead charges @ 10%				104.50	
			e) Contractor's profit @ 10%				114.95	
			Cost for 100 sqm				1264.45	
			Rate per sqm				12.64	
						say	*13.00*	
11.11	308.2		Supply at Site Well Decayed Farm Yard Manure					
			Supply at site of work well decayed farm yard manure, from any available source, approved by the engineer in charge including screening and stacking					
			Unit = cum					
			Taking output = one cum					
			a) Material					
			a) Cost of well decayed farm yard manure duly screened, loading, carriage, unloading and stacking at site	cum	1.000	110.00	110.00	M-167
			b) Overhead charges @ 10%				11.00	
			c) Contractor's profit @ 10%				12.10	
			Rate per cum				133.10	
							133.00	
11.12	308.20		Supply at Site of Work/ Store-Deoiled Neem Cake					
			Supply at site of work/ store-deoiled neem cake duly packed in used gunny bags					
			Unit = quintal					
			Taking output = one quintal					
			a) Cost, carriage, loading, unloading and stacking in store/site	quintal	1.000			
			b) Overheads@ per cent on (a)					
			c) Contractors profit@ per cent on (a+b)					

			Spreading of sludge farm yard manure or/ and good earth in required thickness (cost of sludge, farm yard manure or/and good earth to be paid for separately)					
			Rate per quintal = a+b+c					
11.13	308.2		Supplying Sludge					
			Supplying sludge duly stacked at site/ store					
			Unit = cum					
			Taking output = one cum					
			a) Cost of sludge including carriage, loading, unloading and stacking at site	cum	1.000			
			b) Overheads@ per cent on (a)					
			c) Contractors profit@ per cent on (a+b)					
			Rate per cum = a+b+c					
11.14		New	Half Brick Circular Tree Guard, in 2nd Class Brick, internal diametre 1.25 metres, and height 1.2 metres, above ground and 0.20 metre below ground					
			Half brick circular tree guard, in 2nd class brick, internal diametre 1.25 metres, and height 1.2 metres, above ground and 0.20 metre below ground, bottom two courses laid dry, and top three courses in cement mortar 1:6 (1 cement 6 sand) and the intermediate courses being in dry honey comb masonry, as per design complete					
			Unit = Each					
			Taking output = one tree guard					
			a) Labour					
			Mate	day	0.050	275.00	13.75	L-12
			Mason	day	0.250	245.00	61.25	L-11
			Mazdoor	day	0.250	245.00	61.25	L-13
			b) Material					
			Brick 2nd class including carriage	each	230.000	6.50	1495.00	M-079
			Cement mortar 1:6	cum	0.025	4004.00	100.10	Item 12.6 (D)
			c) Overhead charges @ 10%				173.14	
			d) Contractor's profit @ 10%				190.45	
			Rate per tree Guard				2094.93	
						say	*2095.00*	
11.15		New	Edging with 2nd Class Bricks, Laid Dry Lengthwise					
			Edging with 2nd class bricks, laid dry lengthwise, including excavation, refilling, consolidation, with a hand packing and spreading nearly surplus earth within a lead of 50 metres					
			Unit = Metre					
			Taking output= 10 metres					
			a) Labour					
			Mate	day	0.002	275.00	0.55	L-12
			Mason	day	0.050	245.00	12.25	L-11
			Mazdoor	day	0.050	245.00	12.25	L-13
			b) Material					
			Brick 2nd class including carriage	each	50.000	6.50	325.00	M-079
			c) Overhead charges @ 10%				35.01	
			d) Contractor's profit @ 10%				38.51	
			Cost for 10 metre				423.56	
			Rate per metre				42.36	
						say	*42.00*	
11.16		New	Making Tree Guard 53 cm dia and 1.3 m High as per Design from Empty Bitumen Drums					
			Making tree guard 53 cm dia and 1.3 m high as per design from empty bitumen drum, slit suitably to permit sun and air, (supplied by the department at stock issue rate) including providing and fixing 2 nos MS sheet rings 50 x 0.5 mm with rivets, complete in all respect					
			Unit = Each					
			Taking output = one tree guard					
			a) Labour					
			Mate	day	0.020	275.00	5.50	L-12
			Blacksmith	day	0.150	245.00	36.75	L-02
			Mazdoor	day	0.070	245.00	17.15	L-13
			b) Material					
			Empty bitumen drum	each	1.000	100.00	100.00	M-172
			MS sheet 50 x 0.5 mm	kg	0.650	34.00	22.10	M-179 /1000
			Rivets 6 mm dia and 10 mm in length	each	22.000	3.00	66.00	M-158
			c) Overhead charges @ 10%				24.75	
			d) Contractor's profit @ 10%				27.23	
			Rate for each tree guard				299.48	
						say	*299.00*	
11.17		New	Making Tree Guard 53 cm dia and 2 Metre High as per Design from Empty Bitumen Drums					
			Making tree guard 53 cm dia and 2 metres high as per design from empty bitumen drums, slit suitably to permit sun and air, (supplied by the department at stock issue rate) including providing and fixing four legs 40 cm long of 30 x 3 mm MS riveted to tree guard and providing and fixing 2 nos MS sheet rings 50 x 0.5 mm with rivets complete in all respects					
			Unit = Each					
			Taking output = one tree guard					
			a) Labour					
			Mate		0.040	275.00	11.00	L-12
			Blacksmith	day	0.200	245.00	49.00	L-02
			Mazdoor		0.200	245.00	49.00	L-13
			b) Material					
			Empty bitumen drum	each	1.500	100.00	150.00	M-172
			MS sheet50 x 0.5 mm	kg	0.650	34.00	22.10	M-179 /1000
			Rivets 6 mm dia and 10 mm in length	each	50.000	3.00	150.00	M-158
			MSplate30 x 3 mm	kg	1.300	34.00	44.20	M-179 /1000
			c) Overhead charges @ 10%				47.53	
			d) Contractor's profit @ 10%				52.28	
			Rate for each tree guard				575.11	
						say	*575.00*	

			Spreading of sludge farm yard manure or/ and good earth in required thickness (cost of sludge, farm yard manure or/and good earth to be paid for separately)					
11.18		New	Wrought Iron and Mild Steel Welded Work					
			Wrought iron and mild steel welded work (using angles, square bars, tees and channel grills, grating frames, gates and tree guards of any size and design etc. including cost of screens and welding rods or bolts and nuts complete fixed in position but without the cost of excavation and concrete for fixing which will be paid separately					
			Unit = quintal					
			Taking output = one quintal					
			a) Labour					
			Mate	day	0.450	275.00	123.75	L-12
			Blacksmith/ welder for cutting to design and shape and jointing	day	2.000	245.00	490.00	L-02
			Mazdoor for fixing and helper for Blacksmith/welder	day	2.500	245.00	612.50	L-13
			b) Material					
			Angle, tees, channels etc	quintal	1.050	5119.80	5375.79	M-179 /10
			Deduct the cost of scrap	quintal	0.050	(5375.79)	(268.79)	M-179/10/3
			Add 5 per cent of cost of material for welding rods and other welding accessories				255.35	
			c) Overhead charges @ 10%				658.86	
			d) Contractor's profit @ 10%				724.75	
			Rate per quintal				7972.21	
						say	*7972.00*	
11.19		New	Tree Guard with MS Iron					
			Providing and fixing MS iron tree guard 60 cm dia and 2 metre high above ground level formed of 4 Nos (25 x 6 mm) and 8 Nos (25 x 3 mm) vertical MS riveted to 3 Nos (25 x 6 mm) iron rings in two halves, bolted together with 8 mm dia and 30 mm long bolts including painting two coats with paint of approved brand over a coat of priming, complete in all respects.					
			Unit = Each					
			Taking output = one tree guard					
			a) Labour					
			Mate	day	0.050	275.00	13.75	L-12
			Blacksmith	day	0.250	245.00	61.25	L-02
			Mazdoor	day	0.250	245.00	61.25	L-13
			b) Material					
			MS iron 25 x 6 mm	kg	19.200	51.20	983.00	M-179 /1000
			MS iron 25 x 3 mm	kg	9.600	51.20	491.50	M-179 /1000
			Add 5 per cent of cost of material for riveting, bolting and welding accessories				73.73	
			c) Machinery					
			Tractor-trolley	hour	0.040	280.00	11.20	P&M-053
			d) Painting					
			Painting two coats including priming	sqm	1.770	64.00	113.28	Item 8.9
			e) Overhead charges @ 10%				169.57	
			f) Contractor's profit @ 10%				186.52	
			Rate per tree guard				2165.05	
						say	*2165.00*	
		Note	1 The items of excavation and concreting to be measured and paid separately as per design .					
			2 . Rate of painting may be adopted from the chapter as Traffic signs.					
11.20		New	Tree Guard with MS Angle Iron and Steel Wire					
			Providing and fixing tree guard 0.60 metre square, 2.00 metre high fabricated with MS angle iron 30 x 30 x 3 mm, MS iron 25 x 3 mm and steel wire3 mm dia welded and fabricated as per design in two halves bolted together					
			Unit = Each					
			Taking output = one					
			a) Labour					
			Mate	day	0.050	275.00	13.75	L-12
			Blacksmith	day	0.250	245.00	61.25	L-02
			Welder	day	0.250	250.00	62.50	L-02
			Mazdoor	day	0.250	245.00	61.25	L-13
			b) Material					
			MS angle 30 x 30 x 3 mm	kg	13.500	51.20	691.17	M-179 /1000
			MS iron 25 x 3 mm	kg	18.000	51.20	921.56	M-179 /1000
			Steel wire 3 mm dia	kg	6.000	63.90	383.39	M-192
			Add 5 per cent of cost of material for riveting, bolting and welding accessories				99.81	
			c) Machinery					
			Tractor-trolley	hour	0.040	280.00	11.20	P&M-053
			d) Painting					
			Painting two coats including priming	sqm	1.500	64.00	96.00	Item 8.9
			e) Overhead charges @ 10%				230.59	
			f) Contractor's profit @ 10%				253.65	
			Rate per tree guard				2886.12	
						say	*2886.00*	
11.21		New	Compensatory Afforestation					
			Planting trees as compensatory afforestation at the rate of 290 trees per hectare at a spacing of 6 m by grubbing and leveling the ground upto a depth of 150 mm, digging holes 0.9 m dia, 1 m deep, mixing farm yard/sludge manure with soil, planting of sapling 2 m high with 25 cm dia stem, backfilling the hole and watering					
			Unit = Hectare					
			Taking output = one hectare					
			a) Labour					
			i) Planting					
			Mate	day	2.500	275.00	687.50	L-12
			Mazdoor	day	25.000	245.00	6125.00	L-13
			ii) For Maintenance for one year					
			Mate	day	5.000	275.00	1375.00	L-12

			Spreading of sludge farm yard manure or/ and good earth in required thickness (cost of sludge, farm yard manure or/and good earth to be paid for separately)					
			Mazdoor	day	50.000	245.00	12250.00	L-13
			b) Machinery					
			Dozer 80 HP @ 1000 sqm/hour	hour	10.000	1565.00	15650.00	P&M-015
			Water tanker6 KL capacity (for planting)	hour	3.000	374.00	1122.00	P&M-060
			Water tanker6 KL capacity (for maintenance)	hour	25.000	374.00	9350.00	P&M-060
			c) Material					
			Sapling 1 to 1.5 m high 2 cm dia stem	each	290.000	8.00	2320.00	M-160 x 0.8
			Add 10 per cent of sapling	each	29.000	0.80	23.20	M-160 x 0.8
			Decayed farm yard/sludge manure (planting)	cum	60.900	110.00	6699.00	M-167
			Decayed farm yard/sludge manure (maintenance)	cum	4.000	110.00	440.00	M-167
			Pesticides for planting	kg	0.500	200.00	100.00	M-136
			Pesticides for maintenance	kg	1.500	200.00	300.00	M-136
			Cost of water	KL	18.000	30.00	540.00	M-189
			d) Overhead charges @ 10%				5698.17	
			e) Contractor's profit @ 10%				6267.99	
			Rate per hectare				68947.86	
						say	*68948.00*	
		Note	Cost of fencing to be provided as per size of plot and approved design, measured and paid separately					

CHAPTER-12								
FOUNDATIONS								
Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
12.1	304		Excavation for Structures					
			Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom and backfilling with approved material.					
		I	Ordinary soil					
			Unit = cum					
			Taking output = 10 cum					
		A	Manual Means					
		(i)	Depth upto 3 m					
			a) Labour					
			Mate	day	0.14	275.00	38.50	L-12
			Mazdoor	day	3.50	245.00	857.50	L-13
			b) Overhead charges @ 20%				179.20	
			c) Contractor's profit @ 10%				107.52	
			Cost for 10 cum				1182.72	
			Rate per cum				118.27	
						say	*118.00*	
		Note	1. Cost of dewatering may be added where required upto, 10 per cent of labour cost Assessment for dewatering shall be made as per site conditions.					
			2.The excavated earth can be used partially for backfilling of foundation pit and partly for road work except for marshy soil. Hence cost of disposal has not been added except for marshy soil. This remark is common to all cases of item 12.1 excluding marshy soil.					
			3.The cost of shoring and shuttering, where needed, may be added @ 1 per cent on cost of excavation for open foundation.					
12.1 (I) A		(ii)	Depth 3 m to 6 m					
			a) Labour					
			Mate/Supervisor	day	0.18	275.00	49.50	L-12
			Mazdoor	day	4.50	245.00	1102.50	L-13
			b) Overhead charges @ 20%				230.40	
			c) Contractor's profit @ 10%				138.24	
			Cost for 10 cum				1520.64	
			Rate per cum				152.06	
						say	*152.00*	
		Note	Cost of dewatering may be added where required upto 15 per cent of labour cost. Assessment for dewatering shall be done as per actual ground conditions.					
12.1 (I) A		(iii)	Depth above 6 m					
			a) Labour					
			Mate/Supervisor	day	0.24	275.00	66.00	L-12
			Mazdoor	day	6.00	245.00	1470.00	L-13
			b) Overhead charges @ 20%				307.20	
			c) Contractor's profit @ 10%				184.32	
			Cost for 10 cum				2027.52	
			Rate per cum				202.75	
						say	*203.00*	
		Note	1. Cost of dewatering may be added where required upto 20 per cent of labour cost. Assessment for dewatering shall be made as per site conditions..					
12.1 (I)		B	Mechanical Means					
		(i)	Depth upto 3 m					
			Unit = cum					
			Taking output = 240 cum					
			a) Labour					
			Mate	day	0.32	275.00	88.00	L-12
			Mazdoor	day	8.00	245.00	1960.00	L-13
			b) Machinery					
			Hydraulic excavator 1.0 cum bucket capacity	hour	6.00	1008.00	6048.00	P&M-026
			c) Overhead charges @ 20%				1619.20	
			d) Contractor's profit @ 10%				971.52	
			Cost for 240 cum				10686.72	
			Rate per cum				44.53	
						say	*45.00*	
		Note	Cost of dewatering upto 5 per cent of (a+b) may be added, where required. Assessment for dewatering shall be made as per site conditions..					
12.1 (I) B		(ii)	Depth 3 m to 6 m					
			Unit = cum					
			Taking output = 210 cum					
			a) Labour					
			Mate	day	0.32	275.00	88.00	L-12
			Mazdoor	day	8.00	245.00	1960.00	L-13
			b) Machinery					
			Hydraulic excavator 1.0 cum bucket capacity	hour	6.00	1008.00	6048.00	P&M-026
			c) Overhead charges @ 20%				1619.20	
			d) Contractor's profit @ 10%				971.52	
			Cost for 210 cum				10686.72	
			Rate per cum				50.89	
						say	*51.00*	
		Note	Cost of dewatering upto 7.5 per cent of (a+b) may be added, where required. Assessment for dewatering shall be made as per site conditions..					
12.1 (I) B		(iii)	Depth above 6m					
			Unit = cum					
			Taking output = 180 cum					
			a) Labour					
			Mate	day	0.40	275.00	110.00	L-12
			Mazdoor	day	10.00	245.00	2450.00	L-13
			b) Machinery					
			Hydraulic excavator 1.0 cum bucket capacity	hour	6.00	1008.00	6048.00	P&M-026
			c) Overhead charges @ 20%				1721.60	
			d) Contractor's profit @ 10%				1032.96	
			Cost for 180 cum				11362.56	
			Rate per cum				63.13	
						say	*63.00*	
		Note	1. Cost of dewatering upto 10 per cent of (a+b) may be added, where required. Assessment for dewatering shall be made as per site conditions..					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			2.Labour provided for excavation by mechanical means includes that required for trimming of bottom and side slopes.					
12.1		II	Ordinary Rock (not requiring blasting)					
		A	Manual Means					
		(i)	Depth upto 3 m					
			Unit = cum					
			Taking output = 10 cum					
			a) Labour					
			Mate	day	0.20	275.00	55.00	L-12
			Mazdoor	day	5.00	245.00	1225.00	L-13
			b) Overhead charges @ 20%				256.00	
			c) Contractor's profit @ 10%				153.60	
			Cost for 10 cum				1689.60	
			Rate per cum				168.96	
						say	*169.00*	
		Note	Cost of dewatering upto 10 per cent of labour cost may be added, where required. Assessment for dewatering shall be made as per site conditions..					
12.1(II)		B	Mechanical Means					
			Unit = cum					
			Taking output = 180 cum					
			a) Labour					
			Mate	day	0.24	275.00	66.00	L-12
			Mazdoor	day	6.00	245.00	1470.00	L-13
			b) Machinery					
			Hydraulic excavator 1.0 cum bucket capacity	hour	6.00	1008.00	6048.00	P&M-026
			c) Overhead charges @ 20%				1516.80	
			d) Contractor's profit @ 10%				910.08	
			Cost for 180 cum				10010.88	
			Rate per cum				55.62	
						say	*56.00*	
		Note	1.Cost of dewatering upto 10 per cent of (a+b), may be added, where required Assessment for dewatering shall be made as per site conditions.					
			2.In case of rock, foundation beyond3 m is not dug and hence not included.					
12.1		III	Hard Rock (requiring blasting)					
		A	Manual Means					
			Unit = cum					
			Taking output = 10 cum					
			a) Labour					
			Mate	day	0.35	275.00	96.25	L-12
			Driller	day	0.50	245.00	122.50	L-06
			Blaster	day	0.25	250.00	62.50	L-03
			Mazdoor	day	8.00	245.00	1960.00	L-13
			b) Machinery					
			Air Compressor 250 cfm with 2 jack hammer for drilling.	hour	1.00	257.00	257.00	P&M-001
			c) Material					
			Blasting Material	kg	3.50	102.00	357.00	M-104
			Detonator electric	each	14.00	6.12	85.68	M-094/100
			d) Overhead charges @ 20%				588.19	
			e) Contractor's profit @ 10%				352.91	
			Cost for 10 cum				3882.03	
			Rate per cum				388.20	
						say	*388.00*	
		Note	Cost of dewatering @ 10 per cent of (a+b) may be added, where required Assessment for dewatering shall be made as per site conditions.					
12.1		IV	Hard Rock (blasting prohibited)					
			Unit = cum					
			Taking output = 10 cum					
		A	Mechanical Means					
			a) Labour					
			Mate	day	0.20	275.00	55.00	L-12
			Mazdoor	day	5.00	245.00	1225.00	L-13
			b) Machinery					
			Air Compressor 250 cfm with 2 leads of pneumatic breaker	hour	6.00	257.00	1542.00	P&M-001
			c) Overhead charges @ 20%				564.40	
			d) Contractor's profit @ 10%				338.64	
			Cost for 10 cum				3725.04	
			Rate per cum				372.50	
						say	*373.00*	
		Note	1. Cost of dewatering upto10 per cent of (a+b), may be added, where required Assessment for dewatering shall be made as per site conditions.					
			2.In case of rock, foundation beyond3 m is not dug and hence not included.					
12.1		V	Marshy Soil					
			Unit = cum					
			Taking output = 10 cum					
			Depth upto 3 m					
		A	Manual means					
			a) Labour					
			Mate/Supervisor	day	0.40	275.00	110.00	L-12
			Mazdoor	day	10.00	245.00	2450.00	L-13
			b) Machinery					
			Tractor-trolley for removal.	hour	2.67	280.00	747.60	P&M-053
			c) Overhead charges @ 20%				661.52	
			d) Contractor's profit @ 10%				396.91	
			Cost for 10 cum				4366.03	
			Rate per cum				436.60	
						say	*437.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		Note	1. Cost of dewatering @ 30 per cent of (a), may be added, where required Assessment for dewatering shall be made as per site conditions.					
			2. Shoring & strutting 15 per cent of (a), where required may be added					
			3. It is assumed that Marshy Soil will be available upto 3 m depth only. For deeper excavation below 3 m depth, refer analysis in item12.1 (i) to (iv) for ordinary soil					
12.1 (V)		B	Mechanical Means					
			a) Labour					
			Mate	day	0.08	275.00	22.00	L-12
			Mazdoor for dressing sides, bottom and backfilling	day	2.00	245.00	490.00	L-13
			b) Machinery					
			Hydraulic excavator 1.0 cum bucket capacity @ 60 cum per hour	hour	0.17	1008.00	171.36	P&M-026
			Tipper 5.5 cum capacity, 4 trips per hour.	hour	0.45	240.00	108.00	P&M-048
			c) Overhead charges @ 20%				158.27	
			d) Contractor's profit @ 10%				94.96	
			Cost for 10 cum				1044.60	
			Rate per cum				104.46	
						say	*104.00*	
		Note	1. Cost of dewatering @ 20 per cent of (a+b) may be added, where required					
			2. Shoring & strutting @ 10 per cent of (a+b), where required may be added					
			3. It is assumed that Marshy Soil will be available upto 3 m depth only. For deeper excavation below 3 m depth, refer analysis in item 12.1 (i) to (iv) for ordinary soil					
		VI	Back Filling in Marshy Foundation Pits					
			Unit : Cum					
			Taking Output : 6 cum					
			a) Labour					
			Mate	day	0.12	275.00	33.00	L-12
			Mazdoor for dressing sides, bottom and backfilling	day	3.00	245.00	735.00	L-13
			b) Machinery					
			Tractor-trolley for transportation	hour	2.00	280.00	560.00	P&M-053
			c) Overhead charges @ 20%				265.60	
			d) Contractor's profit @ 10%				159.36	
			Cost for 6 cum				1752.96	
			Rate per cum				292.16	
						say	*292.00*	
12.2	304		Filling Annular Space Around Footing in Rock					
			Unit = cum					
			Taking out put = 1 cum					
			Lean cement concrete 1:3:6 nominal mix. Rate may be taken as per item 12.4.					
12.3	304		Sand Filling in Foundation Trenches as per Drawing & Technical Specification					
			Unit = cum					
			Taking output = 1 cum					
			a) Labour					
			Mate	day	0.01	275.00	2.75	L-12
			Mazdoor	day	0.30	245.00	73.50	L-13
			b) Material					
			Sand (assuming 20 per cent voids)	cum	1.20	1184.68	1421.62	M-006
			c) Overhead charges @ 20%				299.57	
			d) Contractor's profit @ 10%				179.74	
			Rate per cum				1977.18	
						say	*1977.00*	
12.4	2100		PCC 1:3:6 in Foundation					
			Plain cement concrete 1:3:6 nominal mix in foundation with crushed stone aggregate 40 mm nominal size mechanically mixed, placed in foundation and compacted by vibration including curing for 14 days.					
			Unit = cum					
			Taking output = 15 cum					
			a) Labour					
			Mate	day	0.64	275.00	176.00	L-12
			Mason	day	1.00	245.00	245.00	L-11
			Mazdoor	day	15.00	245.00	3675.00	L-13
			b) Material					
			40 mm Aggregate	cum	13.50	974.52	13156.02	M-055
			coarse Sand	cum	6.75	1184.68	7996.59	M-005
			cement	tonne	3.45	7598.00	26213.10	M-081
			Cost of water	KL	18.00	30.00	540.00	M-189
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Water tanker 6 KL capacity	hour	2.00	374.00	748.00	P&M-060
			d) Overhead charges @ 20%				11073.14	
			e) Contractor's profit @ 10%				6643.89	
			Cost for 15 cum				73082.74	
			Rate per cum				4872.18	
						say	*4872.00*	
		Note	Vibrator is a part of minor T & P which is already included in overhead charges of the contractor.					
12.5	1300		Brick Masonry Work in Cement Mortar 1:3 in Foundation complete excluding Pointing and Plastering, as per Drawing and Technical Specifications.					
			Unit = cum					
			Taking output = 5 cum					
			a) Material					
			Bricks Ist class	each	2500.00	6.50	16250.00	M-079
			Cement mortar 1:3 (Rate as in Item 12.6 A sub-analysis)	cum	1.20	5350.00	6420.00	Item 12.6 (A)
			b) Labour					
			Mate	day	0.48	275.00	132.00	L-12

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mason	day	4.00	245.00	980.00	L-11
			Mazdoor	day	8.00	245.00	1960.00	L-13
			c) Overhead charges @ 20%				5148.40	
			d) Contractor's profit @ 10%				3089.04	
			Cost for 5 cum				33979.44	
			Rate per cum				6795.89	
						say	*6796.00*	
12.6	Sub-analysis	(A)	Cement Mortar 1:3 (1 cement : 3 sand)					
			Unit = 1 cum					
			Taking output = 1 cum					
			a) Materials					
			Cement	tonne	0.51	7598.00	3874.98	M-081
			Sand	cum	1.05	1184.68	1243.91	M-005
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mazdoor	day	0.90	245.00	220.50	L-13
			Total Material and Labour = (a+b)			*say*	5350.00	
	Sub-analysis (Addl.)	(B)	Cement Mortar1:2 (1cement :2 sand)					
			Unit = 1 cum					
			Taking output = 1 cum					
			a) Materials					
			Cement	tonne	0.67	7598.00	5105.86	M-081
			Sand	cum	0.93	1184.68	1101.75	M-005
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mazdoor	day	0.90	245.00	220.50	L-13
			Total Material and Labour = (a+b)			*say*	6439.00	
	Sub-analysis (Addl.)	(C)	Cement Mortar1:4 (1cement :4 sand)					
			Unit = 1 cum					
			Taking output = 1 cum					
			a) Materials					
			Cement	tonne	0.40	7598.00	3063.51	M-081
			Sand	cum	1.12	1184.68	1326.84	M-005
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mazdoor	day	0.90	245.00	220.50	L-13
			Total Material and Labour = (a+b)			*say*	4622.00	
	Sub-analysis (Addl.)	(D)	Cement Mortar1:6 (1cement :6 sand)					
			Unit = 1 cum					
			Taking output = 1 cum					
			a) Materials					
			Cement	tonne	0.29	7598.00	2188.22	M-081
			Sand	cum	1.34	1184.68	1584.09	M-005
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mazdoor	day	0.90	245.00	220.50	L-13
			Total Material and Labour = (a+b)			*say*	4004.00	
12.7	1400		Stone Masonry Work in Cement Mortar 1:3 in Foundation complete as per Drawing and Technical Specifications.					
			Unit = cum					
			Taking output = 5 cum					
	1405.4	(A)	Square Rubble Coursed Rubble Masonry (first sort)					
			a) Material					
			Stone	cum	5.50	799.52	4397.36	M-169
			Through and bond stone	each	35.00	13.69	479.20	M-182
			(35no.x0.24mx0.24mx0.39m = 0.79 cu.m)					
			Cement mortar 1:3 (Rate as in Item 12.6 A sub-analysis)	cum	1.50	5350.00	8025.00	Item 12.6 (A)
			b) Labour					
			Mate	day	0.66	275.00	181.50	L-12
			Mason	day	7.50	245.00	1837.50	L-11
			Mazdoor	day	9.00	245.00	2205.00	L-13
			c) Overhead charges @ 20%				3425.11	
			d) Contractor's profit @ 10%				2055.07	
			Cost for 5 cum				22605.74	
			Rate per cum				4521.15	
						say	*4521.00*	
	1405.3	(B)	Random Rubble Masonry					
			(coursed/uncoursed)					
			Unit = cum					
			Taking output = 5 cum					
			a) Material					
			Stone	cum	5.50	799.52	4397.36	M-148
			Through and bond stone	each	35.00	13.69	479.20	M-182
			(35nos.x0.24mx0.24mx0.39m = 0.79 cu.m)					
			Cement mortar 1:3 (Rate as in Item 12.6 A sub-analysis)	cum	1.55	5350.00	8292.50	Item 12.6 (A)
			b) Labour					
			Mate	day	0.62	275.00	170.50	L-12
			Mason	day	6.00	245.00	1470.00	L-11
			Mazdoor	day	9.00	245.00	2205.00	L-13
			c) Overhead charges @ 20%				3402.91	
			d) Contractor's profit @ 10%				2041.75	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Cost for 5 cum				22459.22	
			Rate per cum				4491.84	
						say	*4492.00*	
		Note	The labour already considered in cement mortar has been taken into account while proposing labour for masonry works.					
12.8	1500, 1700 & 2100		Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications.					
		A	PCC Grade M15					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	4.13	7598.00	31379.74	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			40 mm Aggregate	cum	8.10	974.52	7893.61	M-055
			20 mm Aggregate	cum	4.05	974.52	3946.81	M-053
			10 mm Aggregate	cum	1.35	774.52	1045.60	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 63 KVA	hour	6.00	562.00	3372.00	P&M-019
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4145.00*			
			d) Formwork @ 4 per cent on cost of concrete i.e. cost of material, labour and machinery				2486.81	
			e) Overhead charges @ 20%				12931.43	
			f) Contractor's profit @ 10%				7758.86	
			Cost for 15 cum				85347.46	
			Rate per cum				5689.83	
						say	*5690.00*	
		Note	Needle Vibrator is an item of minor T & P which is already included in overhead charges. Hence not added in rate analysis of cement concrete works.					
12.8		B	PCC Grade M20					
			Unit : cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	5.16	7598.00	39205.68	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			40 mm Aggregate	cum	5.40	974.52	5262.41	M-055
			20 mm Aggregate	cum	5.40	974.52	5262.41	M-053
			10 mm Aggregate	cum	2.70	774.52	2091.20	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4530.00*			
			d) Formwork @ 4 per cent on cost of concrete i.e. cost of material, labour and machinery				2717.53	
			e) Overhead charges @ 20%				14131.16	
			f) Contractor's profit @ 10%				8478.70	
			Cost for 15 cum				93265.68	
			Rate per cum				6217.71	
						say	*6218.00*	
12.8		C	RCC Grade M20					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	5.21	7598.00	39585.58	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4519.00*			
			d) Formwork @ 4 per cent				2711.13	
			e) Overhead charges @ 20%				14097.86	
			f) Contractor's profit @ 10%				8458.72	
			Cost for 15 cum				93045.90	
			Rate per cum				6203.06	
						say	*6203.00*	
12.8 C		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Unit : cum					
			Taking Output = 120 cum					
			a) Material					
			Cement	tonne	41.66	7598.00	316532.68	M-081
			Coarse Sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Lead beyond 1 km, L-lead in km	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4262.00*			
			d) Formwork @ 4 per cent on cost of concrete i.e. cost of material, labour and machinery				20455.18	
			e) Overhead charges @ 20%				106366.95	
			f) Contractor's profit @ 10%				63820.17	
			Cost for 120 cum				702021.86	
			Rate per cum				5850.18	
						say	*5850.00*	
12.8		D	PCC Grade M25					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	5.99	7598.00	45512.02	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			40 mm Aggregate	cum	5.40	974.52	5262.41	M-055
			20 mm Aggregate	cum	5.40	974.52	5262.41	M-053
			10 mm Aggregate	cum	2.70	774.52	2091.20	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4950.00*			
			d) Formwork @ 3.75 per cent of (a+b+c)				2784.17	
			e) Overhead charges @ 20%				15405.76	
			f) Contractor's profit @ 10%				9243.46	
			Cost for 15 cum				101678.02	
			Rate per cum				6778.53	
						say	*6779.00*	
12.8 D		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Unit : cum					
			Taking Output = 120 cum					
			a) Material					
			Cement	tonne	47.95	7598.00	364324.10	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			40 mm Aggregate	cum	43.20	974.52	42099.26	M-055
			20 mm Aggregate	cum	43.20	974.52	42099.26	M-053
			10 mm Aggregate	cum	21.60	774.52	16729.63	M-051
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Transit Mixer 4 cum capacity lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4696.00*			
			d) Formwork @ 3.75 per cent of cost of concrete i.e. cost of material, labour and machinery				21130.91	
			e) Overhead charges @ 20%				116924.38	
			f) Contractor's profit @ 10%				70154.63	
			cost of 120 cum				771700.90	
			Rate per cum				6430.84	
						say	*6431.00*	
12.8		E	RCC Grade M25					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	6.05	7598.00	45967.90	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4945.00*			
			d) Formwork @ 3.75 per cent of a+b+c.				2781.02	
			e) Overhead charges @ 20%				15388.31	
			f) Contractor's profit @ 10%				9232.98	
			cost of 15 cum				101562.82	
			Rate per cum				6770.85	
						say	*6771.00*	
12.8 E		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Unit: cum					
			Taking Output = 120 cum					
			a) Material					
			Cement	tonne	48.38	7598.00	367591.24	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity 1 cum	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Transit Mixer 4 cum capacity lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4687.00*			
			d) Formwork @ 3.75 per cent on cost of concrete i.e. cost of material, labour and machinery				21091.43	
			e) Overhead charges @ 20%				116705.91	
			f) Contractor's profit @ 10%				70023.55	
			cost of 120 cum				770259.01	
			Rate per cum				6418.83	
						say	*6419.00*	
12.8		F	PCC Grade M30					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	6.08	7598.00	46195.84	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			40 mm Aggregate	cum	5.40	974.52	5262.41	M-055
			20 mm Aggregate	cum	5.40	974.52	5262.41	M-053
			10 mm Aggregate	cum	2.70	774.52	2091.20	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4996.00*			
			d) Formwork @ 3.50 per cent of cost of concrete i.e. cost of material, labour and machinery				2622.50	
			e) Overhead charges @ 20%				15510.19	
			f) Contractor's profit @ 10%				9306.11	
			cost of 15 cum				102367.25	
			Rate per cum				6824.48	
						say	*6824.00*	
12.8 F		Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit : cum					
			Taking Output = 120 cum					
			a) Material					
			Cement	tonne	48.60	7598.00	369262.80	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			40 mm Aggregate	cum	43.20	974.52	42099.26	M-055
			20 mm Aggregate	cum	43.20	974.52	42099.26	M-053
			10 mm Aggregate	cum	21.60	774.52	16729.63	M-051
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Transit Mixer 4 cum capacity lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4737.00*			
			d) Formwork @ 3.50 per cent of cost of concrete i.e. cost of material, labour and machinery				19895.04	
			e) Overhead charges @ 20%				117664.94	
			f) Contractor's profit @ 10%				70598.97	
			cost of 120 cum				776588.63	
			Rate per cum				6471.57	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
						say	*6472.00*	
12.8		G	RCC Grade M30					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	6.10	7598.00	46347.80	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4970.00*			
			d) Formwork @ 3.5 per cent on cost of concrete i.e. cost of material, labour and machinery				2608.91	
			e) Overhead charges @ 20%				11572.40	
			f) Contractor's profit @ 10%				8872.17	
			cost of 15 cum				97593.90	
			Rate per cum				6506.26	
						say	*6506.00*	
12.8 G		Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	48.80	7598.00	370782.40	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Transit Mixer 4 cum capacity lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4714.00*			
			d) Formwork @ 3.5 per cent of cost of concrete i.e. cost of material, labour and machinery				19797.02	
			e) Overhead charges @ 20%				117085.26	
			f) Contractor's profit @ 10%				70251.16	
			cost of 120 cum				772762.72	
			Rate per cum				6439.69	
						say	*6440.00*	
12.8		H	RCC Grade M35					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	6.33	7598.00	48095.34	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*5086.00*			
			d) Formwork @ 3 per cent on a+b+c				2288.64	
			e) Overhead charges @ 20%				7857.66	
			f) Contractor's profit @ 10%				8643.42	
			cost of 15 cum				95077.67	
			Rate per cum				6338.51	
						say	*6339.00*	
12.8 H		Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit ; cum					
			Taking Output = 120 cum					
			a) Material					
			Cement	tonne	50.64	7598.00	384762.72	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Transit Mixer 4 cum capacity lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4831.00*			
			d) Formwork @ 3 per cent on cost of concrete i.e. cost of material, labour and machinery				17388.29	
			e) Overhead charges @ 20%				119399.58	
			f) Contractor's profit @ 10%				71639.75	
			cost of 120 cum				788037.21	
			Rate per cum				6566.98	
						say	*6567.00*	
		Note:	Where ever concrete is carried out using batching plant, transit mixer, concrete pump, Admixtures @ 0.4 per cent of weight of cement may be added for achieving desired slump of concrete.					
			WELL FOUNDATION					
12.9	1200		Providing and Constructing Temporary Island 16 m diameter for Construction of Well Foundation for 8m dia. Well.					
		A	Assuming depth of water 1.0 m and height of island to be 1.25 m.					
			Unit = 1 No					
			Taking output = 1 No.					
			a) Material					
			Earth (compacted)	cum	251.20	112.0	28134.40	M-092
			Sand bags	each	750.00	50.00	37500.00	M-159
			b) Labour					
			Mate	day	0.40	275.00	110.00	L-12
			Mazdoor for filling sand bags, stitching and placing	day	15.00	245.00	3675.00	L-13
			c) Machinery					
			Crane with grab 1 cum capacity	hour	20.00	550.00	11000.00	P&M-012
			Consumables @ 2.5 per cent of (c) above				275.00	
			e) Overhead charges @ 20%				16138.88	
			f) Contractor's profit @ 10%				9683.33	
			Rate per No.				106516.61	
						say	*106517.00*	
		Note	It is assumed that earth will be available within the working space of crane with grab bucket.					
12.9		B	Assuming depth of water 4.0 m and height of island 4.5 m.					
			Unit = 1No					
			Taking output = 1 No					
			a) Material					
			Earth (compacted)	cum	904.32	112.00	101283.84	M-092
			Sand bags	each	6000.00	50.00	300000.00	M-159
			Wooden ballies 8" Dia and 9 m long	each	95.00	360.00	34200.00	M-194
			Wooden ballies 2" Dia for bracing	metre	190.00	18.00	3420.00	M-193
			b) Labour					
			Mate	day	5.60	275.00	1540.00	L-12
			Mazdoor for piling 8" dia ballies for piling 8" dia ballies	day	18.00	245.00	4410.00	L-13
			Mazdoor for bracing with 2" dia ballies	day	12.00	245.00	2940.00	L-13
			Mazdoor for filling sand bags, stitching and placing	day	110.00	245.00	26950.00	L-13
			c) Machinery					
			Crane with grab 1 cum capacity	hour	50.00	550.00	27500.00	P&M-012
			Consumables and other arrangements for piling ballies @ 2.5 per cent of (a+b+c).				12556.10	
			e) Overhead charges @ 20%				102959.99	
			f) Contractor's profit @ 10%				61775.99	
			Rate per No.				679535.92	
						say	*679536.00*	
		Note	For other well diameters rate can be worked out on the basis of cross-sectional area of well. The diameter of the island shall be in the conformity with clause 1203.2 of MoRTH specifications.					
12.9	C		Providing and constructing one span service road to reach island location from one pier location to another pier location					
			Assuming span length 30 m, width of service road 10m and depth of water 1m					
			Unit = 1 meter					
			Taking output = 30 metre					
			a) Material					
			Earth	cum	450.00	112.00	50400.00	M-092
			Sand bags	each	300.00	50.00	15000.00	M-159
			b) Labour					
			Mate	day	0.24	275.00	66.00	L-12
			Mazdoor for filling sand bags, stitching and placing	day	6.00	245.00	1470.00	L-13
			c) Machinery					
			Front end Loader 1 cum capacity	hour	27.00	624.00	16848.00	P&M-017
			Tipper 5.5 cum capacity	hour	28.00	240.00	6720.00	P&M-048
			d) Overhead charges @ 20%				18100.80	
			e) Contractor's profit @ 10%				10860.48	
			Cost for 30 m				119465.28	
			Rate per m				3982.18	
						say	*3982.00*	
12.10	1200 & 1900		Providing and Laying Cutting Edge of Mild Steel weighing 40 kg per metre for Well Foundation complete as per Drawing and Technical Specification.					
			Unit = 1 MT					
			Taking output = 1 MT					
			a) Material					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Structural steel in plates, angles, etc including 5 per cent wastage	tonne	1.05	51198.00	53757.90	M-179
			Nuts & bolts	Kg	20.00	37.00	740.00	M-130
			b) Labour					
			(for cutting, bending, making holes, joining, welding and erecting in position)					
			Mate	day	1.32	275.00	363.00	L-12
			Fitter	day	5.50	270.00	1485.00	L-08
			Blacksmith	day	5.50	245.00	1347.50	L-02
			Welder	day	5.50	250.00	1375.00	L-02
			Mazdoor	day	16.50	245.00	4042.50	L-13
			Electrodes, cutting gas and other consumables @ 10 per cent of cost of (a) above				5449.79	
			c) Overhead charges @ 20%				13712.14	
			d) Contractor's profit @ 10%				8227.28	
			Rate per MT (a+b+c+d)				90500.11	
						say	90500.00	
12.11	1200, 1500 & 1700		Plain/Reinforced Cement Concrete, in Well Foundation complete as per Drawing and Technical Specification.					
			Unit = 1 cum					
			Taking output = 1 cum					
		A	Well curb					
		(i)	RCC M20 Grade					
			Same as for 12.8 (C) except for formwork which shall be@ 20 per cent of the cost of concrete instead of 4 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4519.00	
			d) formwork @ 20 per cent of the cost of concrete				903.80	
			e) Overhead charges @ 20%				542.28	
			f) Contractor's profit @ 10%				596.51	
			Rate perm				6561.59	
						say	6562.00	
12.11 A (i)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4262.00	
			d) formwork @ 20 per cent of the cost of concrete				852.40	
			e) Overhead charges @ 20%				511.44	
			f) Contractor's profit @ 10%				562.58	
			Rate perm				6188.42	
						say	6188.00	
12.11 A		(ii)	RCC M25 Grade					
			Same as for 12.8 (E) except for formwork which shall be@ 20 per cent of the cost of concrete instead of 3.75 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4945.00	
			d) formwork @ 20 per cent of the cost of concrete				989.00	
			e) Overhead charges @ 20%				593.40	
			f) Contractor's profit @ 10%				652.74	
			Rate perm				7180.14	
						say	7180.00	
12.11 A (ii)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4687.00	
			d) formwork @ 20 per cent of the cost of concrete				937.40	
			e) Overhead charges @ 20%				1124.88	
			f) Contractor's profit @ 10%				674.93	
			Rate perm (a+b+c+d+e+f)				7424.21	
						say	7424.00	
12.11 A		(iii)	RCC M35 Grade					
			Same as for 12.8 (H) except for formwork which shall be@ 20 per cent of the cost of concrete instead of 3.0 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				5086.00	
			d) formwork @ 20 per cent of the cost of concrete				1017.20	
			e) Overhead charges @ 20%				1220.64	
			f) Contractor's profit @ 10%				732.38	
			Rate perm (a+b+c+d+e+f)				8056.22	
						say	8056.00	
12.11 A (iii)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4831.00	
			d) formwork @ 20 per cent of the cost of concrete				966.20	
			e) Overhead charges @ 0.15 on (a+b+c+d)				869.58	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				666.68	
			Rate perm (a+b+c+d+e+f)				7333.46	
						say	7333.00	
		Note.	If curb concrete is carried out within steel liner, cost of formwork shall be excluded.					
12.11		B	Well steining					
		(I)	PCC M15 Grade					
			Same as for 12.8 (A) except for formwork which shall be @ 10 per cent of the cost of concrete instead of 4 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4145.00	
			d) formwork @ 10 per cent of the cost of concrete				414.50	
			e) Overhead charges @ 0.15 on (a+b+c+d)				683.93	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				524.34	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Rate perm (a+b+c+d+e+f)				5767.77	
						say	5768.00	
12.11 B		(ii)	PCC M20 Grade					
			Same as for 12.8 (B) except for formwork which shall be @ 10 per cent of the cost of concrete instead of 4 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4530.00	
			d) formwork @ 10 per cent of the cost of concrete				453.00	
			e) Overhead charges @ 0.15 on (a+b+c+d)				747.45	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				573.05	
			Rate perm (a+b+c+d+e+f)				6303.50	
						say	6303.00	
12.11 B		(iii)	RCC M20 Grade					
			Same as for 12.8 (C) except for formwork which shall be @ 10 per cent of the cost of concrete instead of 4 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4519.00	
			d) formwork @ 10 per cent of the cost of concrete				451.90	
			e) Overhead charges @ 0.15 on (a+b+c+d)				745.64	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				571.65	
			Rate perm (a+b+c+d+e+f)				6288.19	
						say	6288.00	
12.11 B (iii)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4262.00	
			d) formwork @ 10 per cent of the cost of concrete				426.20	
			e) Overhead charges @ 0.15 on (a+b+c+d)				703.23	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				539.14	
			Rate perm (a+b+c+d+e+f)				5930.57	
						say	5931.00	
12.11 B		(iv)	PCC M25 Grade					
			Same as for 12.8 (D) except for formwork which shall be @ 10 per cent of the cost of concrete instead of 4 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4950.00	
			d) formwork @ 10 per cent of the cost of concrete				495.00	
			e) Overhead charges @ 0.15 on (a+b+c+d)				816.75	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				626.18	
			Rate perm (a+b+c+d+e+f)				6887.93	
						say	6888.00	
12.11 B (iv)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4696.00	
			d) formwork @ 10 per cent of the cost of concrete				469.60	
			e) Overhead charges @ 0.15 on (a+b+c+d)				774.84	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				594.04	
			Rate perm (a+b+c+d+e+f)				6534.48	
						say	6534.00	
'12.11 B		(v)	RCC M25 Grade					
			Same as for 12.8 (E) except for formwork which shall be @ 10 per cent of the cost of concrete instead of 3.5 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4945.00	
			d) formwork @ 10 per cent of the cost of concrete				494.50	
			e) Overhead charges @ 0.15 on (a+b+c+d)				815.93	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				625.54	
			Rate perm (a+b+c+d+e+f)				6880.97	
						say	6881.00	
12.11 B (v)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4687.00	
			d) formwork @ 10 per cent of the cost of concrete				468.70	
			e) Overhead charges @ 0.15 on (a+b+c+d)				773.36	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				592.91	
			Rate perm (a+b+c+d+e+f)				6521.96	
						say	6522.00	
'12.11 B		(vi)	PCC M30 Grade					
			Same as for 12.8 (F) except for formwork which shall be @ 10 per cent of the cost of concrete instead of 3.5 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4996.00	
			d) formwork @ 10 per cent of the cost of concrete				499.60	
			e) Overhead charges @ 0.15 on (a+b+c+d)				824.34	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				631.99	
			Rate perm (a+b+c+d+e+f)				6951.93	
						say	6952.00	
12.11 B (vi)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4737.00	
			d) formwork @ 10 per cent of the cost of concrete				473.70	
			e) Overhead charges @ 0.15 on (a+b+c+d)				781.61	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				599.23	
			Rate perm (a+b+c+d+e+f)				6591.54	
						say	6592.00	
'12.11 B		(vii)	RCC M30 Grade					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Same as for 12.8 (G) except for formwork which shall be @ 10 per cent of the cost of concrete instead of 3.5 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4970.00	
			d) formwork @ 10 per cent of the cost of concrete				497.00	
			e) Overhead charges @ 0.15 on (a+b+c+d)				820.05	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				628.71	
			Rate perm (a+b+c+d+e+f)				6915.76	
						say	*6916.00*	
12.11 B (vii)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4714.00	
			d) formwork @ 10 per cent of the cost of concrete				471.40	
			e) Overhead charges @ 0.15 on (a+b+c+d)				777.81	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				596.32	
			Rate perm (a+b+c+d+e+f)				6559.53	
						say	*6560.00*	
'12.11 B		(viii)	RCC M35 Grade					
			Same as for 12.8 (H) except for formwork which shall be @ 10 per cent of the cost of concrete instead of 3 per cent.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				5086.00	
			d) formwork @ 10 per cent of the cost of concrete				508.60	
			e) Overhead charges @ 0.15 on (a+b+c+d)				839.19	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				643.38	
			Rate perm (a+b+c+d+e+f)				7077.17	
						say	*7077.00*	
12.11 B (viii)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				4831.00	
			d) formwork @ 10 per cent of the cost of concrete				483.10	
			e) Overhead charges @ 0.15 on (a+b+c+d)				797.12	
			f) Contractor's profit @ 0.1 on (a+b+c+d+e)				611.12	
			Rate perm (a+b+c+d+e+f)				6722.34	
						say	*6722.00*	
'12.11 B		(ix)	RCC M40 Grade					
			Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	51.60	7598.00	392056.80	M-081
			Coarse Sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			Admixture	kg	206.00	61.20	12607.20	M-180
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Transit Mixer 4 cum capacity for lead beyond 1 km.	tonne.km	300.00	3.00	900.00	Lead= 10 , P&M-050
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*39968.00*			
			d) Formwork @ 10 per cent on cost of concrete i.e. cost of material, labour and machinery				59951.09	
			e) Overhead charges @ 20%				131892.39	
			f) Contractor's profit @ 10%				79135.44	
			cost of 120 cum				870489.80	
			Rate per cum				7254.08	
						say	*7254.00*	
12.11 C		C	Bottom Plug					
			Concrete to be placed using tremie pipe					
			Note: 10% extra cement to be added where under water concreting is involved					
		(i)	PCC Grade M20					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	5.55	7598.00	42168.90	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			40 mm Aggregate	cum	5.40	974.52	5262.41	M-055
			20 mm Aggregate	cum	5.40	974.52	5262.41	M-053
			10 mm Aggregate	cum	2.70	774.52	2091.20	M-051
			Admixture	Kg	18.60	61.20	1138.32	M-180
			b) Labour					
			Mate	day	0.90	275.00	247.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Light Crane 3 tonnes capacity for handling tremie pipe	hour	6.00	241.00	1446.00	P&M-013

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4900.00*			
			Add 5 per cent of cost of material and labour towards cost of forming sump, protective bunds, chiselling and making arrangements for under water concreting with tremie pipe..				3471.74	
			d) Overhead charges @ 20%				15393.71	
			e) Contractor's profit @ 10%				9236.23	
			cost of 15 cum				101598.51	
			Rate per cum				6773.23	
						say	*6773.00*	
12.11 C (i)		Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump					
			Unit ; cum					
			Taking Output = 120 cum					
			a) Material					
			Cement	tonne	44.40	7598.00	337351.20	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			Admixture	Kg	148.80	61.20	9106.56	M-180
			b) Labour					
			Mate	day	0.88	275.00	242.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Transit Mixer 4 cum capacity, lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4511.00*			
			Add 5 per cent of cost of material and labour towards cost of forming sump, protective bunds, chiselling and making arrangements for under water concreting with tremie pipe..				25621.28	
			d) Overhead charges @ 20%				113387.38	
			e) Contractor's profit @ 10%				68032.43	
			cost of 120 cum				748356.74	
			Rate per cum				6236.31	
						say	*6236.00*	
'12.11 C		(ii)	PCC Grade M25					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	5.99	7598.00	45512.02	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			40 mm Aggregate	cum	5.40	974.52	5262.41	M-055
			20 mm Aggregate	cum	5.40	974.52	5262.41	M-053
			10 mm Aggregate	cum	2.70	774.52	2091.20	M-051
			Admixture	Kg	21.60	61.20	1321.92	M-180
			b) Labour					
			Mate	day	0.90	275.00	247.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Light Crane of 3 tonnes capacity for handling tremie pipe	hour	6.00	241.00	1446.00	P&M-013
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*5135.00*			
			Add 5 per cent of cost of material and labour towards cost of forming sump, protective bunds, chiselling and making arrangements for under water concreting with tremie pipe..				3648.08	
			d) Overhead charges @ 20%				16134.33	
			e) Contractor's profit @ 10%				9680.60	
			cost of 15 cum				106486.55	
			Rate per cum				7099.10	
						say	*7099.00*	
12.11 C (ii)		Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	47.88	7598.00	363792.24	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			Admixture	Kg	172.80	61.20	10575.36	M-180
			b) Labour					
			Mate	day	0.88	275.00	242.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Transit Mixer 4 cum capacity, lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4744.00*			
			Add 5 per cent of cost of material and labour towards cost of forming sump, protective bunds, chiselling and making arrangements for under water concreting with tremie pipe..				27016.77	
			d) Overhead charges @ 20%				119248.45	
			e) Contractor's profit @ 10%				71549.07	
			cost of 120 cum				787039.78	
			Rate per cum				6558.66	
						say	*6559.00*	
'12.11 C		(iii)	PCC Grade M30					
		Case I	Using Concrete Mixer					
			Unit = 1 cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	6.08	7598.00	46195.84	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			40 mm Aggregate	cum	5.40	974.52	5262.41	M-055
			20 mm Aggregate	cum	5.40	974.52	5262.41	M-053
			10 mm Aggregate	cum	2.70	774.52	2091.20	M-051
			Admixture	Kg	21.60	61.20	1321.92	M-180
			b) Labour					
			Mate	day	0.90	275.00	247.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Light Crane of 3 tonnes capacity for handling tremie pipe	hour	6.00	241.00	1446.00	P&M-013
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*5181.00*			
			Add 5 per cent of cost of material and labour towards cost of forming sump, protective bunds, chiselling and making arrangements for under water concreting with tremie pipe..				3682.27	
			d) Overhead charges @ 20%				16277.93	
			e) Contractor's profit @ 10%				9766.76	
			cost of 15 cum				107434.32	
			Rate per cum				7162.29	
						say	*7162.00*	
12.11 C (iii)		Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	48.64	7598.00	369566.72	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			Admixture	Kg	172.80	61.20	10575.36	M-180
			b) Labour					
			Mate	day	0.88	275.00	242.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Transit Mixer 4 cum capacity, lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4792.00*			
			Add 5 per cent of cost of material and labour towards cost of forming sump, protective bunds, chiselling and making arrangements for under water concreting with tremie pipe..				27305.50	
			d) Overhead charges @ 20%				120461.09	
			e) Contractor's profit @ 10%				72276.65	
			cost of 120 cum				795043.20	
			Rate per cum				6625.36	
						say	*6625.00*	
'12.11 C		(iv)	PCC Grade M35					
		Case I	Using Concrete Mixer					
			Unit = 1 cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	6.29	7598.00	47791.42	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			40 mm Aggregate	cum	5.40	974.52	5262.41	M-055
			20 mm Aggregate	cum	5.40	974.52	5262.41	M-053
			10 mm Aggregate	cum	2.70	774.52	2091.20	M-051
			Admixture	Kg	21.60	61.20	1321.92	M-180
			b) Labour					
			Mate	day	0.90	275.00	247.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Light Crane of 3 tonnes capacity for handling tremie pipe	hour	6.00	241.00	1446.00	P&M-013

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*5287.00*			
			Add 5 per cent of cost of material and labour towards cost of forming sump, protective bunds, chiselling and making arrangements for under water concreting with tremie pipe..				3762.05	
			d) Overhead charges @ 20%				16613.00	
			e) Contractor's profit @ 10%				9967.80	
			cost of 15 cum				109645.80	
			Rate per cum				7309.72	
						say	*7310.00*	
12.11 C (iv)		Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	50.28	7598.00	382027.44	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			Admixture	Kg	172.80	61.20	10575.36	M-180
			b) Labour					
			Mate	day	0.88	275.00	242.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Transit Mixer 4 cum capacity, lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)		*4896.00*			
			Add 5 per cent of cost of material and labour towards cost of forming sump, protective bunds, chiselling and making arrangements for under water concreting with tremie pipe..				27928.53	
			d) Overhead charges @ 20%				123077.84	
			e) Contractor's profit @ 10%				73846.71	
			cost of 120 cum				812313.76	
			Rate per cum				6769.28	
						say	*6769.00*	
12.11		D	Intermediate plug					
		(i)	Grade M20 PCC					
			Same as in bottom plug concrete, excluding cost of forming sump, protective bunds, chiseling etc.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
12.11 D (i)		Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
'12.11 D		(ii)	Grade M25 PCC					
			Same as in bottom plug concrete, excluding cost of forming sump, protective bunds, chiseling etc.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
12.11 D (ii)		Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
'12.11 D		(iii)	Grade M30 PCC					
			Same as in bottom plug concrete, excluding cost of forming sump, protective bunds, chiseling etc.					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
12.11 D (iii)		Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
12.11		E	Top plug					
		(i)	Grade M15 PCC					
			Same as Item 12.8(a) excluding formwork					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
'12.11 E		(ii)	Grade M20 PCC					
			Same as Item 12.8(b) excluding formwork					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
'12.11 E		(iii)	Grade M25 PCC					
			Same as Item 12.8 (d) excluding formwork					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
12.11 E (iii)		Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
'12.11 E		(iv)	Grade M30 PCC					
			Same as Item 12.8(f) excluding formwork					
		Case I	Using Concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
12.11 E (iv)		Case II	Using Batching Plant, Transit Mixer and Crane/concrete pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c)				586422.68	
			d) Overhead charges @ 20%				117284.54	
			e) Contractor's profit @ 10%				70370.72	
			Rate per cum				6450.65	
						say	*6451.00*	
12.11		F	Well cap					
		(i)	RCC Grade M20					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	5.12	7598.00	38901.76	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Form Work @ 4 per cent of a+b+c				2683.77	
			d) Overhead charges @ 20%				13955.63	
			e) Contractor's profit @ 10%				8373.38	
			cost of 15 cum				92107.15	
			Rate per cum				6140.48	
						say	*6140.00*	
12.11 F (i)		Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	40.92	7598.00	310910.16	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader (capacity 1 cum)	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Formwork @ 4 per cent of (a+b+c)				20230.28	
			d) Overhead charges @ 20%				105197.46	
			e) Contractor's profit @ 10%				63118.48	
			cost of 120 cum				694303.26	
			Rate per cum				5785.86	
						say	*5786.00*	
12.11 F		(ii)	RCC Grade M25					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	6.05	7598.00	45967.90	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Form Work @ 3.75 per cent of a+b+c				2781.02	
			d) Overhead charges @ 20%				15388.31	
			e) Contractor's profit @ 10%				9232.98	
			cost of 15 cum				101562.82	
			Rate per cum				6770.85	
						say	*6771.00*	
12.11 F (ii)		Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	48.40	7598.00	367743.20	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader (capacity 1 cum)	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Formwork @ 3.75 per cent of (a+b+c)				21097.13	
			d) Overhead charges @ 20%				116737.44	
			e) Contractor's profit @ 10%				70042.46	
			cost of 120 cum				770467.11	
			Rate per cum				6420.56	
						say	*6421.00*	
12.11 F		(iii)	RCC Grade M30					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	6.10	7598.00	46347.80	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Formwork @ 3.5 per cent of (a+b+c)				2608.91	
			d) Overhead charges @ 20%				15429.86	
			e) Contractor's profit @ 10%				9257.92	
			cost of 15 cum				101837.11	
			Rate per cum				6789.14	
						say	*6789.00*	
12.11 F (iii)		Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	48.79	7598.00	370706.42	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader (capacity 1 cum)	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Formwork @ 3.5 per cent of (a+b+c)				19794.37	
			d) Overhead charges @ 20%				117069.53	
			e) Contractor's profit @ 10%				70241.72	
			cost of 120 cum				772658.92	
			Rate per cum				6438.82	
						say	6439.00	
12.11 F		(iv)	RCC Grade M35					
		Case I	Using Concrete Mixer					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	6.33	7598.00	48095.34	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Formwork @ 3 per cent of (a+b+c)				2288.64	
			d) Overhead charges @ 20%				15715.32	
			e) Contractor's profit @ 10%				9429.19	
			cost of 15 cum				103721.10	
			Rate per cum				6914.74	
						say	6915.00	
12.11 F (iv)		Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	50.64	7598.00	384762.72	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader (capacity 1 cum)	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Formwork @ 3 per cent of (a+b+c)				17388.29	
			d) Overhead charges @ 20%				119399.58	
			e) Contractor's profit @ 10%				71639.75	
			cost of 120 cum				788037.21	
			Rate per cum				6566.98	
						say	6567.00	
		Note	Where ever concrete is carried out using batching plant, transit mixer, concrete pump, Admixtures @ 0.4 per cent of weight of cement may be added for achieving desired slump of concrete.					
'12.11 F		(v)	RCC M40 Grade					
			Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	52.20	7598.00	396615.60	M-081
			Coarse Sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			Admixture	kg	206.00	61.20	12607.20	M-180
			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader 1 cum capacity	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer 4 cum capacity for lead upto 1 km.	hour	15.00	660.00	9900.00	P&M-049

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Transit Mixer 4 cum capacity for lead beyond 1 km.	tonne.km	300.00	3.00	900.00	P&M-050 Lead= 10 km
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Formwork @ 3 per cent on cost of concrete i.e. cost of material, labour and machinery				18122.09	
			d) Overhead charges @ 20%				124438.35	
			e) Contractor's profit @ 10%				74663.01	
			cost of 120 cum				821293.14	
			Rate per cum				6844.11	
						say	*6844.00*	
12.12	Section 1200		Sinking of 6 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.					
			Unit = Running Meter.					
			Taking output = 1 m					
			Diameter of well - 6 m.					
		A	Sandy Soil					
		(i)	Depth below bed level upto 3.0 M					
			Rate of sinking = 0.50 m per hour.					
			a) Labour					
			Mate	day	0.12	275.00	33.00	L-12
			Sinker (skilled)	day	1.00	279.00	279.00	L-15
			Sinking helper (semi-skilled)	day	2.00	279.00	558.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	2.00	550.00	1100.00	P&M-075
			Consumables in sinking @10 per cent of (b)				110.00	
			c) Overhead charges @ 20%				208.00	
			d) Contractor's profit @ 10%				228.80	
			Rate per metre				2516.80	
						say	*2517.00*	
12.12 A		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking = 0.33 m per hour.					
			a) Labour					
			Mate	day	0.15	275.00	41.25	L-12
			Sinker	day	1.25	279.00	348.75	L-15
			Sinking helper (semi-skilled)	day	2.50	279.00	697.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories	hour	3.00	550.00	1650.00	P&M-075
			Consumables in sinking @10 per cent of (b)				165.00	
			c) Overhead charges @ 20%				580.50	
			d) Contractor's profit @ 10%				348.30	
			Rate per metre				3831.30	
						say	*3831.00*	
12.12 A		(iii)	Beyond 10m upto 20m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
			11th m	5%	4023.00			
			12th m	5%	4224.00			
			13th m	5%	4435.00			
			14th m	5%	4657.00			
			15th m	5%	4890.00			
			16th m	5%	5135.00			
			17th m	5%	5392.00			
			18th m	5%	5662.00			
			19th m	5%	5945.00			
			20th m	5%	6242.00			
			Total Cost from 10m upto 20m		50605.00			
			Avg Rate per metre		*5061.00*			
12.12 A		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour.			Including 20% for Kentledge		
			21st m	7.5%	6710.00	8052.00		
			22nd m	7.5%	7213.00	8656.00		
			23rd m	7.5%	7754.00	9305.00		
			24th m	7.5%	8336.00	10003.00		
			25th m	7.5%	8961.00	10753.00		
			26th m	7.5%	9633.00	11560.00		
			27th m	7.5%	10355.00	12426.00		
			28th m	7.5%	11132.00	13358.00		
			29th m	7.5%	11967.00	14360.00		
			30th m	7.5%	12865.00	15438.00		
			Total Cost from 20m upto 30m		94926.00	113911.00		
			Avg Rate per metre		*9493.00*	*11391.00*		
12.12 A		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour.			Including 20% for Kentledge		
			31st m	10%	14152.00	16982.00		
			32nd	10%	15567.00	18680.00		
			33rd m	10%	17124.00	20549.00		
			34th m	10%	18836.00	22603.00		
			35th m	10%	20720.00	24864.00		
			36th m	10%	22792.00	27350.00		
			37th m	10%	25071.00	30085.00		
			38th m	10%	27578.00	33094.00		
			39th m	10%	30336.00	36403.00		
			40th m	10%	33370.00	40044.00		
			Total Cost from 30m upto 40m		225546.00	270654.00		

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Avg Rate per metre		*22555.00*	*27065.00*		
12.12		B	Clayey Soil (6m dia. Well)					
			Unit = Running Meter.					
			Taking output = 1 meter					
		(i)	Depth below bed level upto 3.0 M					
			Rate of sinking = 0.33 m per hour.					
			a) Labour					
			Mate	day	0.15	275.00	41.25	L-12
			Sinker (skilled)	day	1.50	279.00	418.50	L-15
			Sinking helper (semi-skilled)	day	2.25	279.00	627.75	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories	hour	3.00	550.00	1650.00	P&M-075
			Consumables in sinking @ 10 per cent of (b)				165.00	
			c) Overhead charges @ 20%				290.25	
			d) Contractor's profit @ 10%				319.28	
			Rate per metre				3512.03	
						say	*3512.00*	
12.12 B		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking = 0.17 m per hour.					
			a) Labour					
			Mate	day	0.30	275.00	82.50	L-12
			Sinker	day	3.00	279.00	837.00	L-15
			Sinking helper (semi-skilled)	day	4.50	279.00	1255.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Air compressor with pneumatic chisel attachment for cutting hard clay.	hour	2.00	257.00	514.00	P&M-063
			Consumables in sinking @ 10 per cent of (b)				381.40	
			c) Overhead charges @ 20%				637.04	
			d) Contractor's profit @ 10%				700.74	
			Rate per metre				7708.18	
						say	*7708.00*	
12.12 B		(iii)	Beyond 10 m upto 20 m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add for dewatering @ 5 per cent of cost, if required.			Including for dewatering @ 5% of cost, if required		
			11th m	5%	8093.00	8498.00		
			12th m	5%	8498.00	8923.00		
			13th m	5%	8923.00	9369.00		
			14th m	5%	9369.00	9837.00		
			15th m	5%	9837.00	10329.00		
			16th m	5%	10329.00	10845.00		
			17th m	5%	10845.00	11387.00		
			18th m	5%	11387.00	11956.00		
			19th m	5%	11956.00	12554.00		
			20th m	5%	12554.00	13182.00		
			Total Cost from 10m upto 20m		101791.00	106880.00		
			Avg Rate per metre		*10179.00*	*10688.00*		
12.12 B		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering of the cost, if required					
		c	Add 25 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 25% for Kentledge	Including 5% for dewatering, if required	
			21st m	7.5%	13496.00	16870.00	17714.00	
			22nd m	7.5%	14508.00	18135.00	19042.00	
			23rd m	7.5%	15596.00	19495.00	20470.00	
			24th m	7.5%	16766.00	20958.00	22006.00	
			25th m	7.5%	18023.00	22529.00	23655.00	
			26th m	7.5%	19375.00	24219.00	25430.00	
			27th m	7.5%	20828.00	26035.00	27337.00	
			28th m	7.5%	22390.00	27988.00	29387.00	
			29th m	7.5%	24069.00	30086.00	31590.00	
			30th m	7.5%	25874.00	32343.00	33960.00	
			Total Cost from 20m upto 30m		190925.00	238658.00	250591.00	
			Avg Rate per metre		*19093.00*	*23866.00*	*25059.00*	
12.12 B		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering, if required					
		c	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 20% for Kentledge	Including 5% for dewatering, if required	
			31st m	10%	28461.00	34153.00	35861.00	
			32nd	10%	31307.00	37568.00	39446.00	
			33rd m	10%	34438.00	41326.00	43392.00	
			34th m	10%	37882.00	45458.00	47731.00	
			35th m	10%	41670.00	50004.00	52504.00	
			36th m	10%	45837.00	55004.00	57754.00	
			37th m	10%	50421.00	60505.00	63530.00	
			38th m	10%	55463.00	66556.00	69884.00	
			39th m	10%	61009.00	73211.00	76872.00	
			40th m	10%	67110.00	80532.00	84559.00	
			Total Cost from 30m upto 40m		453598.00	544317.00	571533.00	
			Avg Rate per metre		*45360.00*	*54432.00*	*57153.00*	
12.12		C	Soft Rock (6m dia well)					
			Unit = Running Meter.					
			Taking output = 1 m					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Depth in Soft rock strata up to 3m					
			Rate of sinking = 0.25 m per hour.					
			a) Labour					
			Mate	day	0.92	275.00	253.00	L-12
			Sinker (skilled)	day	3.00	279.00	837.00	L-15
			Sinking helper (semi-skilled)	day	20.00	279.00	5580.00	L-14
			Diver	day	0.50	250.00	125.00	L-07
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	4.00	550.00	2200.00	P&M-075
			Air compressor with pneumatic breakers	hour	3.50	257.00	899.50	P&M-063
			Consumables in sinking @ 10 per cent of (b)				309.95	
			Add for dewatering @ of 5 per cent of (a+b), if required				510.22	
			c) Overhead charges @ 20%				1071.47	
			d) Contractor's profit @ 10%				1178.61	
			Rate per metre				12964.75	
						say	*12965.00*	
12.12		D	Hard Rock (6m dia well)					
			Unit = Running Meter					
			Taking output = 1 m					
			Depth in hard rock strata upto 3 m					
			Rate of sinking = 0.17 m per hour.					
			a) Material					
			Gelatine 80 per cent	Kg	4.00	102.00	408.00	M-104
			Electric Detonators	each	18.00	6.12	110.16	M-094/100
			b) Labour					
			Mate	day	1.56	275.00	429.00	L-12
			Driller	day	2.00	245.00	490.00	L-06
			Blaster	day	0.25	250.00	62.50	L-03
			Mazdoor	day	12.00	245.00	2940.00	L-13
			Mazdoor (Skilled)	day	4.00	245.00	980.00	L-15
			c) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Hire & running charges of compressor with pneumatic breaker/Jack hammer for drilling.	hour	2.00	257.00	514.00	P&M-063
			Dewatering @ 5 per cent of cost of (b+c), if				435.78	
			Consumables in sinking @ 10 per cent of cost of				381.40	
			c) Overhead charges @ 20%				2010.17	
			d) Contractor's profit @ 10%				1206.10	
			Rate per metre				13267.10	
						say	*13267.00*	
12.13	Section 1200		Sinking of 7 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.					
			Unit = Running Meter.					
			Taking output = 1 m					
			Diameter of well - 7 m.					
		A	Sandy Soil					
		(i)	Depth below bed level upto 3.0 M					
			Rate of sinking = 0.30 m per hour.					
			a) Labour					
			Mate	day	0.15	275.00	41.25	L-12
			Sinker (skilled)	day	1.25	279.00	348.75	L-15
			Sinking helper (semi-skilled)	day	2.50	279.00	697.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	3.25	550.00	1787.50	P&M-075
			Consumables in sinking @10 per cent of (b)				178.75	
			c) Overhead charges @ 20%				305.38	
			d) Contractor's profit @ 10%				305.38	
			Rate per metre				3664.50	
12.13 A		(ii)	Beyond 3m upto 10m depth				7329.00	
			Rate of sinking = 0.22 m per hour.			*say*	*7329.00*	
			a) Labour					
			Mate	day	0.18	275.00	49.50	L-12
			Sinker	day	1.50	279.00	418.50	L-15
			Sinking helper (semi-skilled)	day	3.00	279.00	837.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	4.50	550.00	2475.00	P&M-075
			Consumables in sinking @10 per cent of (b)				247.50	
			c) Overhead charges @ 20%				604.13	
			d) Contractor's profit @ 10%				463.16	
			Rate per metre				5094.79	
						say	*5095.00*	
12.13 A		(iii)	Beyond 10m upto 20m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
			11th m	5%	5350.00			
			12th m	5%	5618.00			
			13th m	5%	5899.00			
			14th m	5%	6194.00			
	0.165		15th m	5%	6504.00			
			16th m	5%	6829.00			
			17th m	5%	7170.00			
			18th m	5%	7529.00			
			19th m	5%	7905.00			
			20th m	5%	8300.00			
			Total Cost from 10m upto 20m		67298.00			
			Avg Rate per metre		*6730.00*			
12.13 A		(iv)	Beyond 20m upto 30 m					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 20% for Kentledge		
			21st m	7.5%	8923.00	10708.00		
			22nd m	7.5%	9592.00	11510.00		
			23rd m	7.5%	10311.00	12373.00		
			24th m	7.5%	11084.00	13301.00		
			25th m	7.5%	11915.00	14298.00		
			26th m	7.5%	12809.00	15371.00		
			27th m	7.5%	13770.00	16524.00		
			28th m	7.5%	14803.00	17764.00		
			29th m	7.5%	15913.00	19096.00		
			30th m	7.5%	17106.00	20527.00		
			Total Cost from 20m upto 30m		126226.00	151472.00		
			Avg Rate per metre		*12623.00*	*15147.00*		
12.13 A		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement, and Labour etc.			Including 20% for Kentledge		
			31st m	10%	18817.00	22580.00		
			32nd	10%	20699.00	24839.00		
			33rd m	10%	22769.00	27323.00		
			34th m	10%	25046.00	30055.00		
			35th m	10%	27551.00	33061.00		
			36th m	10%	30306.00	36367.00		
			37th m	10%	33337.00	40004.00		
			38th m	10%	36671.00	44005.00		
			39th m	10%	40338.00	48406.00		
			40th m	10%	44372.00	53246.00		
			Total Cost from 30m upto 40m		299906.00	359886.00		
			Avg Rate per metre		*29991.00*	*35989.00*		
12.13		B	Clayey Soil (7m dia. Well)					
			Unit = Running Meter.					
			Taking output = 1 cum					
		(I)	Depth below bed level upto 3.0 M					
			Rate of sinking = 0.22 m per hour.					
			a) Labour					
			Mate	day	0.18	275.00	49.50	L-12
			Sinker (skilled)	day	1.50	279.00	418.50	L-15
			Sinking helper (semi-skilled)	day	3.00	279.00	837.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	4.50	550.00	2475.00	P&M-075
			Consumables in sinking @ 10 per cent of (b)				247.50	
			c) Overhead charges @ 20%				805.50	
			d) Contractor's profit @ 10%				483.30	
			Rate per metre				5316.30	
						say	*5316.00*	
12.13 B		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking = 0.17 m per hour.					
			a) Labour					
			Mate	day	0.26	275.00	71.50	L-12
			Sinker	day	2.00	279.00	558.00	L-15
			Sinking helper (semi-skilled)	day	4.00	279.00	1116.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Air compressor with pneumatic chisel attachment for cutting hard clay.	hour	3.25	257.00	330.00	P&M-063
			Consumables in sinking @ 10 per cent of (b)				363.00	
			c) Overhead charges @ 20%				1147.70	
			d) Contractor's profit @ 10%				688.62	
			Rate per metre				7574.82	
						say	*7575.00*	
12.13 B		(iii)	Beyond 10 m upto 20 m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add for dewatering @ 5 per cent of cost, if required.			Including for dewatering @ 5% of cost, if required		
			11th m	5%	7954.00	8352.00		
			12th m	5%	8352.00	8770.00		
			13th m	5%	8770.00	9209.00		
			14th m	5%	9209.00	9669.00		
			15th m	5%	9669.00	10152.00		
			16th m	5%	10152.00	10660.00		
			17th m	5%	10660.00	11193.00		
			18th m	5%	11193.00	11753.00		
			19th m	5%	11753.00	12341.00		
			20th m	5%	12341.00	12958.00		
			Total Cost from 10m upto 20m		100053.00	105057.00		
			Avg Rate per metre		*10005.00*	*10506.00*		
12.13 B		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering on the cost, if required					
		c	Add 25 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 25% for Kentledge	Including 5% for dewatering, if required	
			31st m	7.5%	13267.00	16584.00	17413.00	
			32nd	7.5%	14262.00	17828.00	18719.00	
			33rd m	7.5%	15332.00	19165.00	20123.00	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			34th m	7.5%	16482.00	20603.00	21633.00	
			35th m	7.5%	17718.00	22148.00	23255.00	
			36th m	7.5%	19047.00	23809.00	24999.00	
			37th m	7.5%	20476.00	25595.00	26875.00	
			38th m	7.5%	22012.00	27515.00	28891.00	
			39th m	7.5%	23663.00	29579.00	31058.00	
			40th m	7.5%	25438.00	31798.00	33388.00	
			Total Cost from 30m upto 40m		187697.00	234624.00	246354.00	
			Avg Rate per metre		*18770.00*	*23462.00*	*24635.00*	
12.13 B		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering, if required					
		c	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 20% for Kentledge	Including 5% for dewatering, if required	
			31st m	10%	27982.00	33578.00	35257.00	
			32nd	10%	30780.00	36936.00	38783.00	
			33rd m	10%	33858.00	40630.00	42662.00	
			34th m	10%	37244.00	44693.00	46928.00	
			35th m	10%	40968.00	49162.00	51620.00	
			36th m	10%	45065.00	54078.00	56782.00	
			37th m	10%	49572.00	59486.00	62460.00	
			38th m	10%	54529.00	65435.00	68707.00	
			39th m	10%	59982.00	71978.00	75577.00	
			40th m	10%	65980.00	79176.00	83135.00	
			Total Cost from 30m upto 40m		445960.00	535152.00	561911.00	
			Avg Rate per metre		*44596.00*	*53515.00*	*56191.00*	
12.13		C	Soft Rock (7m dia well)					
			Unit = Running Meter.					
			Taking output = 1 m					
			Depth in soft rock strata upto 3m					
			Rate of sinking = 0.22 m per hour.					
			a) Labour					
			Mate	day	0.58	275.00	159.50	L-12
			Sinker (skilled)	day	4.00	279.00	1116.00	L-15
			Sinking helper (semi-skilled)	day	10.00	279.00	2790.00	L-14
			Diver	day	0.75	250.00	187.50	L-07
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	4.50	550.00	2475.00	P&M-075
			Air compressor with pneumatic breakers	hour	3.75	257.00	963.75	P&M-063
			Consumables in sinking @ 10 per cent of (b)				343.88	
			Add for dewatering @ of 5 per cent of (a+b), if required				384.59	
			c) Overhead charges @ 20%				1684.04	
			d) Contractor's profit @ 10%				1010.43	
			Rate per metre				11114.68	
						say	*11115.00*	
12.13		D	Hard Rock (7m dia well)					
			Unit = Running Meter					
			Taking output = 1 m					
			Depth in Hard rock strata up to 3 m					
			Rate of sinking = 0.17 m per hour.					
			a) Material					
			Gelatine 80 per cent	Kg	7.00	102.00	714.00	M-104
			Electric Detonators	each	30.00	6.12	183.60	M-094/100
			b) Labour					
			Mate	day	1.60	275.00	440.00	L-12
			Driller	day	2.00	245.00	490.00	L-06
			Blaster	day	0.25	250.00	62.50	L-03
			Mazdoor	day	18.00	245.00	4410.00	L-13
			Mazdoor (Skilled)	day	4.00	245.00	980.00	L-15
			Diver	day	0.50	250.00	125.00	L-07
			c) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Hire & running charges of compressor with pneumatic breaker/Jack hammer for drilling.	hour	2.00	257.00	514.00	P&M-063
			Dewatering @ 5 per cent of cost of (b+c), if				516.08	
			Consumables in sinking @ 10 per cent of cost of				433.01	
			d) Overhead charges @ 20%				2433.64	
			e) Contractor's profit @ 10%				1460.18	
			Rate per metre				16062.00	
						say	*16062.00*	
12.14	Section 1200		Sinking of 8 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.					
			Unit = Running Meter.					
			Taking output = 1 m					
			Diameter of well - 8 m.					
		A	Sandy Soil					
		(i)	Depth below bed level upto 3.0 M					
			Rate of sinking @ 0.25 m/hour					
			a) Labour					
			Mate	day	0.18	275.00	49.50	L-12
			Sinker (skilled)	day	1.50	279.00	418.50	L-15
			Sinking helper (semi-skilled)	day	3.00	279.00	837.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	4.00	550.00	2200.00	P&M-075
			Consumables in sinking @10 per cent of (b)				220.00	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			c) Overhead charges @ 20%				745.00	
			d) Contractor's profit @ 10%				447.00	
			Rate per metre				4917.00	
						say	*4917.00*	
12.14 A		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking @ 0.20 m/hour					
			a) Labour					
			Mate	day	0.25	275.00	68.75	L-12
			Sinker	day	1.75	279.00	488.25	L-15
			Sinking helper (semi-skilled)	day	3.50	279.00	976.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	5.00	550.00	2750.00	P&M-075
			Consumables in sinking @10 per cent of (b)				275.00	
			c) Overhead charges @ 20%				911.70	
			d) Contractor's profit @ 10%				547.02	
			Rate per metre				6017.22	
						say	*6017.00*	
12.14 A		(iii)	Beyond 10m upto 20m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
			11th m	5%	6318.00			
			12th m	5%	6634.00			
			13th m	5%	6966.00			
			14th m	5%	7314.00			
			15th m	5%	7680.00			
			16th m	5%	8064.00			
			17th m	5%	8467.00			
			18th m	5%	8890.00			
			19th m	5%	9335.00			
			20th m	5%	9802.00			
			Total Cost from 10m upto 20m		79470.00			
			Avg Rate per metre		*7947.00*			
12.14 A		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour.			Including 20% for Kentledge		
			21st m	7.5%	10537.00	12644.00		
			22nd m	7.5%	11327.00	13592.00		
			23rd m	7.5%	12177.00	14612.00		
			24th m	7.5%	13090.00	15708.00		
			25th m	7.5%	14072.00	16886.00		
			26th m	7.5%	15127.00	18152.00		
			27th m	7.5%	16262.00	19514.00		
			28th m	7.5%	17482.00	20978.00		
			29th m	7.5%	18793.00	22552.00		
			30th m	7.5%	20202.00	24242.00		
			Total Cost from 20m upto 30m		149069.00	178880.00		
			Avg Rate per metre		*14907.00*	*17888.00*		
12.14 A		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement, and Labour etc.			Including 20% for Kentledge		
			31st m	10%	22222.00	26666.00		
			32nd	10%	24444.00	29333.00		
			33rd m	10%	26888.00	32266.00		
			34th m	10%	29577.00	35492.00		
			35th m	10%	32535.00	39042.00		
			36th m	10%	35789.00	42947.00		
			37th m	10%	39368.00	47242.00		
			38th m	10%	43305.00	51966.00		
			39th m	10%	47636.00	57163.00		
			40th m	10%	52400.00	62880.00		
			Total Cost from 30m upto 40m		52400.00	62880.00		
			Avg Rate per metre		*5240.00*	*6288.00*		
12.14		B	Clayey Soil (8m dia. Well)					
			Unit = Running Meter.					
			Taking output = 1 meter					
		(i)	Depth from bed level upto 3.0 M					
			Rate of sinking @ 0.18 m/hour					
			a) Labour					
			Mate	day	0.22	275.00	60.50	L-12
			Sinker (skilled)	day	2.00	279.00	558.00	L-15
			Sinking helper (semi-skilled)	hour	3.50	279.00	976.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.		5.50	550.00	3025.00	P&M-075
			Consumables in sinking @ 10 per cent of (b)				302.50	
			c) Overhead charges @ 20%				984.50	
			d) Contractor's profit @ 10%				590.70	
			Rate per metre				6497.70	
						say	*6498.00*	
12.14 B		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking @ 0.17 m/hour					
			a) Labour					
			Mate	day	0.32	275.00	88.00	L-12
			Sinker	day	2.50	279.00	697.50	L-15
			Sinking helper (semi-skilled)	day	4.50	279.00	1255.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Air compressor with pneumatic chisel attachment for cutting hard clay,	hour	3.50	257.00	899.50	P&M-063

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Consumables in sinking @ 10 per cent of (b)				419.95	
			c) Overhead charges @ 20%				1332.09	
			d) Contractor's profit @ 10%				799.25	
			Rate per metre				8791.79	
						say	*8792.00*	
12.14 B		(iii)	Beyond 10 m upto 20 m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add for dewatering @ 5 per cent of cost, if required.			Including for dewatering @ 5% of cost, if required		
			11th m	5%	9231.00	9693.00		
			12th m	5%	9693.00	10178.00		
			13th m	5%	10178.00	10687.00		
			14th m	5%	10687.00	11221.00		
			15th m	5%	11221.00	11782.00		
			16th m	5%	11782.00	12371.00		
			17th m	5%	12371.00	12990.00		
			18th m	5%	12990.00	13640.00		
			19th m	5%	13640.00	14322.00		
			20th m	5%	14322.00	15038.00		
			Total Cost from 10m upto 20m		116115.00	121922.00		
			Avg Rate per metre		*11612.00*	*12192.00*		
12.14 B		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering on the cost, if required					
		c	Add 25 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 25% for Kentledge	Including 5% for dewatering, if required	
			31st m	7.5%	15396.00	19245.00	20207.00	
			32nd	7.5%	16551.00	20689.00	21723.00	
			33rd m	7.5%	17792.00	22240.00	23352.00	
			34th m	7.5%	19126.00	23908.00	25103.00	
			35th m	7.5%	20560.00	25700.00	26985.00	
			36th m	7.5%	22102.00	27628.00	29009.00	
			37th m	7.5%	23760.00	29700.00	31185.00	
			38th m	7.5%	25542.00	31928.00	33524.00	
			39th m	7.5%	27458.00	34323.00	36039.00	
			40th m	7.5%	29517.00	36896.00	38741.00	
			Total Cost from 30m upto 40m		217804.00	272257.00	285868.00	
			Avg Rate per metre		*21780.00*	*27226.00*	*28587.00*	
12.14 B		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering, if required					
		c	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 20% for Kentledge	Including 5% for dewatering, if required	
			31st m	10%	32469.00	38963.00	40911.00	
			32nd	10%	35716.00	42859.00	45002.00	
			33rd m	10%	39288.00	47146.00	49503.00	
			34th m	10%	43217.00	51860.00	54453.00	
			35th m	10%	47539.00	57047.00	59899.00	
			36th m	10%	52293.00	62752.00	65890.00	
			37th m	10%	57522.00	69026.00	72477.00	
			38th m	10%	63274.00	75929.00	79725.00	
			39th m	10%	69601.00	83521.00	87697.00	
			40th m	10%	76561.00	91873.00	96467.00	
			Total Cost from 30m upto 40m		517480.00	620976.00	652024.00	
			Avg Rate per metre		*51748.00*	*62098.00*	*65202.00*	
12.14		C	Soft Rock (8m dia well)					
			Unit = Running Meter.					
			Taking output = 1 m					
			Depth in soft rock strata upto 3m					
			Rate of sinking @ 0.20 m/hour					
			a) Labour					
			Mate	day	0.68	275.00	187.00	L-12
			Sinker (skilled)	day	4.00	279.00	1116.00	L-15
			Sinking helper (semi-skilled)	day	12.00	279.00	3348.00	L-14
			Diver	day	1.00	250.00	250.00	L-07
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	5.00	550.00	2750.00	P&M-075
			Air compressor with pneumatic breakers	hour	3.75	257.00	963.75	P&M-063
			Consumables in sinking @ 10 per cent of (b)				371.38	
			Add for dewatering @ of 5 per cent of (a+b), if required				449.31	
			c) Overhead charges @ 20%				1887.09	
			d) Contractor's profit @ 10%				1132.25	
			Rate per metre				12454.77	
						say	*12455.00*	
12.14		D	Hard Rock (8m dia well)					
			Unit = Running Meter					
			Taking output = 1 m					
			Depth in hard rock strata upto 3 m					
			Rate of sinking @ 0.17 m/hour					
			a) Material					
			Gelatine 80 per cent	Kg	8.00	102.00	816.00	M-104
			Electric Detonators	each	32.00	6.12	195.84	M-094/100
			b) Labour					
			Mate	day	1.09	275.00	299.75	L-12

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Driller	day	2.00	245.00	490.00	L-06
			Blaster	day	0.25	250.00	62.50	L-03
			Mazdoor	day	20.00	245.00	4900.00	L-13
			Mazdoor (Skilled)	day	4.00	245.00	980.00	L-15
			c) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Hire & running charges of compressor with pneumatic breaker/Jack hammer for drilling.	hour	2.00	257.00	514.00	P&M-063
			Dewatering @ 5 per cent of cost of (b+c), if				527.31	
			Consumables in sinking @ 10 per cent of cost of				673.23	
			d) Overhead charges @ 20%				2551.73	
			e) Contractor's profit @ 10%				1531.04	
			Rate per metre				16841.39	
						say	*16841.00*	
12.15	Section 1200		Sinking of 9 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.					
			Unit = Running Meter.					
			Taking output = 1 m					
			Diameter of well - 9 m.					
		A	Sandy Soil					
		(i)	Depth below bed level upto 3.0 M					
			Rate of sinking @ 0.25 m/hour					
			a) Labour					
			Mate	day	0.19	275.00	52.25	L-12
			Sinker (skilled)	day	1.50	279.00	418.50	L-15
			Sinking helper (semi-skilled)	day	3.25	279.00	906.75	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	4.00	550.00	2200.00	P&M-075
			Consumables in sinking @10 per cent of (b)				220.00	
			c) Overhead charges @ 20%				759.50	
			d) Contractor's profit @ 10%				455.70	
			Rate per metre				5012.70	
						say	*5013.00*	
12.15 A		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking @ 0.18 m/hour					
			a) Labour					
			Mate	day	0.27	275.00	74.25	L-12
			Sinker	day	1.75	279.00	488.25	L-15
			Sinking helper (semi-skilled)	day	4.00	279.00	1116.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	5.50	550.00	3025.00	P&M-075
			Consumables in sinking @10 per cent of (b)				302.50	
			c) Overhead charges @ 20%				1001.20	
			d) Contractor's profit @ 10%				600.72	
			Rate per metre				6607.92	
						say	*6608.00*	
12.15 A		(iii)	Beyond 10m upto 20m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
			11th m	5%	6938.00			
			12th m	5%	7285.00			
			13th m	5%	7649.00			
			14th m	5%	8031.00			
			15th m	5%	8433.00			
			16th m	5%	8855.00			
			17th m	5%	9298.00			
			18th m	5%	9763.00			
			19th m	5%	10251.00			
			20th m	5%	10764.00			
			Total Cost from 10m upto 20m		87267.00			
			Avg Rate per metre		*8727.00*			
12.15 A		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour.			Including 20% for Kentledge		
			21st m	7.5%	11571.30	13886.00		
			22nd m	7.5%	12439.00	14927.00		
			23rd m	7.5%	13372.00	16046.00		
			24th m	7.5%	14375.00	17250.00		
			25th m	7.5%	15453.00	18544.00		
			26th m	7.5%	16612.00	19934.00		
			27th m	7.5%	17858.00	21430.00		
			28th m	7.5%	19197.00	23036.00		
			29th m	7.5%	20637.00	24764.00		
			30th m	7.5%	22185.00	26622.00		
			Total Cost from 20m upto 30m		163699.30	196439.00		
			Avg Rate per metre		*16370.00*	*19644.00*		
12.15 A		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement, and Labour etc.			Including 20% for Kentledge		
			31st m	10%	24403.50	29284.00		
			32nd	10%	26844.00	32213.00		
			33rd m	10%	29528.00	35434.00		
			34th m	10%	32481.00	38977.00		
			35th m	10%	35729.00	42875.00		
			36th m	10%	39302.00	47162.00		

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			37th m	10%	43232.00	51878.00		
			38th m	10%	47555.00	57066.00		
			39th m	10%	52311.00	62773.00		
			40th m	10%	57542.00	69050.00		
			Total Cost from 30m upto 40m		388927.50	466712.00		
			Avg Rate per metre		*38893.00*	*46671.00*		
12.15		B	Clayey Soil (9m dia. Well)					
			Unit = Running Meter.					
			Taking output = 1 cum					
		(i)	Depth below bed level upto 3.0 M					
			Rate of sinking 0.17 m / hour					
			a) Labour					
			Mate	day	0.24	275.00	66.00	L-12
			Sinker (skilled)	day	2.25	279.00	627.75	L-15
			Sinking helper (semi-skilled)	day	3.75	279.00	1046.25	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	5.75	550.00	3162.50	P&M-075
			Consumables in sinking @ 10 per cent of (b)				316.25	
			c) Overhead charges @ 20%				1043.75	
			d) Contractor's profit @ 10%				626.25	
			Rate per metre				6888.75	
						say	*6889.00*	
12.15 B		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking 0.15 m / hour					
			a) Labour					
			Mate	day	0.34	275.00	93.50	L-12
			Sinker	day	2.50	279.00	697.50	L-15
			Sinking helper (semi-skilled)	day	5.00	279.00	1395.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.50	550.00	3575.00	P&M-075
			Air compressor with pneumatic chisel attachment for cutting hard clay.	hour	3.75	257.00	963.75	P&M-063
			Consumables in sinking @ 10 per cent of (b)				453.88	
			c) Overhead charges @ 20%				1076.79	
			d) Contractor's profit @ 10%				825.54	
			Rate per metre				9080.96	
						say	*9081.00*	
12.15 B		(iii)	Beyond 10 m upto 20 m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add for dewatering @ 5 per cent of cost, if required.			Including for dewatering @ 5% of cost, if required		
			11th m	5%	9535.00	10012.00		
			12th m	5%	10012.00	10513.00		
			13th m	5%	10513.00	11039.00		
			14th m	5%	11039.00	11591.00		
			15th m	5%	11591.00	12171.00		
			16th m	5%	12171.00	12780.00		
			17th m	5%	12780.00	13419.00		
			18th m	5%	13419.00	14090.00		
			19th m	5%	14090.00	14795.00		
			20th m	5%	14795.00	15535.00		
			Total Cost from 10m upto 20m		119945.00	125945.00		
			Avg Rate per metre		*11995.00*	*12595.00*		
12.15 B		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering on the cost, if required					
		c	Add 25 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 25% for Kentledge	Including 5% for dewatering, if required	
			31st m	7.5%	15905.00	19881.00	20875.00	
			32nd	7.5%	17098.00	21373.00	22442.00	
			33rd m	7.5%	18380.00	22975.00	24124.00	
			34th m	7.5%	19759.00	24699.00	25934.00	
			35th m	7.5%	21241.00	26551.00	27879.00	
			36th m	7.5%	22834.00	28543.00	29970.00	
			37th m	7.5%	24547.00	30684.00	32218.00	
			38th m	7.5%	26388.00	32985.00	34634.00	
			39th m	7.5%	28367.00	35459.00	37232.00	
			40th m	7.5%	30495.00	38119.00	40025.00	
			Total Cost from 30m upto 40m		225014.00	281269.00	295333.00	
			Avg Rate per metre		*22501.00*	*28127.00*	*29533.00*	
12.15 B		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering, if required					
		c	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 20% for Kentledge	Including 5% for dewatering, if required	
			31st m	10%	33545.00	40254.00	42267.00	
			32nd	10%	36900.00	44280.00	46494.00	
			33rd m	10%	40590.00	48708.00	51143.00	
			34th m	10%	44649.00	53579.00	56258.00	
			35th m	10%	49114.00	58937.00	61884.00	
			36th m	10%	54025.00	64830.00	68072.00	
			37th m	10%	59428.00	71314.00	74880.00	
			38th m	10%	65371.00	78445.00	82367.00	
			39th m	10%	71908.00	86290.00	90605.00	
			40th m	10%	79099.00	94919.00	99665.00	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Total Cost from 30m upto 40m		534629.00	641556.00	673635.00	
			Avg Rate per metre		*53463.00*	*64156.00*	*67364.00*	
12.15		C	Soft Rock (9m dia well)					
			Unit = Running Meter.					
			Taking output = 1 m					
			Depth in soft rock strata up to 3m					
			Rate of sinking 0.15 m / hour					
			a) Labour					
			Mate	day	0.76	275.00	209.00	L-12
			Sinker (skilled)	day	4.00	279.00	1116.00	L-15
			Sinking helper (semi-skilled)	day	14.00	279.00	3906.00	L-14
			Diver	day	1.20	250.00	300.00	L-07
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.50	550.00	3575.00	P&M-075
			Air compressor with pneumatic breakers	hour	4.00	257.00	1028.00	P&M-063
			Consumables in sinking @ 10 per cent of (b)				460.30	
			Add for dewatering @ of 5 per cent of (a+b), if required				1059.43	
			c) Overhead charges @ 20%				2330.75	
			d) Contractor's profit @ 10%				1398.45	
			Rate per metre				15382.92	
						say	*15383.00*	
12.15		D	Hard Rock (9m dia well)					
			Unit = Running Meter					
			Taking output = 1 m					
			Depth in hard rock strata upto 3 m					
			Rate of sinking 0.15 m / hour					
			a) Material					
			Gelatine 80 per cent	Kg	10.00	102.00	1020.00	M-104
			Electric Detonators	each	40.00	6.12	244.80	M-094/100
			b) Labour					
			Mate	day	1.17	275.00	321.75	L-12
			Driller	day	2.00	245.00	490.00	L-06
			Blaster	day	0.25	250.00	62.50	L-03
			Mazdoor	day	22.00	245.00	5390.00	L-13
			Mazdoor (Skilled)	day	4.00	245.00	980.00	L-15
			Diver	day	1.00	250.00	250.00	L-07
			c) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	7.00	550.00	3850.00	P&M-075
			Hire & running charges of compressor with pneumatic breaker/Jack hammer for drilling.	hour	2.50	257.00	642.50	P&M-063
			Dewatering @ 5 per cent of cost of (b+c), if				599.34	
			Consumables in sinking @ 10 per cent of cost of				749.43	
			d) Overhead charges @ 20%				2920.06	
			e) Contractor's profit @ 10%				1752.04	
			Rate per metre				19272.41	
						say	*19272.00*	
12.16	1200		Sinking of 10 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.					
			Unit = Running Meter					
			Taking output = 1 m					
			Diameter of well - 10 m.					
		A	Sandy Soil					
		(i)	Depth below bed level upto 3.0 M					
			Rate of sinking 0.20 m / hour					
			a) Labour					
			Mate	day	0.20	275.00	55.00	L-12
			Sinker (skilled)	day	1.50	279.00	418.50	L-15
			Sinking helper (semi-skilled)	day	3.50	279.00	976.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	5.00	550.00	2750.00	P&M-075
			Consumables in sinking @10 per cent of (b)				275.00	
			c) Overhead charges @ 20%				895.00	
			d) Contractor's profit @ 10%				537.00	
			Rate per metre				5907.00	
						say	*5907.00*	
12.16 A		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking 0.17 m / hour					
			a) Labour					
			Mate	day	0.31	275.00	85.25	L-12
			Sinker	day	2.00	279.00	558.00	L-15
			Sinking helper (semi-skilled)	day	4.25	279.00	1185.75	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	5.75	550.00	3162.50	P&M-075
			Consumables in sinking @10 per cent of (b)				316.25	
			c) Overhead charges @ 20%				1061.55	
			d) Contractor's profit @ 10%				636.93	
			Rate per metre				7006.23	
						say	*7006.00*	
12.16 A		(iii)	Beyond 10m upto 20m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
			11th m	5%	7357.00			
			12th m	5%	7725.00			
			13th m	5%	8111.00			
			14th m	5%	8517.00			
			15th m	5%	8943.00			
			16th m	5%	9390.00			

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			17th m	5%	9860.00			
			18th m	5%	10353.00			
			19th m	5%	10871.00			
			20th m	5%	11415.00			
			Total Cost from 10m upto 20m		92542.00			
			Avg Rate per metre		*9254.00*			
12.16 A		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour.			Including 20% for Kentledge		
			21st m	7.5%	12271.00	14725.00		
			22nd m	7.5%	13191.00	15829.00		
			23rd m	7.5%	14180.00	17016.00		
			24th m	7.5%	15244.00	18293.00		
			25th m	7.5%	16387.00	19664.00		
			26th m	7.5%	17616.00	21139.00		
			27th m	7.5%	18937.00	22724.00		
			28th m	7.5%	20357.00	24428.00		
			29th m	7.5%	21884.00	26261.00		
			30th m	7.5%	23525.00	28230.00		
			Total Cost from 20m upto 30m		173592.00	208309.00		
			Avg Rate per metre		*17359.00*	*20831.00*		
12.16 A		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement, and Labour etc.			Including 20% for Kentledge		
			31st m	10%	25878.00	31054.00		
			32nd	10%	28466.00	34159.00		
			33rd m	10%	31313.00	37576.00		
			34th m	10%	34444.00	41333.00		
			35th m	10%	37888.00	45466.00		
			36th m	10%	41677.00	50012.00		
			37th m	10%	45845.00	55014.00		
			38th m	10%	50430.00	60516.00		
			39th m	10%	55473.00	66568.00		
			40th m	10%	61020.00	73224.00		
			Total Cost from 30m upto 40m		412434.00	494922.00		
			Avg Rate per metre		*41243.00*	*49492.00*		
12.16		B	Clayey Soil (10m dia. Well)					
			Unit = Running Meter					
			Taking output = 1 cum					
		(i)	Depth below bed level upto 3.0 M					
			Rate of sinking 0.18m/hour.					
			a) Labour					
			Mate	day	0.25	275.00	68.75	L-12
			Sinker (skilled)	day	2.50	279.00	697.50	L-15
			Sinking helper (semi-skilled)	day	5.50	279.00	1534.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Consumables in sinking @ 10 per cent of (b)				330.00	
			c) Overhead charges @ 20%				1186.15	
			d) Contractor's profit @ 10%				711.69	
			Rate per metre				7828.59	
						say	*7829.00*	
12.16 B		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking 0.15m/hour.					
			a) Labour					
			Mate	day	0.40	275.00	110.00	L-12
			Sinker	day	3.00	279.00	837.00	L-15
			Sinking helper (semi-skilled)	day	5.50	279.00	1534.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Air compressor with pneumatic chisel attachment for cutting hard clay	hour	4.00	257.00	1028.00	P&M-063
			Consumables in sinking @ 10 per cent of (b)				432.80	
			c) Overhead charges @ 20%				1448.46	
			d) Contractor's profit @ 10%				869.08	
			Rate per metre				9559.84	
						say	*9560.00*	
12.16 B		(iii)	Beyond 10 m upto 20 m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add for dewatering @ 5 per cent of cost, if required.			Including for dewatering @ 5% of cost, if required		
			11th m	5%	10038.00	10540.00		
			12th m	5%	10540.00	11067.00		
			13th m	5%	11067.00	11620.00		
			14th m	5%	11620.00	12201.00		
			15th m	5%	12201.00	12811.00		
			16th m	5%	12811.00	13452.00		
			17th m	5%	13452.00	14125.00		
			18th m	5%	14125.00	14831.00		
			19th m	5%	14831.00	15573.00		
			20th m	5%	15573.00	16352.00		
			Total Cost from 10m upto 20m		126258.00	132572.00		
			Avg Rate per metre		*12626.00*	*13257.00*		
12.16 B		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		b	Add 5 per cent of cost for dewatering on the cost, if required					
		c	Add 25 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 25% for Kentledge	Including 5% for dewatering, if required	
			31st m	7.5%	16741.00	20926.00	21972.00	
			32nd	7.5%	17997.00	22496.00	23621.00	
			33rd m	7.5%	19347.00	24184.00	25393.00	
			34th m	7.5%	20798.00	25998.00	27298.00	
			35th m	7.5%	22358.00	27948.00	29345.00	
			36th m	7.5%	24035.00	30044.00	31546.00	
			37th m	7.5%	25838.00	32298.00	33913.00	
			38th m	7.5%	27776.00	34720.00	36456.00	
			39th m	7.5%	29859.00	37324.00	39190.00	
			40th m	7.5%	32098.00	40123.00	42129.00	
			Total Cost from 30m upto 40m		236847.00	296061.00	310863.00	
			Avg Rate per metre		*23685.00*	*29606.00*	*31086.00*	
12.16 B		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering, if required					
		c	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 20% for Kentledge	Including 5% for dewatering, if required	
			31st m	10%	35308.00	42370.00	44489.00	
			32nd	10%	38839.00	46607.00	48937.00	
			33rd m	10%	42723.00	51268.00	53831.40	
			34th m	10%	46995.00	56394.00	59213.70	
			35th m	10%	51695.00	62034.00	65135.70	
			36th m	10%	56865.00	68238.00	71649.90	
			37th m	10%	62552.00	75062.00	78815.10	
			38th m	10%	68807.00	82568.00	86696.40	
			39th m	10%	75688.00	90826.00	95367.30	
			40th m	10%	83257.00	99908.00	104903.40	
			Total Cost from 30m upto 40m		562729.00	675275.00	709038.90	
			Avg Rate per metre		*56273.00*	*67528.00*	*70904.00*	
12.16		C	Soft Rock (10m dia well)					
			Unit = Running Meter.					
			Taking output = 1 m					
			Depth in soft rock strata upto 3m					
			Rate of sinking 0.14m/hour.					
			a) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Sinker (skilled)	day	4.00	279.00	1116.00	L-15
			Sinking helper (semi-skilled)	day	16.00	279.00	4464.00	L-14
			Diver	day	1.40	250.00	350.00	L-07
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	7.00	550.00	3850.00	P&M-075
			Air compressor with pneumatic breakers	hour	4.25	257.00	1092.25	P&M-063
			Consumables in sinking @ 10 per cent of (b)				494.23	
			Add for dewatering @ 5 per cent of cost, if required				271.82	
			c) Overhead charges @ 20%				2374.96	
			d) Contractor's profit @ 10%				1424.98	
			Rate per metre				15674.73	
						say	*15675.00*	
12.16		D	Hard Rock (10m dia well)					
			Unit = Running Meter.					
			Taking output = 1 m					
			Depth in hard rock strata upto 3 m					
			Rate of sinking 0.12 m/ hour.					
			a) Material					
			Gelatine 80 per cent	Kg	11.00	102.00	1122.00	M-104
			Electric Detonators	each.	44.00	6.12	269.28	M-094/100
			b) Labour					
			Mate	day	1.27	275.00	349.25	L-12
			Driller	day	2.00	245.00	490.00	L-06
			Blaster	day	0.25	250.00	62.50	L-03
			Mazdoor	day	24.00	245.00	5880.00	L-13
			Mazdoor (Skilled)	day	4.00	245.00	980.00	L-15
			c) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	8.50	550.00	4675.00	P&M-075
			Hire & running charges of compressor with pneumatic breaker/Jack hammer or drill	hour	3.00	257.00	771.00	P&M-063
			Dewatering @ 5 per cent of cost (c), if required.				272.30	
			Consumables in sinking @ 10 per cent of cost of (b+c).				1348.01	
			c) Overhead charges @ 20%				3243.87	
			d) Contractor's profit @ 10%				1946.32	
			Rate per metre				21409.52	
						say	*21410.00*	
12.17	1200		Sinking of 11 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.					
			Unit = Running Meter					
			Taking output = 0.50 m					
			Diameter of well - 11 m.					
		A	Sandy Soil					
		(i)	Depth from bed level upto 3.0 M					
			Rate of sinking @ 0.15 m/hour					
			a) Labour					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mate	day	0.21	275.00	57.75	L-12
			Sinker (skilled)	day	1.50	279.00	418.50	L-15
			Sinking helper (semi-skilled)	day	3.30	279.00	920.70	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Consumables in sinking @10 per cent of (b)				330.00	
			c) Overhead charges @ 20%				1005.39	
			d) Contractor's profit @ 10%				603.23	
			Cost for 0.5m				6635.57	
			Rate per metre = (a+b+c+d)/0.50				13271.15	
						say	*13271.00*	
12.17 A		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking @ 0.13 m/hour					
			a) Labour					
			Mate	day	0.32	275.00	88.00	L-12
			Sinker	day	2.00	279.00	558.00	L-15
			Sinking helper (semi-skilled)	day	4.50	279.00	1255.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	4.00	550.00	2200.00	P&M-075
			Consumables in sinking @10 per cent of (b)				220.00	
			c) Overhead charges @ 20%				864.30	
			d) Contractor's profit @ 10%				518.58	
			Cost for 0.5m				5704.38	
			Rate per metre				11408.76	
						say	*11409.00*	
12.17 A		(iii)	Beyond 10m upto 20m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
			11th m	5%	11979.00			
			12th m	5%	12578.00			
			13th m	5%	13207.00			
			14th m	5%	13867.00			
			15th m	5%	14560.00			
			16th m	5%	15288.00			
			17th m	5%	16052.00			
			18th m	5%	16855.00			
			19th m	5%	17698.00			
			20th m	5%	18583.00			
			Total Cost from 10m upto 20m		150667.00			
			Avg Rate per metre		*15067.00*			
12.17 A		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour.			Including 20% for Kentledge		
			21st m	7.5%	19977.00	23972.00		
			22nd m	7.5%	21475.00	25770.00		
			23rd m	7.5%	23086.00	27703.00		
			24th m	7.5%	24817.00	29780.00		
			25th m	7.5%	26678.00	32014.00		
			26th m	7.5%	28679.00	34415.00		
			27th m	7.5%	30830.00	36996.00		
			28th m	7.5%	33142.00	39770.00		
			29th m	7.5%	35628.00	42754.00		
			30th m	7.5%	38300.00	45960.00		
			Total Cost from 20m upto 30m		282612.00	339134.00		
			Avg Rate per metre		*28261.00*	*33913.00*		
12.17 A		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement, and Labour etc.			Including 20% for Kentledge		
			31st m	10%	42130.00	50556.00		
			32nd	10%	46343.00	55612.00		
			33rd m	10%	50977.00	61172.00		
			34th m	10%	56075.00	67290.00		
			35th m	10%	61683.00	74020.00		
			36th m	10%	67851.00	81421.00		
			37th m	10%	74636.00	89563.00		
			38th m	10%	82100.00	98520.00		
			39th m	10%	90310.00	108372.00		
			40th m	10%	99341.00	119209.00		
			Total Cost from 30m upto 40m		671446.00	805735.00		
			Avg Rate per metre		*67145.00*	*80574.00*		
12.17		B	Clayey Soil (11 m dia. Well)					
			Unit = Running Meter					
			Taking output = 0.50 meter					
		(i)	Depth from bed level upto 3.0 M					
			Rate of sinking @ 0.10 m/hour					
			a) Labour					
			Mate	day	0.26	275.00	71.50	L-12
			Sinker (skilled)	day	2.50	279.00	697.50	L-15
			Sinking helper (semi-skilled)	day	4.00	279.00	1116.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	5.00	550.00	2750.00	P&M-075
			Consumables in sinking @ 10 per cent of (b)				275.00	
			c) Overhead charges @ 20%				982.00	
			d) Contractor's profit @ 10%				589.20	
			Cost for 0.5m				6481.20	
			Rate per metre				12962.40	
						say	*12962.00*	
12.17 B		(ii)	Beyond 3m upto 10m depth					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Rate of sinking @ 0.08 m/hour					
			a) Labour					
			Mate	day	0.43	275.00	118.25	L-12
			Sinker	day	3.50	279.00	976.50	L-15
			Sinking helper (semi-skilled)	day	5.75	279.00	1604.25	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Air compressor with pneumatic chisel attachment for cutting hard clay	hour	4.25	257.00	1092.25	P&M-063
			Consumables in sinking @ 10 per cent of (b)				439.23	
			c) Overhead charges @ 20%				1506.10	
			d) Contractor's profit @ 10%				903.66	
			Cost for 0.5m				9940.23	
			Rate per metre				19880.45	
						say	*19880.00*	
12.17 B		(iii)	Beyond 10 m upto 20 m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add for dewatering @ 5 per cent of cost, if required.			Including for dewatering @ 5% of cost, if required		
			11th m	5%	20874.00	21918.00		
			12th m	5%	21918.00	23014.00		
			13th m	5%	23014.00	24165.00		
			14th m	5%	24165.00	25373.00		
			15th m	5%	25373.00	26642.00		
			16th m	5%	26642.00	27974.00		
			17th m	5%	27974.00	29373.00		
			18th m	5%	29373.00	30842.00		
			19th m	5%	30842.00	32384.00		
			20th m	5%	32384.00	34003.00		
			Total Cost from 10m upto 20m		262559.00	275687.00		
			Avg Rate per metre		*26256.00*	*27569.00*		
12.17 B		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering on the cost, if required					
		c	Add 25 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 25% for Kentledge	Including 5% for dewatering, if required	
			31st m	7.5%	34813.00	43516.00	45692.00	
			32nd	7.5%	37424.00	46780.00	49119.00	
			33rd m	7.5%	40231.00	50289.00	52803.00	
			34th m	7.5%	43248.00	54060.00	56763.00	
			35th m	7.5%	46492.00	58115.00	61021.00	
			36th m	7.5%	49979.00	62474.00	65598.00	
			37th m	7.5%	53727.00	67159.00	70517.00	
			38th m	7.5%	57757.00	72196.00	75806.00	
			39th m	7.5%	62089.00	77611.00	81492.00	
			40th m	7.5%	66746.00	83433.00	87605.00	
			Total Cost from 30m upto 40m		492506.00	615633.00	646415.00	
			Avg Rate per metre		*49251.00*	*61563.00*	*64642.00*	
12.17 B		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering, if required					
		c	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 20% for Kentledge	Including 5% for dewatering, if required	
			31st m	10%	73421.00	88105.00	92510.00	
			32nd	10%	80763.00	96916.00	101762.00	
			33rd m	10%	88839.00	106607.00	111937.00	
			34th m	10%	97723.00	117268.00	123131.00	
			35th m	10%	107495.00	128994.00	135444.00	
			36th m	10%	118245.00	141894.00	148989.00	
			37th m	10%	130070.00	156084.00	163888.00	
			38th m	10%	143077.00	171692.00	180277.00	
			39th m	10%	157385.00	188862.00	198305.00	
			40th m	10%	173124.00	207749.00	218136.00	
			Total Cost from 30m upto 40m		1170142	1404171	1474379	
			Avg Rate per metre		*117014.00*	*140417.00*	*147438.00*	
12.17		C	Soft Rock (11m dia well)					
			Unit = Running Meter.					
			Taking output = 0.50 m					
			Depth in soft rock strata upto 3m					
			Rate of sinking @ 0.06 m/hour					
			a) Labour					
			Mate	day	0.95	275.00	261.25	L-12
			Sinker (skilled)	day	4.25	279.00	1185.75	L-15
			Sinking helper (semi-skilled)	day	18.00	279.00	5022.00	L-14
			Diver	day	1.50	250.00	375.00	L-07
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	8.00	550.00	4400.00	P&M-075
			Air compressor with pneumatic breakers	hour	4.50	257.00	1156.50	P&M-063
			Consumables in sinking @ 10 per cent of (b)				555.65	
			Add for dewatering @ 5 per cent of cost, if required				305.61	
			c) Overhead charges @ 20%				2652.35	
			d) Contractor's profit @ 10%				1591.41	
			Cost for 0.5m				17505.52	
			Rate per metre				35011.04	
						say	*35011.00*	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
12.17		D	Hard Rock (11m dia well)					
			Unit = Running Meter.					
			Taking output = 0.50 m					
			Depth in hard rock upto 3 m					
			Rate of sinking @ 0.05 m/hour					
			a) Material					
			Gelatine 80 per cent	Kg	12.00	102.00	1224.00	M-104
			Electric Detonators	each.	48.00	6.12	293.76	M-094/100
			b) Labour					
			Mate	day	1.35	275.00	371.25	L-12
			Driller	day	2.00	245.00	490.00	L-06
			Blaster	day	0.25	250.00	62.50	L-03
			Mazdoor	day	26.00	245.00	6370.00	L-13
			Mazdoor (Skilled)	day	4.00	245.00	980.00	L-15
			c) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	10.00	550.00	5500.00	P&M-075
			Hire & running charges of compressor with pneumatic breaker/Jack hammer or drill	hour	3.50	257.00	899.50	P&M-063
			Dewatering @ 5 per cent of cost (c), if required.				319.98	
			Consumables in sinking @ 10 per cent of cost of (b+c).				1467.33	
			c) Overhead charges @ 20%				3595.66	
			d) Contractor's profit @ 10%				2157.40	
			Cost for 0.5m				23731.37	
			Rate per metre				47462.74	
						say	*47463.00*	
12.18	1200		Sinking of 12 m external diameter well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.					
			Unit = Running Meter					
			Taking output = 0.25 m					
			Diameter of well - 12 m.					
		A	Sandy Soil					
		(i)	I) Depth below bed level upto 3.0 M					
			Rate of sinking @ 0.05 m/hour					
			a) Labour					
			Mate	day	0.22	275.00	60.50	L-12
			Sinker (skilled)	day	1.75	279.00	488.25	L-15
			Sinking helper (semi-skilled)	day	4.00	279.00	1116.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.00	550.00	3300.00	P&M-075
			Consumables in sinking @10 per cent of (b)				330.00	
			c) Overhead charges @ 20%				1058.95	
			d) Contractor's profit @ 10%				635.37	
			Cost for 0.25m				6989.07	
			Rate per metre = (a+b+c+d)/0.25				27956.28	
						say	*27956.00*	
12.18 A		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking @ 0.038 m/hour					
			a) Labour					
			Mate	day	0.37	275.00	101.75	L-12
			Sinker	day	2.50	279.00	697.50	L-15
			Sinking helper (semi-skilled)	day	4.75	279.00	1325.25	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.50	550.00	3575.00	P&M-075
			Consumables in sinking @10 per cent of (b)				715.00	
			c) Overhead charges @ 20%				641.45	
			d) Contractor's profit @ 10%				705.60	
			Cost for 0.25m				7761.55	
			Rate per metre				31046.18	
						say	*31046.00*	
12.18 A		(iii)	Beyond 10m upto 20m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
			11th m	5%	32598.00			
			12th m	5%	34228.00			
			13th m	5%	35939.40			
			14th m	5%	37736.37			
			15th m	5%	39623.19			
			16th m	5%	41604.35			
			17th m	5%	43684.57			
			18th m	5%	45868.79			
			19th m	5%	48162.23			
			20th m	5%	50570.34			
			Total Cost from 10m upto 20m		410015.24			
			Avg Rate per metre		*41002.00*			
12.18 A		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour.			Including 20% for Kentledge		
			21st m	7.5%	54363.00	65236.00		
			22nd m	7.5%	58440.00	70128.00		
			23rd m	7.5%	62823.00	75388.00		
			24th m	7.5%	67535.00	81042.00		
			25th m	7.5%	72600.00	87120.00		
			26th m	7.5%	78045.00	93654.00		
			27th m	7.5%	83898.00	100678.00		
			28th m	7.5%	90190.00	108228.00		
			29th m	7.5%	96954.00	116345.00		

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			30th m	7.5%	104226.00	125071.00		
			Total Cost from 20m upto 30m		769074.00	922890.00		
			Avg Rate per metre		*76907.00*	*92289.00*		
12.18 A		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement, and Labour etc.			Including 20% for Kentledge		
			31st m	10%	114649.00	137579.00		
			32nd	10%	126114.00	151337.00		
			33rd m	10%	138725.00	166470.00		
			34th m	10%	152598.00	183118.00		
			35th m	10%	167858.00	201430.00		
			36th m	10%	184644.00	221573.00		
			37th m	10%	203108.00	243730.00		
			38th m	10%	223419.00	268103.00		
			39th m	10%	245761.00	294913.00		
			40th m	10%	270337.00	324404.00		
			Total Cost from 30m upto 40m		1827213	2192657		
			Avg Rate per metre		*182721.00*	*219266.00*		
12.18		B	Clayey Soil (12 m dia. Well)					
			Unit = Running Meter.					
			Taking output = 0.25 meter.					
		(i)	Depth below bed level upto 3.0 M					
			Rate of sinking @ 0.04 m/hour					
			a) Labour					
			Mate	day	0.30	275.00	82.50	L-12
			Sinker (skilled)	day	3.00	279.00	837.00	L-15
			Sinking helper (semi-skilled)	day	4.50	279.00	1255.50	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.25	550.00	3437.50	P&M-075
			Consumables in sinking @ 10 per cent of (b)				343.75	
			c) Overhead charges @ 20%				1191.25	
			d) Contractor's profit @ 10%				714.75	
			Cost for 0.25m				7862.25	
			Rate per metre				31449.00	
						say	*31449.00*	
12.18 B		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking @ 0.03 m/hour					
			a) Labour					
			Mate	day	0.48	275.00	132.00	L-12
			Sinker	day	3.75	279.00	1046.25	L-15
			Sinking helper (semi-skilled)	day	6.00	279.00	1674.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	8.33	550.00	4581.50	P&M-075
			Air compressor with pneumatic chisel attachment for cutting hard clay.	hour	4.50	257.00	1156.50	P&M-063
			Consumables in sinking @ 10 per cent of (b)				573.80	
			c) Overhead charges @ 20%				1832.81	
			d) Contractor's profit @ 10%				1099.69	
			Cost for 0.25m				12096.55	
			Rate per metre				48386.18	
						say	*48386.00*	
12.18 B		(iii)	Beyond 10 m upto 20 m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add for dewatering @ 5 per cent of cost, if required.			Including for dewatering @ 5% of cost, if required		
			11th m	5%	50805.00	53345.00		
			12th m	5%	53345.00	56012.00		
			13th m	5%	56012.00	58813.00		
			14th m	5%	58813.00	61754.00		
			15th m	5%	61754.00	64842.00		
			16th m	5%	64842.00	68084.00		
			17th m	5%	68084.00	71488.00		
			18th m	5%	71488.00	75062.00		
			19th m	5%	75062.00	78815.00		
			20th m	5%	78815.00	82756.00		
			Total Cost from 10m upto 20m		639020.00	670971.00		
			Avg Rate per metre		*63902.00*	*67097.00*		
12.18 B		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering on the cost, if required					
		c	Add 25 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 25% for Kentledge	Including 5% for dewatering, if required	
			31st m	7.5%	84726.00	105908.00	111203.00	
			32nd	7.5%	91080.00	113850.00	119543.00	
			33rd m	7.5%	97911.00	122389.00	128508.00	
			34th m	7.5%	105254.00	131568.00	138146.00	
			35th m	7.5%	113148.00	141435.00	148507.00	
			36th m	7.5%	121634.00	152043.00	159645.00	
			37th m	7.5%	130757.00	163446.00	171618.00	
			38th m	7.5%	140564.00	175705.00	184490.00	
			39th m	7.5%	151106.00	188883.00	198327.00	
			40th m	7.5%	162439.00	203049.00	213201.00	
			Total Cost from 30m upto 40m		1198619	1498276	1573188	
			Avg Rate per metre		*119862.00*	*149828.00*	*157319.00*	
12.18 B		(v)	Beyond 30m upto 40 m					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering, if required					
		c	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 20% for Kentledge	Including 5% for dewatering, if required	
			31st m	10%	178683.00	214420.00	225141.00	
			32nd	10%	196551.00	235861.00	247654.00	
			33rd m	10%	216206.00	259447.00	272419.00	
			34th m	10%	237827.00	285392.00	299662.00	
			35th m	10%	261610.00	313932.00	329629.00	
			36th m	10%	287771.00	345325.00	362591.00	
			37th m	10%	316548.00	379858.00	398851.00	
			38th m	10%	348203.00	417844.00	438736.00	
			39th m	10%	383023.00	459628.00	482609.00	
			40th m	10%	421325.00	505590.00	530870.00	
			Total Cost from 30m upto 40m		2847747	3417297	3588162	
			Avg Rate per metre		*284775.00*	*341730.00*	*358816.00*	
12.18		C	Soft Rock (12m dia well)					
			Unit = Running Meter					
			Taking output = 0.25 m					
			Depth in soft rock strata upto 3m					
			Rate of sinking @ 0.025 m/hour					
			a) Labour					
			Mate	day	1.06	275.00	291.50	L-12
			Sinker (skilled)	day	4.50	279.00	1255.50	L-15
			Sinking helper (semi-skilled)	day	20.00	279.00	5580.00	L-14
			Diver	day	1.75	250.00	437.50	L-07
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	10.00	550.00	5500.00	P&M-075
			Air compressor with pneumatic chisel attachment for cutting hard clay.	hour	4.75	257.00	1220.75	P&M-063
			Consumables in sinking @ 10 per cent of (b)				672.08	
			Add for dewatering @ 5 per cent, if required				369.64	
			c) Overhead charges @ 20%				3065.39	
			d) Contractor's profit @ 10%				1839.24	
			Cost for 0.25m = a+b+c+d				20231.60	
			Rate per metre = (a+b+c+d)/0.25				80926.38	
						say	*80926.00*	
12.18		D	Hard Rock (12m dia well)					
			Unit = Running Meter					
			Taking output = 0.25 m					
		(i)	Depth in hard rock strata upto 3 m					
			Rate of sinking @ 0.020 m/hour					
			a) Material					
			Gelatine80 per cent	Kg	14.00	102.00	1428.00	M-104
			Electric detonator	each.	56.00	6.12	342.72	M-094/100
			b) Labour					
			Mate	day	1.44	275.00	396.00	L-12
			Driller	day	2.00	245.00	490.00	L-06
			Blaster	day	0.25	250.00	62.50	L-03
			Mazdoor	day	28.00	245.00	6860.00	L-13
			Mazdoor (Skilled)	day	4.50	245.00	1102.50	L-15
			c) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	12.50	550.00	6875.00	P&M-075
			Hire & running charges of compressor with pneumatic breaker/Jack hammer or drill	hour	4.00	257.00	1028.00	P&M-063
			Dewatering @ 5 per cent, if required.				395.15	
			Consumables in sinking @ 10 per cent of (c).				829.82	
			d) Overhead charges @ 20%				3961.94	
			e) Contractor's profit @ 10%				2377.16	
			Cost for 0.25m				26148.78	
			Rate per metre				104595.14	
						say	*104595.00*	
12.19	1200		Sinking of Twin D Type well (other than pneumatic method of sinking) through all types of strata namely sandy soil, clayey soil and rock as shown against each case, complete as per drawing and technical specifications. Depth of sinking is reckoned from bed level.					
			Unit = Running Meter					
			Taking output = 1 m					
			Dimensions of well.					
			Overall length = 12 m					
			Overall width = 6 m					
		A	Sandy Soil					
		(i)	Depth from bed level upto 3.0 M					
			Rate of sinking @ 0.18 m/hour					
			a) Labour					
			Mate	day	0.20	275.00	55.00	L-12
			Sinker (skilled)	day	1.25	279.00	348.75	L-15
			Sinking helper (semi-skilled)	day	3.75	279.00	1046.25	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	5.50	550.00	3025.00	P&M-075
			Consumables in sinking @10 per cent of (b)				302.50	
			c) Overhead charges @ 20%				955.50	
			d) Contractor's profit @ 10%				573.30	
			Rate per metre				6306.30	
						say	*6306.00*	
12.19 A		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking @ 0.17 m/hour					
			a) Labour					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mate	day	0.30	275.00	82.50	L-12
			Sinker	day	1.50	279.00	418.50	L-15
			Sinking helper (semi-skilled)	day	4.00	279.00	1116.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	5.88	550.00	3234.00	P&M-075
			Consumables in sinking @10 per cent of (b)				323.40	
			c) Overhead charges @ 20%				1034.88	
			d) Contractor's profit @ 10%				620.93	
			Rate per metre				6830.21	
						say	*6830.00*	
12.19 A		(iii)	Beyond 10m upto 20m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
			11th m	5%	7172.00			
			12th m	5%	7531.00			
			13th m	5%	7908.00			
			14th m	5%	8303.00			
			15th m	5%	8718.00			
			16th m	5%	9154.00			
			17th m	5%	9612.00			
			18th m	5%	10093.00			
			19th m	5%	10598.00			
			20th m	5%	11128.00			
			Total Cost from 10m upto 20m		90217.00			
			Avg Rate per metre		*9022.00*			
12.19 A		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour.			Including 20% for Kentledge		
			21st m	7.5%	11963.00	14356.00		
			22nd m	7.5%	12860.00	15432.00		
			23rd m	7.5%	13825.00	16590.00		
			24th m	7.5%	14862.00	17834.00		
			25th m	7.5%	15977.00	19172.00		
			26th m	7.5%	17175.00	20610.00		
			27th m	7.5%	18463.00	22156.00		
			28th m	7.5%	19848.00	23818.00		
			29th m	7.5%	21337.00	25604.00		
			30th m	7.5%	22937.00	27524.00		
			Total Cost from 20m upto 30m		169247.00	203096.00		
			Avg Rate per metre		*16925.00*	*20310.00*		
12.19 A		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 20 per cent of cost for Kentledge including supports, loading arrangement, and Labour etc.			Including 20% for Kentledge		
			31st m	10%	25231.00	30277.00		
			32nd	10%	27754.00	33305.00		
			33rd m	10%	30529.00	36635.00		
			34th m	10%	33582.00	40298.00		
			35th m	10%	36940.00	44328.00		
			36th m	10%	40634.00	48761.00		
			37th m	10%	44697.00	53636.00		
			38th m	10%	49167.00	59000.00		
			39th m	10%	54084.00	64901.00		
			40th m	10%	59492.00	71390.00		
			Total Cost from 30m upto 40m		402110.00	482531.00		
			Avg Rate per metre		*40211.00*	*48253.00*		
12.19		B	Clayey Soil (Twin D Type Well)					
			Unit = Running Meter					
			Taking output = 1 meter					
		(i)	Depth below bed level upto 3.0 M					
			Rate of sinking @ 0.16 m/hour					
			a) Labour					
			Mate	day	0.26	275.00	71.50	L-12
			Sinker (skilled)	day	2.50	279.00	697.50	L-15
			Sinking helper (semi-skilled)	day	4.00	279.00	1116.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.25	550.00	3437.50	P&M-075
			Consumables in sinking @ 10 per cent of (b)				343.75	
			c) Overhead charges @ 20%				1133.25	
			d) Contractor's profit @ 10%				679.95	
			Rate per metre				7479.45	
						say	*7479.00*	
12.19 B		(ii)	Beyond 3m upto 10m depth					
			Rate of sinking @ 0.15 m/hour					
			a) Labour					
			Mate	day	0.45	275.00	123.75	L-12
			Sinker	day	3.25	279.00	906.75	L-15
			Sinking helper (semi-skilled)	day	6.00	279.00	1674.00	L-14
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	6.67	550.00	3668.50	P&M-075
			Air compressor with pneumatic chisel attachment for cutting hard clay.	hour	4.50	257.00	1156.50	P&M-063
			Consumables in sinking @ 10 per cent of (b)				482.50	
			c) Overhead charges @ 20%				1602.40	
			d) Contractor's profit @ 10%				961.44	
			Rate per metre				10575.84	
						say	*10576.00*	
12.19 B		(iii)	Beyond 10 m upto 20 m					
		a	Add 5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		b	Add for dewatering @ 5 per cent of cost, if required.			Including for dewatering @ 5% of cost, if required		
			11th m	5%	11105.00	11660.00		
			12th m	5%	11660.00	12243.00		
			13th m	5%	12243.00	12855.00		
			14th m	5%	12855.00	13498.00		
			15th m	5%	13498.00	14173.00		
			16th m	5%	14173.00	14882.00		
			17th m	5%	14882.00	15626.00		
			18th m	5%	15626.00	16407.00		
			19th m	5%	16407.00	17227.00		
			20th m	5%	17227.00	18088.00		
			Total Cost from 10m upto 20m		139676.00	146659.00		
			Avg Rate per metre		*13968.00*	*14666.00*		
12.19 B		(iv)	Beyond 20m upto 30 m					
		a	Add 7.5 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering on the cost, if required					
		c	Add 25 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 25% for Kentledge	Including 5% for dewatering, if required	
			31st m	7.5%	18519.00	23149.00	24306.00	
			32nd	7.5%	19908.00	24885.00	26129.00	
			33rd m	7.5%	21401.00	26751.00	28089.00	
			34th m	7.5%	23006.00	28758.00	30196.00	
			35th m	7.5%	24731.00	30914.00	32460.00	
			36th m	7.5%	26586.00	33233.00	34895.00	
			37th m	7.5%	28580.00	35725.00	37511.00	
			38th m	7.5%	30724.00	38405.00	40325.00	
			39th m	7.5%	33028.00	41285.00	43349.00	
			40th m	7.5%	35505.00	44381.00	46600.00	
			Total Cost from 30m upto 40m		261988.00	327486.00	343860.00	
			Avg Rate per metre		*26199.00*	*32749.00*	*34386.00*	
12.19 B		(v)	Beyond 30m upto 40 m					
		a	Add 10 per cent for every additional meter depth of sinking over the rate of sinking for the previous meter					
		b	Add 5 per cent of cost for dewatering, if required					
		c	Add 20 per cent of cost for Kentledge including supports, loading arrangement and Labour).			Including 20% for Kentledge	Including 5% for dewatering, if required	
			31st m	10%	39056.00	46867.00	49210.00	
			32nd	10%	42962.00	51554.00	54132.00	
			33rd m	10%	47258.00	56710.00	59546.00	
			34th m	10%	51984.00	62381.00	65500.00	
			35th m	10%	57182.00	68618.00	72049.00	
			36th m	10%	62900.00	75480.00	79254.00	
			37th m	10%	69190.00	83028.00	87179.00	
			38th m	10%	76109.00	91331.00	95898.00	
			39th m	10%	83720.00	100464.00	105487.00	
			40th m	10%	92092.00	110510.00	116036.00	
			Total Cost from 30m upto 40m		622453.00	746943.00	784291.00	
			Avg Rate per metre		*62245.00*	*74694.00*	*78429.00*	
12.19		C	Soft Rock (Twin D Type Well)					
			Unit = Running Meter					
			Taking output = 1 m					
			Depth in soft rock strata upto 3m					
			Rate of sinking @ 0.12 m/hour					
			a) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Sinker (skilled)	day	4.50	279.00	1255.50	L-15
			Sinking helper (semi-skilled)	day	15.00	279.00	4185.00	L-14
			Diver	day	1.50	250.00	375.00	L-07
			b) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	8.33	550.00	4581.50	P&M-075
			Air compressor with pneumatic breakers	hour	6.00	257.00	1542.00	P&M-063
			Consumables in sinking @ 10 per cent of (b)				612.35	
			Add for dewatering @ 5 per cent, if required				336.79	
			c) Overhead charges @ 20%				2624.93	
			d) Contractor's profit @ 10%				1574.96	
			Rate per metre				17324.53	
						say	*17325.00*	
12.19		D	Hard Rock (Twin D Type Well)					
			Unit = Running Meter					
			Taking output = 1 m					
			Depth in hard rock strata upto 3 m					
			Rate of sinking @ 0.10 m/hour					
			a) Material					
			Geletine80 per cent	Kg	10.00	102.00	1020.00	M-104
			Electric detonators	each.	40.00	6.12	244.80	M-094/100
			b) Labour					
			Mate	day	1.34	275.00	368.50	L-12
			Driller	day	2.00	245.00	490.00	L-06
			Blaster	day	0.25	250.00	62.50	L-03
			Mazdoor	day	25.00	245.00	6125.00	L-13
			Mazdoor (Skilled)	day	4.25	245.00	1041.25	L-15
			c) Machinery					
			Hire & running charges of crane with grab bucket of 0.75 cum capacity and accessories.	hour	10.00	550.00	5500.00	P&M-075
			Hire & running charges of compressor with pneumatic breaker/Jack hammer or drill	hour	3.00	257.00	771.00	P&M-063

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Dewatering @ 5 per cent of cost of (b+c), if				717.91	
			Consumables in sinking @ 10 per cent of (b).				698.89	
			d) Overhead charges @ 20%				3407.97	
			e) Contractor's profit @ 10%				2044.78	
			Rate per metre				22492.61	
						say	22493.00	
12.20	1200		Pneumatic sinking of wells with equipment of approved design, drawing and specifications worked by competent and trained personnel and comprising of compression and decompression chambers, reducers, two air locks separately for men and plant & materials, arrangement for supply of fresh air to working chambers, check valves, exhaust valves, shafts made from steel plates of riveted construction not less than 6 mm thick to withstand an air pressure of 0.50 MPa, controlled blasting of hard rock where required, staircases and 1 m wide landing plateforms with railing, arrangement for compression and decompression, electric lighting of 50 V maximum, proper rooms for rest and medical examinations and compliance with safety precautions as per IS:4138, all as per clause1207.6 of MoRTH Specifications.					
			Unit - 1 cum					
			Taking output = 5 cum					
			a) Material					
			M35 grade RCC corbel provided for supporting of equipment (Dimensions as per ground conditions). Rate may be adopted vide Item 12.8 (H)	Cum	8.00	4200.00	33600.00	Item 12.8 (H)
			HYSD bar reinforcement in corbel	tonne	0.48	49196.00	23615.04	M-082
			Blasting material					
			Gelatine 80 per cent	Kg	1.50	102.00	153.00	M-104
			Electric detonators	each	6.00	6.12	36.72	M-094/100
			b) Labour					
			Medical Officer	day	0.50	500.00	250.00	L-16
			Para medical personnel	day	1.00	350.00	350.00	L-19
			Mate	day	1.86	275.00	511.50	L-12
			Driller	day	1.00	245.00	245.00	L-06
			Blaster	day	0.50	250.00	125.00	L-03
			Mazdoor (for cutting, blasting, cleaning, removal of Material etc.)	day	30.00	245.00	7350.00	L-13
			Mazdoor (Skilled) (for fixation and removal of adopter for air lock, carrying out mechanical and electrical operations and repairs and other skilled jobs.)	day	10.00	245.00	2450.00	L-15
			Diver	day	4.00	250.00	1000.00	L-07
			c) Machinery					
			(i) Induction, deinduction and erection of plant and equipment including all components and accessories for pneumatic method of well sinking.	hour	6.00	input	#VALUE!	P&M-082
			Induction and deinduction	L.S			100000.00	
			Erection at site and commissioning	L.S			150000.00	
			Usage of plant and equipment for pneumatic method of well sinking	hour	6.00	input	#VALUE!	P&M-038
			Air compressor 250 cfm, 2 nos.	hour	2 x 6	268.00	3216.00	P&M-001
			Hire and running charges of crane of 15 tonne capacity	hour	6.00	577.00	3462.00	P&M-072
			Motorised barge of 20 tonne capacity	hour	6.00	input	#VALUE!	P&M-066
			Boat to carry atleast 20 persons	hour	6.00	input	#VALUE!	P&M-066
			Electric generating set 33 KVA	hour	6.00	562.00	3372.00	P&M-079
			Tipper 10 tonne capacity	hour	6.00	225.00	1350.00	P&M-048
			d) Overhead charges @ 0.15 on (a+b+c)				#VALUE!	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				#VALUE!	
			Cost for 5 cum = a+b+c+d+e (see notes below)					
			Rate per cum = (a+b+c+d+e)/5					
		Note	1.The cost of induction, deinduction and erection of equipment shall be divided by the total quantity of pneumatic sinking for all the wells of a particular bridge to arrive at the per cum rate on account of this item.					
			2.Cost of pneumatic sinking per cum of individual wells will be added to the cost indicated at (1) above to arrive at the final rate of pneumatic sinking per cum.					
			3.The cost of induction and deinduction will depend upon the distance involved for shifting of equipment which may be assessed in individual cases as per actual ground conditions at the time of making of cost estimates.					
			4.In case pneumatic sinking is involved on a dry bed, the provision of barge and boat may be omitted.					
			5.The necessity and dimensions of the corbel will be as per actual ground conditions.					
			6.Small equipments like welding sets, pumps, vibrators, pneumatic tools, portable lamps, fire extinguishers, hose pipes etc., have not been included as the same are covered as items of minor T&P under overhead charges.					
			7.Depth of sinking shall be restricted to 30 m.					
12.21	1207		Sand Filling in Wells complete as per Drawing and Technical Specifications.					
			Unit = 1 cum					
			Taking output = 1 cum					
			a) Material					
			Sand (assuming 20 per cent voids)	cum	1.20	338.00	405.60	M-006
			b) Labour					
			Mate	day	0.01	275.00	2.75	L-12
			Mazdoor	day	0.30	245.00	73.50	L-13
			c) Overhead charges @ 0.15 on (a+b)				72.28	
			d) Contractor's profit @ 0.1 on (a+b+c)				55.41	
			Rate per cum (a+b+c+d)				609.54	
						say	610.00	
12.22	1200 & 1900		Providing Steel Liner 10 mm thick for Curbs and 6 mm thick for Steining of Wells including Fabricating and Setting out as per Detailed Drawing.					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Unit = 1 MT					
			Taking output = 1 MT					
			a) Material					
			i) Structural steel including 5 per cent wastage	tonne	1.05	51198.00	53757.90	M-179
			b) Labour					
			Mate	day	1.24	275.00	341.00	L-12
			Fitter	day	6.00	270.00	1620.00	L-08
			Blacksmith	day	5.00	245.00	1225.00	L-01
			Welder	day	5.00	250.00	1250.00	L-02
			Mazdoor	day	10.00	245.00	2450.00	L-13
			Electrodes, cutting gas and other consumables @ 5 per cent on cost a (a) above.				2687.90	
			c) Overhead charges @ 0.15 on (a+b)				9499.77	
			d) Contractor's profit @ 0.1 on (a+b+c)				7283.16	
			Rate for per MT (a+b+c+d)				80114.72	
						say	*80115.00*	
12.23	1100 & 1700		Bored cast-in-situ M35 grade R.C.C. Pile excluding Reinforcement complete as per Drawing and Technical Specifications and removal of excavated earth with all lifts and lead upto 1000 m.					
			Pile diameter-750 mm					
			Unit = meter					
			Taking output = 15 m					
			a) Materials					
			PCC Grade M35	cum	6.62	6769.00	44810.78	Item 12.11 (C) iv
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(C) (IV)					
			Concrete to be cast with a tremie pipe 200mm dia.					
			b) Machinery(for boring and construction)					
			Hire and running charges of hydraulic piling rig with power unit and complete accessories including shifting from one bore location to another.	hour	6.00	4000.00	24000.00	P&M-038
			Hire and running charges of light crane for lowering reinforcement cage	hour	0.50	250.00	125.00	P&M-013
			Hire and running charges of Bentonite pump	hour	6.00	Rate included in piling rig		
			Loader I cum bucket capacity.	hour	0.30	624.00	187.20	P&M-017
			Tipper 5.5 cum capacity for disposal of muck from pile bore hole	hour	0.30	240.00	72.00	P&M-048
			Bentonite	kg	300.00	8.00	2400.00	M-071
			c) Labour					
			Mate/Supervisor	day	0.14	275.00	38.50	L-12
			Mazdoor	day	3.50	245.00	857.50	L-13
			d) Overhead charges @ 0.15 on (b+c)				4152.03	
			e) Contractor's profit @ 0.1 on (b+c+d)				3183.22	
			Cost for 15 m = a+b+c+d+e				79826.23	
			Rate per metre (a+b+c+d+e)/15				5321.75	
						Say	*5322.00*	
12.24	1100,1600 & 1700		Bored cast-in-situ M35 grade R.C.C. Pile excluding Reinforcement complete as per Drawing and Technical Specifications and removal of excavated earth with all lifts and lead upto 1000 m.					
			Pile diameter-1000 mm					
			Unit = meter					
			Taking output = 10 m					
			a) Materials					
			PCC Grade M35	cum	7.85	6769.00	53136.65	Item 12.11 (C) iv
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(C) (IV)					
			Concrete to be cast with a tremie pipe 200mm dia.					
			b) Machinery(for boring and construction)					
			Hire and running charges of hydraulic piling rig with power unit and complete accessories including shifting from one bore location to another.	hour	6.00	4000.00	24000.00	P&M-038
			Hire and running charges of light crane for lowering reinforcement cage	hour	0.50	250.00	125.00	P&M-013
			Hire and running charges of Bentonite pump	hour	6.00	Rate included in piling rig		
			Loader I cum bucket capacity.	hour	0.40	600.00	240.00	P&M-017
			Tipper 5.5 cum capacity for disposal of muck from pile bore hole	hour	0.40	240.00	96.00	P&M-048
			Bentonite	kg	350.00	8.00	2800.00	M-071
			c) Labour					
			Mate/Supervisor	day	0.16	275.00	44.00	L-12
			Mazdoor	day	4.00	245.00	980.00	L-13
			d) Overhead charges @ 0.15 on (b+c)				4242.75	
			e) Contractor's profit @ 0.1 on (b+c+d)				3252.78	
			Cost for 10 m = a+b+c+d+e				88917.18	
			Rate per metre (a+b+c+d+e)/10				8891.72	
						Say	*8892.00*	
12.25	1100 & 1700		Bored cast-in-situ M35 grade R.C.C. Pile excluding Reinforcement complete as per Drawing and Technical Specifications and removal of excavated earth with all lifts and lead upto 1000 m.					
			Pile diameter-1200 mm					
			Unit = meter					
			Taking output = 9 m					
			a) Materials					
			PCC Grade M35	cum	10.17	6769.00	68840.73	Item 12.11 (C) iv
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(C) (IV)					
			Concrete to be cast with a tremie pipe 200mm dia.					
			b) Machinery(for boring and construction)					
			Hire and running charges of hydraulic piling rig with power unit and complete accessories including shifting from one bore location to another.	hour	6.00	4000.00	24000.00	P&M-038
			Hire and running charges of light crane for lowering reinforcement cage	hour	0.50	250.00	125.00	P&M-013

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Hire and running charges of Bentonite pump	hour	6.00	Rate included in piling rig		
			Loader I cum bucket capacity.	hour	0.50	624.00	312.00	P&M-017
			Tipper 5.5 cum capacity for disposal of muck from pile bore hole	hour	0.50	240.00	120.00	P&M-048
			Bentonite	kg	385.00	8.00	3080.00	M-071
			c) Labour					
			Mate/Supervisor	day	0.18	275.00	49.50	L-12
			Mazdoor	day	4.50	245.00	1102.50	L-13
			d) Overhead charges @ 0.15 on (b+c)				4318.35	
			e) Contractor's profit @ 0.1 on (b+c+d)				3310.74	
			Cost for 9 m = a+b+c+d+e				105258.82	
			Rate per metre (a+b+c+d+e)/9				11695.42	
						Say	11695.00	
12.26	1100 & 1700		Driven cast-in-place vertical M35 grade R.C.C. Pile excluding Reinforcement complete as per Drawing and & Technical Specification					
			Pile diameter - 750 mm					
			Unit = Running meter					
			Taking output = 40 metre					
			a) Materials					
			PCC Grade M35	cum	17.66	6769.00	119540.54	Item 12.11 (C) iv
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(C) (IV)					
			b) Materials Pile shoes					
			i) C.I. shoes for the pile	Kg	100.00	40.00	6400.00	M-080
			ii) M.S. clamps for shoe @ 35 Kg per pile of 15 m	Kg	70.00	Input	#VALUE!	M-124
			iii) Steel helmet and cushion block on top of casing head during driving	Kg	50.00	Input	#VALUE!	M-173
			c) Machinery					
			Hire and running charges of piling rig including double acting pile driving hammer complete with power unit and accessories..	hour	6.00	Input	#VALUE!	P&M-085
			Hiring and running charges for light crane 5 tonnes lifting capacity for lowering reinforcement and handling steel casing.	hour	0.50	Input	#VALUE!	P&M-070
			d) Labour					
			Mate/Supervisor	day	0.12	275.00	33.00	L-12
			Mazdoor	day	3.00	245.00	735.00	L-13
			e) Overhead charges @ 0.15 on (b+c+d)				#VALUE!	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				#VALUE!	
			Cost for 40 m = a+b+c+d+e				#VALUE!	
			Rate per metre (a+b+c+d+e)/40				#VALUE!	
						Say	#VALUE!	
		Note	1.The quantity of concrete required to be removed above the designed top level of concrete, if any, will be provided for in the rate analysis.					
			2.In case steel lining is included in the design for driven cast-in-situ pile and is planned to be retained, the same may be included in the rate analysis. In case the temporary steel casing used during casting is planned to be removed, an additional cost @ 0.50 per cent of cost of concrete may be provided to cover its usage.					
12.27	1100 & 1700		Driven cast-in-place vertical M35 grade R.C.C. Pile excluding Reinforcement complete as per Drawing and & Technical Specification					
			Pile diameter - 1000 mm					
			Unit = Running meter					
			Taking output = 30 metre					
			a) Materials					
			PCC Grade M35	cum	23.55	6769.00	159409.95	Item 12.11 (C) iv
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(C) (IV)					
			b) Materials Pile shoes					
			i) C.I. shoes for the pile	Kg	100.00	40.00	6400.00	M-080
			ii) M.S. clamps for shoe @ 35 Kg per pile of 15 m	Kg	70.00	Input	#VALUE!	M-124
			iii) Steel helmet and cushion block on top of casing head during driving	Kg	50.00	Input	#VALUE!	M-173
			c) Machinery					
			Hire and running charges of piling rig including double acting pile driving hammer complete with power unit and accessories.	hour	6.00	Input	#VALUE!	P&M-085
			Hiring and running charges for light crane 5 tonnes lifting capacity for lowering reinforcement and handling steel casing.	hour	0.50	Input	#VALUE!	P&M-070
			Hire and running charges for light crane for lowering reinforcement cage.	hour	0.50	250.00	125.00	P&M-013
			d) Labour					
			Mate/Supervisor	day	0.16	275.00	44.00	L-12
			Mazdoor	day	4.00	245.00	980.00	L-13
			e) Overhead charges @ 0.15 on (b+c+d)				#VALUE!	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				#VALUE!	
			Cost for 30 m = a+b+c+d+e				#VALUE!	
			Rate per metre (a+b+c+d+e)/30				#VALUE!	
						Say	#VALUE!	
		Note	1.The quantity of concrete required to be removed above the designed top level of concrete, if any, will be provided for in the rate analysis.					
			2.In case steel lining is included in the design for driven cast-in-situ pile and is planned to be retained, the same may be included in the rate analysis. In case the temporary steel casing used during casting is planned to be removed, an additional cost @ 0.50 per cent of cost of concrete may be provided to cover its usage.					
12.28	1100 & 1700		Driven cast-in-place vertical M35 grade R.C.C. Pile excluding Reinforcement complete as per Drawing and & Technical Specification					
			Pile diameter - 1200 mm					
			Unit = Running meter					
			Taking output = 20 metre					
			a) Materials					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			PCC Grade M35	cum	22.61	6769.00	153047.09	Item 12.11 (C) iv
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(C) (IV)					
			b) Materials Pile shoes					
			i) C.I. shoes for the pile	Kg	160.00	40.00	6400.00	M-080
			ii) M.S. clamps for shoe @ 35 Kg per pile of 15 m	Kg	70.00	input	#VALUE!	M-124
			iii) Steel helmet on top of casing head during driving	Kg	50.00	input	#VALUE!	M-173
			c) Machinery					
			Hire and running charges of piling rig including double acting pile driving hammer complete with power unit and accessories.	hour	6.00	input	#VALUE!	P&M-088
			Hiring and running charges for light crane 5 tonnes lifting capacity for lowering reinforcement and handling steel casing.	hour	0.50	input	#VALUE!	P&M-076
			d) Labour					
			Mate/Supervisor	day	0.18	275.00	49.50	L-12
			Mazdoor	day	4.50	245.00	1102.50	L-13
			e) Overhead charges @ 0.15 on (b+c+d)				#VALUE!	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				#VALUE!	
			Cost for 20 m = a+b+c+d+e				#VALUE!	
			Rate per metre (a+b+c+d+e)/20				#VALUE!	
						Say	#VALUE!	
		Note	1.The quantity of concrete required to be removed above the designed top level of concrete, if any, will be provided for in the rate analysis.					
			2.In case steel lining is included in the design for driven cast-in-situ pile and is planned to be retained, the same may be included in the rate analysis. In case the temporary steel casing used during casting is planned to be removed, an additional cost @ 0.50 per cent of cost of concrete may be provided to cover its usage.					
12.29	1100 & 1700		Driven precast vertical M35 grade R.C.C. Piles excluding Reinforcement complete as per Drawing and & Technical Specification					
			Pile Diameter = 500 mm					
			Unit = Running Meter					
			Taking output = 60 m					
			a) Materials					
			RCC Grade M35	cum	11.78	6567.00	77359.26	Item 12.11 (F) iv
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(F) (IV)					
			b) Material Pile shoes					
			a) C.I Shoes	Kg	240.00	40.00	9600.00	M-080
			b) M.S. shoes	Kg	105.00	input	#VALUE!	M-125
			c) Steel helmet and cushion block on top of pile head during driving.	Kg	30.00	input	#VALUE!	M-173
			c) Machinery					
			Crane20 t capacity	hour	6.00	input	#VALUE!	P&M-073
			Vibrating Pile driving hammer complete with power unit and accessories.	hour	6.00	input	#VALUE!	P&M-092
			d) Labour					
			Mate/Supervisor	day	0.12	275.00	33.00	L-12
			Mazdoor	day	3.00	245.00	735.00	L-13
			Add 1 per cent of (a+b+c) for carriage of piles from casting yard to work site and stacking, and other imponderables during installation.				#VALUE!	
			e) Overhead charges @ 0.15 on (b+c+d)				#VALUE!	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				#VALUE!	
			Cost for 60 m = a+b+c+d+e+f				#VALUE!	
			Rate per metre (a+b+c+d+e+f)/60				#VALUE!	
						Say	#VALUE!	
		Note	The quantity of concrete required to be removed above the designed top level of concrete, if any, will be provided for in the rate analysis.					
12.30	1100 & 1700		Driven precast vertical M35 grade R.C.C. Piles excluding Reinforcement complete as per Drawing and & Technical Specification					
			Pile Diameter = 750 mm					
			Unit = Running Meter					
			Taking output = 50 m					
			a) Materials					
			RCC Grade M35	cum	22.08	6567.00	144999.36	Item 12.11 (F) iv
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(F) (IV)					
			b) Material Pile shoes					
			a) C.I. shoes	Kg	160.00	40.00	6400.00	M-080
			b) M.S. shoes	Kg	70.00	input	#VALUE!	M-125
			c) Steel helmet and cushion block on top of pile head during driving.	Kg	40.00	input	#VALUE!	M-173
			c) Machinery					
			Crane 40 T capacity	hour	6.00	866.00	5196.00	P&M-074
			Vibrating Pile driving hammer complete with power unit and accessories.	hour	6.00	input	#VALUE!	P&M-092
			d) Labour					
			Mate/Supervisor	day	0.16	275.00	44.00	L-12
			Mazdoor	day	4.00	245.00	980.00	L-13
			Add 1 per cent of (a+b+c) for carriage of piles from casting yard to work site and stacking, and other imponderables during installation.				#VALUE!	
			e) Overhead charges @ 0.15 on (b+c+d)				#VALUE!	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				#VALUE!	
			Cost for 50 m = a+b+c+d+e+f				#VALUE!	
			Rate per metre (a+b+c+d+e+f)/50				#VALUE!	
						Say	#VALUE!	
		Note	The quantity of concrete required to be removed above the designed top level of concrete, if any, will be provided for in the rate analysis.					
12.31	1100 & 1700		Driven precast vertical M35 grade R.C.C. Piles excluding Reinforcement complete as per Drawing and & Technical Specification					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Pile Diameter = 1000 mm					
			Unit = Running Meter					
			Taking output = 40 m					
			a) Materials					
			RCC Grade M35	cum	31.40	6567.00	206203.80	Item 12.11 (F) iv
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(F) (IV)					
			b) Material Pile shoes					
			a) C.I. shoes for the pile	Kg	160.00	40.00	6400.00	M-080
			b) M.S. shoes @ 35 Kg per pile of 15 m	Kg	70.00	Input	#VALUE!	M-125
			c) Steel helmet and cushion block on top of pile head during driving.	Kg	50.00	Input	#VALUE!	M-173
			c) Machinery					
			Crane 50 t capacity.	hour	6.00	866.00	5196.00	P&M-011
			Vibrating Pile driving hammer complete with power unit and accessories.	hour	6.00	Input	#VALUE!	P&M-092
			d) Labour					
			Mate/Supervisor	day	0.20	275.00	55.00	L-12
			Mazdoor	day	5.00	245.00	1225.00	L-13
			Add 1 per cent of (a+b+c) for carriage of piles from casting yard to work site and stacking, and other imponderables during installation.				#VALUE!	
			e) Overhead charges @ 0.15 on (b+c+d)				#VALUE!	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				#VALUE!	
			Cost for 40 m = a+b+c+d+e+f				#VALUE!	
			Rate per metre (a+b+c+d+e+f)/40				#VALUE!	
						Say	*#VALUE!*	
		Note	The quantity of concrete required to be removed above the designed top level of concrete, if any, will be provided for in the rate analysis.					
12.32	1100&1700		Driven precast vertical M35 grade R.C.C. Piles excluding Reinforcement complete as per Drawing and & Technical Specification					
			Size of pile - 300 mm x 300 mm					
			Unit = Running Meter					
			Taking output = 60 m					
			a) Materials					
			RCC Grade M-35					
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(F) (IV)	cum	5.40	6567.00	35461.80	Item 12.11 (F) iv
			b) Material Pile shoes					
			a) C I shoes	kg	240.00	40.00	9600.00	M-080
			b) M. S shoes	kg	105.00	Input	#VALUE!	M-125
			c) Steel helmet and cushion block on top of pile head during driving.	Kg	30.00	Input	#VALUE!	M-173
			c) Machinery					
			Crane 10 tonne capacity	hour	6.00	577.00	3462.00	P&M-071
			Vibrating Pile driving hammer complete with power unit and accessories.	hour	6.00	Input	#VALUE!	P&M-092
			d) Labour					
			Mate/Supervisor	day	0.12	150.00	18.00	L-12
			Mazdoor	day	3.00	100.00	300.00	L-13
			Add 1 per cent of (a+b+c) for carriage of piles from casting yard to work site and stacking, and other imponderables during installation.				#VALUE!	
			e) Overhead charges @ 0.15 on (b+c+d)				#VALUE!	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				#VALUE!	
			Cost for 60 m = a+b+c+d+e+f				#VALUE!	
			Rate per metre (a+b+c+d+e+f)/60				#VALUE!	
						Say	*#VALUE!*	
		Note	The quantity of concrete required to be removed above the designed top level of concrete, if any, will be provided for in the rate analysis.					
12.33	1100 &1700		Driven precast vertical M35 grade R.C.C. Piles excluding Reinforcement complete as per Drawing and & Technical Specification					
			Size of pile - 500 mm x 500 mm					
			Unit = Running Meter					
			Taking output = 50 m					
			a) Materials					
			RCC Grade M-35					
			Rate for concrete may be adopted same as for bottom plug vide item no. 12.11(F) (IV)	cum	12.50	3476.00	43450.00	Item 12.11 (F) iv
			b) Material Pile shoes					
			a) C I shoes	kg	160.00	40.00	6400.00	M-080
			b) M. S shoes	kg	70.00	Input	#VALUE!	M-125
			c) Steel helmet and cushion block on top of pile head during driving.	Kg	30.00	Input	#VALUE!	M-173
			c) Machinery					
			Crane 20 tonne capacity	hour	6.00	577.00	3462.00	P&M-073
			Vibrating Pile driving hammer complete with power unit and accessories.	hour	6.00	Input	#VALUE!	P&M-092
			d) Labour					
			Mate/Supervisor	day	0.16	275.00	44.00	L-12
			Mazdoor	day	4.00	245.00	980.00	L-13
			Add 1 per cent of (a+b+c) for carriage of piles from casting yard to work site and stacking, and other imponderables during installation.				#VALUE!	
			e) Overhead charges @ 0.15 on (b+c+d)				#VALUE!	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				#VALUE!	
			Cost for 50 m = a+b+c+d+e+f				#VALUE!	
			Rate per metre (a+b+c+d+e+f)/50				#VALUE!	
						Say	*#VALUE!*	
		Note	The quantity of concrete required to be removed above the designed top level of concrete, if any, will be provided for in the rate analysis.					
12.34	1100 &1700		Driven precast vertical M35 grade R.C.C. Piles excluding Reinforcement complete as per Drawing and & Technical Specification					
			Size of pile - 750 mm x 750 mm					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Unit = Running Meter					
			Taking output = 40 m					
			a) Materials					
			RCC Grade M-35					
			Rate for concrete may be adopted same as for bottom plug vide item no. 13.11(F) (IV)	cum	22.50	3476.00	78210.00	Item 12.11 (F) iv
			b) Material					
			Pile shoes					
			a) C I shoes	kg	160.00	40.00	6400.00	M-080
			b) M. S shoes	kg	70.00	Input	#VALUE!	M-125
			c) Steel helmet and cushion block on top of pile head during driving.	Kg	30.00	Input	#VALUE!	M-173
			c) Machinery					
			Crane 20 tonne capacity	hour	6.00	577.00	3462.00	P&M-073
			Vibrating Pile driving hammer complete with power unit and accessories.	hour	6.00	Input	#VALUE!	P&M-092
			d) Labour					
			Mate/Supervisor	day	0.18	275.00	49.50	L-12
			Mazdoor	day	4.50	245.00	1102.50	L-13
			Add 1 per cent of (a+b+c) for carriage of piles from casting yard to work site and stacking, and other imponderables during installation.				#VALUE!	
			e) Overhead charges @ 0.15 on (b+c+d)				#VALUE!	
			f) Contractor's profit @ 0.1 on (b+c+d+e)				#VALUE!	
			Cost for 40 m = a+b+c+d+e+f				#VALUE!	
			Rate per metre (a+b+c+d+e+f)/40				#VALUE!	
						Say	#VALUE!	
		Note	The quantity of concrete required to be removed above the designed top level of concrete, if any, will be provided for in the rate analysis.					
12.35	1100, 1900		Driven Vertical Steel Piles complete as per Drawing and & Technical Specification					
			Section of the pile - H Section steel column 400 x 250 mm (ISHB Series)					
			Unit = Running Meter					
			Taking output = 70 m					
			a) Materials					
			Structural steel including 5 per cent wastage @ 82.20 kg/m	tonnes	6.04	53757.90	324697.72	M-179
			b) Machinery					
			Crane 10 T capacity	hour	6.00	577.00	3462.00	P&M-071
			Vibrating Pile driving hammer complete with power unit and other accessories.	hour	6.00	Input	#VALUE!	P&M-092
			c) Labour					
			Mate/Supervisor	day	0.12	275.00	33.00	L-12
			Mazdoor	day	3.00	245.00	735.00	L-13
			Add 0.5 per cent of (a+b+c) for providing steel helmet on top of pile head during driving, stacking of piles at site, providing anti-corrosion treatment and other imponderables during installation.				#VALUE!	
			d) Overhead charges @ 0.15 on (a+b+c)				#VALUE!	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				#VALUE!	
			Cost for 70 m = a+b+c+d+e				#VALUE!	
			Rate per metre (a+b+c+d+e)/70				#VALUE!	
						Say	#VALUE!	
12.36	1100 &1900		Driven Vertical Steel Piles complete as per Drawing and & Technical Specification					
			Section of the pile - H Section steel column 450 x 250 mm (ISHB Series)					
			Unit = Running Meter					
			Taking output = 60 m					
			a) Materials					
			Structural steel including 5 per cent wastage @92.50 kg/m	tonnes	5.83	53757.90	313408.56	M-179
			b) Machinery					
			Crane 10 T capacity	hour	6.00	577.00	3462.00	P&M-071
			Vibrating Pile driving hammer complete with power unit and accessories.	hour	6.00	Input	#VALUE!	P&M-092
			c) Labour					
			Mate/Supervisor	day	0.14	275.00	38.50	L-12
			Mazdoor	day	3.50	245.00	857.50	L-13
			Add 0.5 per cent of (a+b+c) for providing steel helmet and cushion block on top of pile head during driving, stacking of piles at site, providing anti-corrosive treatment and other imponderables during installation.				#VALUE!	
			d) Overhead charges @ 0.15 on (a+b+c)				#VALUE!	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				#VALUE!	
			Cost for 60 m = a+b+c+d+e				#VALUE!	
			Rate per metre (a+b+c+d+e)/60				#VALUE!	
						Say	#VALUE!	
12.37	1100		Pile Load Test on single Vertical Pile in accordance with IS:2911(Part-IV)					
			Unit = 1 MT					
			Taking output = 1 MT					
			a) Initial and routine load test	tonne	1.00	300.00		
			b) Lateral load test	tonne	1.00	5000.00		
		Note	Although, this item is incidental to work and is not required to be included in BOQ of contract, the same is required to be added in the estimate to assess cost of work.					
12.38	1100 1500 &1700		Cement Concrete for Reinforced Concrete in Pile Cap complete as per Drawing and Technical Specification					
		A	RCC Grade M20					
			Unit = cum					
			Taking output = 15 cum					
		(i)	Using Concrete Mixer					
			a) Material					
			Cement	tonne	5.12	7598.00	38901.76	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.90	275.00	247.50	L-12
			Mason	day	1.50	245.00	367.50	L-10
			Mazdoor for concreting	day	20.00	245.00	4900.00	L-13
			Mazdoor for breaking pile head, bending bars, cleaning etc.	day	1.00	245.00	245.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator (capacity 33 KVA)	hour	6.00	562.00	3372.00	P&M-079
			Formwork @ 4 per cent on cost of concrete i.e. cost of a) Material, b) Labour and c)				2765.53	
			d) Overhead charges @ 0.15 on (a+b+c)				10785.59	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				8268.95	
			Cost for 15 cum = a+b+c+d+e				90958.44	
			Rate per metre (a+b+c+d+e)/15				6063.90	
						Say	6064.00	
12.38A		(ii)	Using Batching Plant, Transit Mixer and Concrete Pump					
			a) Material					
			Cement	tonne	5.12	7598.00	38901.76	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-004
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.16	275.00	44.00	L-12
			Mason	day	0.38	245.00	93.10	L-10
			Mazdoor for concreting	day	2.50	245.00	612.50	L-13
			Mazdoor for breaking pile head, bending bars, cleaning etc.	day	1.00	245.00	245.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	0.75	1656.00	1242.00	P&M-002
			Generator 100 KVA	hour	0.75	562.00	421.50	P&M-080
			Loader (capacity 1 cum)	hour	0.75	624.00	468.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Lead upto 1 Km	hour	2.00	780.00	1560.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	37.50	3.00	1125.00	Lead =10 km & P&M-050
			Concrete Pump	hour	0.75	173.00	129.75	P&M-007
			Formwork @ 4 per cent on cost of concrete i.e. cost of a) Material, b) Labour and c)				2596.61	
			d) Overhead charges @ 0.15 on (a+b+c)				10126.77	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				7763.86	
			Cost for 15 cum = a+b+c+d+e				85462.46	
			Rate per metre (a+b+c+d+e)/15				5693.50	
						Say	5693.00	
		Note	The value of a, b and c may be taken as applicable i.e. either using concrete mixer or batching plant.					
12.38		B	RCC Grade M25					
			Unit = cum					
			Taking output = 15 cum					
		(i)	Using Concrete Mixer					
			a) Material					
			Cement	tonne	5.99	7598.00	45512.02	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.90	275.00	247.50	L-12
			Mason	day	1.50	245.00	367.50	L-10
			Mazdoor for concreting	day	20.00	245.00	4900.00	L-13
			Mazdoor for breaking pile head, bending bars, cleaning etc.	day	1.00	245.00	245.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator (capacity 33 KVA)	hour	6.00	264.00	1584.00	P&M-079
			Formwork @ 4 per cent on cost of concrete i.e. cost of a) Material, b) Labour and c)				2958.43	
			d) Overhead charges @ 0.15 on (a+b+c)				11537.86	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				8845.69	
			Cost for 15 cum = a+b+c+d+e				97302.60	
			Rate per metre (a+b+c+d+e)/15				6486.84	
						Say	6487.00	
12.38B		(ii)	Using Batching Plant, Transit Mixer and Concrete Pump					
			a) Material					
			Cement	tonne	5.99	7598.00	45512.02	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-004
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.16	275.00	44.00	L-12
			Mason	day	0.38	245.00	93.10	L-10
			Mazdoor for concreting	day	2.50	245.00	612.50	L-13
			Mazdoor for breaking pile head, bending bars, cleaning etc.	day	1.00	245.00	245.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	0.75	172.00	129.00	P&M-002
			Generator 125 KVA	hour	0.75	674.40	505.80	P&M-018
			Loader (capacity 1 cum)	hour	0.75	624.00	468.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Lead upto 1 Km	hour	2.00	780.00	1560.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	37.50	3.00	1125.00	Lead =10 km & P&M-050

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Concrete Pump	hour	0.75	173.00	129.75	P&M-007
			Formwork @ 4 per cent on cost of concrete i.e. cost of a) Material, b) Labour and c)				2819.87	
			d) Overhead charges @ 0.15 on (a+b+c)				10997.50	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				8431.41	
			Cost for 15 cum = a+b+c+d+e				92745.56	
			Rate per metre (a+b+c+d+e)/15				6183.04	
						Say	6183.00	
		Note	The value of a, b and c may be taken as applicable i.e. either using concrete mixer or batching plant.					
12.38		C	RCC Grade M30					
			Unit = cum					
			Taking output = 15 cum					
		(i)	Using Concrete Mixer					
			a) Material					
			Cement	tonne	6.10	7598.00	46347.80	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.90	275.00	247.50	L-12
			Mason	day	1.50	245.00	367.50	L-10
			Mazdoor for concreting	day	20.00	245.00	4900.00	L-13
			Mazdoor for breaking pile head, bending bars, cleaning etc.	day	1.00	245.00	245.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator (capacity 33 KVA)	hour	6.00	264.00	1584.00	P&M-079
			Formwork @ 4 per cent on cost of concrete i.e. cost of a) Material, b) Labour and c)				2991.86	
			d) Overhead charges @ 0.15 on (a+b+c)				11668.24	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				8945.65	
			Cost for 15 cum = a+b+c+d+e				98402.16	
			Rate per metre (a+b+c+d+e)/15				6560.14	
						Say	6560.00	
'12.38C		(ii)	Using Batching Plant, Transit Mixer and Concrete Pump					
			a) Material					
			Cement	tonne	6.10	7598.00	46347.80	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-004
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.16	275.00	44.00	L-12
			Mason	day	0.38	245.00	93.10	L-10
			Mazdoor for concreting	day	2.50	245.00	612.50	L-13
			Mazdoor for breaking pile head, bending bars, cleaning etc.	day	1.00	245.00	245.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	0.75	172.00	129.00	P&M-002
			Generator 100 KVA	hour	0.75	562.00	421.50	P&M-080
			Loader (capacity 1 cum)	hour	0.75	624.00	468.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Lead upto 1 Km	hour	2.00	780.00	1560.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	37.50	3.00	1125.00	Lead =10 km & P&M-050
			Concrete Pump	hour	0.75	173.00	129.75	P&M-007
			Formwork @ 4 per cent on cost of concrete i.e. cost of a) Material, b) Labour and c)				2849.93	
			d) Overhead charges @ 0.15 on (a+b+c)				11114.73	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				8521.29	
			Cost for 15 cum = a+b+c+d+e				93734.21	
			Rate per metre (a+b+c+d+e)/15				6248.95	
						Say	6249.00	
		Note	The value of a, b and c may be taken as applicable i.e. either using concrete mixer or batching plant.					
12.38		D	RCC Grade M35					
			Unit = cum					
			Taking output = 15 cum					
		(i)	Using Concrete Mixer					
			a) Material					
			Cement	tonne	6.33	7598.00	48095.34	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.90	275.00	247.50	L-12
			Mason	day	1.50	245.00	367.50	L-10
			Mazdoor	day	20.00	245.00	4900.00	L-13
			Mazdoor for breaking pile head, bending bars, cleaning etc.	day	1.00	245.00	245.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator (capacity 33 KVA)	hour	6.00	264.00	1584.00	P&M-079
			Formwork @ 4 per cent on cost of concrete i.e. cost of a) Material, b) Labour and c)				3061.76	
			d) Overhead charges @ 0.15 on (a+b+c)				11940.86	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				9154.66	
			Cost for 15 cum = a+b+c+d+e				100701.22	
			Rate per metre (a+b+c+d+e)/15				6713.41	
						Say	6713.00	
'12.38D		(ii)	Using Batching Plant, Transit Mixer and Concrete Pump					
			a) Material					
			Cement	tonne	6.33	7598.00	48095.34	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-004

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.16	275.00	44.00	L-12
			Mason	day	0.38	245.00	93.10	L-10
			Mazdoor for concreting	day	2.50	245.00	612.50	L-13
			Mazdoor for breaking pile head, bending bars, cleaning etc.	day	1.00	245.00	245.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	0.75	1656.00	1242.00	P&M-002
			Generator 125 KVA	hour	0.75	674.40	505.80	P&M-018
			Loader (capacity 1 cum)	hour	0.75	624.00	468.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Lead upto 1 Km	hour	2.00	780.00	1560.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	37.5L	3.00	1125.00	Lead =10 km & P&M-050
			Concrete Pump	hour	0.75	173.00	129.75	P&M-007
			Formwork @ 4 per cent on cost of concrete i.e. cost of a) Material, b) Labour and c) Machinery				2967.72	
			d) Overhead charges @ 0.15 on (a+b+c)				11574.12	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				8873.49	
			Cost for 15 cum = a+b+c+d+e				97608.44	
			Rate per metre (a+b+c+d+e)/15				6507.23	
						say	6507.00	
12.39	1100&1700		Levelling Course for Pile cap					
			Providing and laying of PCC M15 levelling course 100mm thick below the pile cap.					
			Unit = cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	4.13	7598.00	31379.74	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			40 mm aggregate	cum	8.10	974.52	7893.61	M-055
			20 mm Aggregate	cum	4.05	974.52	3946.81	M-053
			10 mm Aggregate	cum	1.35	774.52	1045.60	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-10
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			d) Overhead charges @ 0.15 on (a+b+c)				9057.35	
			e) Contractor's profit @ 0.1 on (a+b+c+d)				6943.97	
			Cost for 15 cum = a+b+c+d+e				76383.67	
			Rate per metre (a+b+c+d+e)/15				5092.24	
						say	5092.00	
12.40	1600		Supplying, Fitting and Placing un-coated HYSD bar Reinforcement in Foundation complete as per Drawing and Technical Specifications.					
			Unit = 1 MT					
			Taking output = 1 MT					
			a) Material					
			HYSD bars including5 per cent overlaps and wastage	tonne	1.05	49198.00	51657.90	M-082
			Binding wire	Kg	6.00	45.80	274.80	M-072
			b) Labour for cutting, bending, shifting to site, tying and placing in position					
			Mate	day	0.40	275.00	110.00	L-12
			Blacksmith	day	2.00	245.00	490.00	L-02
			Mazdoor	day	6.00	245.00	1470.00	L-13
			c) Overhead charges @ 20% on (a+b)				10800.54	
			d) Contractor's profit @ 10% on (a+b+c)				6480.32	
			Rate for per MT (a+b+c+d)				71283.56	
						say	71284.00	
12.41	1600		Supplying, fitting and placing un-coated Mild steel reinforcement complete in foundation as per drawing and technical specification					
			Unit = 1 MT					
			Taking output = 1 MT					
			a) Material					
			MS bars including 5 per cent overlaps and wastage	tonne	1.05	53757.90	56445.80	M-126
			Binding wire	Kg	6.00	45.80	274.80	M-072
			b) Labour for straightening, cutting, bending, shifting to site, tying and placing in position					
			Mate	day	0.43	275.00	118.25	L-12
			Blacksmith	day	2.25	245.00	551.25	L-02
			Mazdoor	day	6.50	245.00	1592.50	L-13
			c) Overhead charges @ 0.15 on (a+b)				8847.39	
			d) Contractor's profit @ 0.1 on (a+b+c)				6783.00	
			Rate for per MT (a+b+c+d)				74612.98	
						say	74613.00	

CHAPTER-13								
SUB-STRUCTURE								
Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
13.1	1300 & 2200		Brick masonry work in 1:3 in sub-structure complete excluding pointing and plastering, as per drawing and Technical Specifications					
			Unit = cum					
			Taking output = 1 cum					
			a) Material					
			Bricks Ist class	each	500.00	6.50	3250.00	M-079
			Cement mortar 1:3 (Rate as in Item 12.6 A sub-analysis)	cum	0.24	5350.00	1284.00	Item 12.6 (A)
			b) Labour					
			Mate	day	0.06	275.00	16.50	L-12
			Mason	day	0.80	245.00	196.00	L-11
			Mazdoor	day	0.80	245.00	196.00	L-13
			Add for scaffolding @ 5 per cent of cost of material and labour				247.13	
			c) Overhead charges @ 20%				1037.93	
			d) Contractor's profit @ 10%				622.76	
			Rate per cum				6850.31	
						say	*6850.00*	
13.2	1300 & 2200		Pointing with cement mortar (1:3) on brick work in substructure as per Technical Specifications					
			Unit = 10 sqm					
			Taking output = 10 sqm					
			a) Material					
			Cement mortar 1:3 (Rate as in Item 12.6)	cum	0.03	5350.00	160.50	Item 12.6
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mason	day	0.50	245.00	122.50	L-11
			Mazdoor	day	0.50	245.00	122.50	L-13
			c) Overhead charges @ 20%				83.30	
			d) Contractor's profit @ 10%				49.98	
			Rate per 10 sqm				54.98	
						say	*55.00*	
	Note		Scaffolding is already included in item 13.1					
13.3	1300 & 2200		Plastering with cement mortar (1:3) on brick work in sub-structure as per Technical Specifications					
			Unit = 10 sqm					
			Taking output = 10 sqm					
			a) Material					
			Cement mortar 1:3 (Rate as in Item 12.6)	cum	0.144	5350.00	770.40	Item 12.6 (A)
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mason	day	0.50	245.00	122.50	L-11
			Mazdoor	day	0.50	245.00	122.50	L-13
			c) Overhead charges @ 20%				102.64	
			d) Contractor's profit @ 10%				112.90	
			Rate per 10 sqm				124.19	
						say	*124.00*	
	Note		1.Scaffolding is already included in item no. 13.1					
			2.The number of masons and Mazdoors already catered in the cement mortar have been taken into account while providing these categories in brick masonry, pointing and plastering.					
13.4	1400 & 2200		Stone masonry work in cement mortar 1:3 for substructure complete as per drawing and Technical Specifications					
		A	Random Rubble Masonry					
			(coursed/uncoursed)					
			Unit = cum					
			Taking output = 1 cum					
			a) Material					
			Stone	cum	1.00	799.52	799.52	M-148
			Through and bond stone	No	7.00	13.69	95.84	M-182
			(7no.x0.24mx0.24mx0.39m = 0.16 cu.m)					
			Cement mortar 1:3 (Rate as in Item 12.6)	cum	0.33	5350.00	1765.50	Item 12.6 (A)
			b) Labour					
			Mate	day	0.10	275.00	27.50	L-12
			Mason	day	1.20	245.00	294.00	L-11
			Mazdoor	day	1.20	245.00	294.00	L-13
			Add for scaffolding @ 5 per cent of cost of a) Material and b) Labour				163.82	
			c) Overhead charges @ 20%				688.04	
			d) Contractor's profit @ 10%				412.82	
			Rate per cum				4541.03	
						say	*4541.00*	
13.4		B	Coursed rubble masonry (first sort)					
			Unit = cum					
			Taking output = 1 cum					
			a) Material					
			Stone	cum	1.10	799.52	879.47	M-148
			Through and bond stone	each	7.00	13.69	95.84	M-182
			(7no.x0.24mx0.24mx0.39m = 0.16 cu.m)					
			Cement mortar 1:3 (Rate as in Item 12.6)	cum	0.30	5350.00	1605.00	Item 12.6 (A)
			b) Labour					
			Mate	day	0.12	275.00	33.00	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	1.50	245.00	367.50	L-13
			Add for scaffolding @ 5 per cent of cost of material and labour				167.42	
			c) Overhead charges @ 20%				703.15	
			d) Contractor's profit @ 10%				421.89	
			Rate per cum				4640.76	
						say	*4641.00*	
13.4		C	Ashlar masonry (first sort)					
			Plain ashlar					
			Unit = cum					
			Taking output = 1 cum					
			a) Material					
			Stone	cum	1.11	799.52	887.47	M-169
			Through and bond stone	each	7.00	13.69	95.84	M-182
			(7no.x0.24mx0.24mx0.39m = 0.16 cu.m)					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Cement mortar 1:3 (Rate as in Item 12.6)	cum	0.33	5350.00	1765.50	Item 12.6 (A)
			b) Labour for masonry work					
			Mate	day	0.20	275.00	55.00	L-12
			Mason	day	2.50	245.00	612.50	L-11
			Mazdoor	day	2.50	245.00	612.50	L-13
			Add for scaffolding @ 5 per cent of cost of a) Material and b) Labour				201.44	
			c) Overhead charges @ 20%				846.05	
			d) Contractor's profit @ 10%				507.63	
			Rate per cum				5583.93	
						say	5584.00	
	Note		The labour already considered in the cement mortar have been taken into account while providing these categories in the stone masonry works.					
13.5	1500, 1700 & 2200		Plain/Reinforced cement concrete in sub-structure complete as per drawing and Technical Specifications					
			Unit = cum					
			Taking output = 1 cum					
		A	PCC Grade M15					
		(p)	Height upto 5m					
			Same as Item 12.8 (A) upto 5 m height, except for formwork which shall be 10 per cent instead of 4 per cent of cost of material, labour and machinery.					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (A)				4145.00	Item 12.8 (A)
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		414.50	
			e) Overhead charges @ 20%				455.95	
			f) Contractor's profit @ 10%				501.55	
			Rate perm				5517.00	
						say	5517.00	
13.5		B	PCC Grade M20					
		(p)	Height upto 5m					
			Same as Item 12.8 (B) upto 5 m height, except for formwork which shall be 10 per cent instead of 4 per cent of cost of material, labour and machinery.					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (B)				4530.00	Item 12.8 (B)
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		453.00	
			e) Overhead charges @ 20%				996.60	
			f) Contractor's profit @ 10%				597.96	
			Rate perm				6577.56	
						say	6578.00	
13.5		C	PCC Grade M25					
		(p)	Height upto 5m					
			Same as Item 12.8 (D) upto 5 m height with the only change that the provision of form work shall be 10 per cent instead of 3.75 per cent of cost of material, labour and machinery.					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (D) Case I				4950.00	Item 12.8 (D)
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		495.00	
			e) Overhead charges @ 20%				1089.00	
			f) Contractor's profit @ 10%				653.40	
			Rate perm				7187.40	
						say	7187.00	
13.5 C (p)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (D) Case II				4696.00	Item 12.8 (D)
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		469.60	
			e) Overhead charges @ 20%				516.56	
			f) Contractor's profit @ 10%				568.22	
			Rate perm				6250.38	
						say	6250.00	
13.5 C		(q)	Height 5m to 10m					
			Same as Item 12.8 (D) with the following changes: (i) Add 2 per cent of cost of material, Labour and machinery excluding form work to cater for extra lift. (ii) The provision of form work shall be 12 per cent instead of 3.75 per cent of cost of material, labour and machinery					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (D) Case I				4950.00	Item 12.8 (D)
			d) formwork					
			Add 12 per cent of cost of material, labour and machinery (a+b+c) for Formwork		12.00		594.00	
			Add 2 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		2.00		99.00	
			e) Overhead charges @ 20%				1128.60	
			f) Contractor's profit @ 10%				677.16	
			Rate perm				7448.76	
						say	7449.00	
13.5 C (q)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (D) Case II				4696.00	
			d) formwork					
			Add 12 per cent of cost of material, labour and machinery (a+b+c) for Formwork		12.00		563.52	
			Add 2 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		2.00		93.92	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			e) Overhead charges @ 20%				535.34	
			f) Contractor's profit @ 10%				588.88	
			Rate perm				6477.66	
						say	6478.00	
13.5 C		(r)	Height above 10m					
			Same as Item 12.8 (D) with the following changes: (i) Add 4 per cent of cost of material, labour and machinery excluding form work to cater for extra lift. (ii) The provision of form work shall be 15 per cent instead of 3.75 per cent of cost of material, labour and machinery.					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (D) Case I				4950.00	Item 12.8 (D)
			d) formwork					
			Add 15 per cent of cost of material, labour and machinery (a+b+c) for Formwork		15.00		742.50	
			Add 4 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		4.00		198.00	
			e) Overhead charges @ 20%				1178.10	
			f) Contractor's profit @ 10%				706.86	
			Rate perm				7775.46	
						say	7775.00	
13.5 C (r)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (D) Case II				4696.00	Item 12.8 (D)
			d) formwork					
			Add 15 per cent of cost of material, labour and machinery (a+b+c) for Formwork		15.00		704.40	
			Add 4 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		4.00		187.84	
			e) Overhead charges @ 20%				1117.65	
			f) Contractor's profit @ 10%				670.59	
			Rate perm				7376.48	
						say	7376.00	
13.5		D	PCC Grade M30					
		(p)	Height upto 5m					
			Same as Item 12.8 (F) upto 5 m height with the only change that the provision of form work shall be 10 per cent instead of 3.50 per cent of cost of material, labour and machinery.					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (F) Case I				4996.00	
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		499.60	
			e) Overhead charges @ 20%				1099.12	
			f) Contractor's profit @ 10%				659.47	
			Rate perm				7254.19	
						say	7254.00	
13.5 D (p)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (F) Case II				4737.00	
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		473.70	
			e) Overhead charges @ 20%				1042.14	
			f) Contractor's profit @ 10%				625.28	
			Rate perm				6878.12	
						say	6878.00	
13.5 D		(q)	Height 5m to 10m					
			Same as Item 12.8 (F) with the following changes: (i) Add 2 per cent of cost of material, Labour and machinery excluding form work to cater for extra lift. (ii) The provision of form work shall be 12 per cent instead of 3.50 per cent of cost of material, labour and machinery.					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (F) Case I				4996.00	
			d) formwork					
			Add 12 per cent of cost of material, labour and machinery (a+b+c) for Formwork		12.00		599.52	
			Add 2 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		2.00		99.92	
			e) Overhead charges @ 20%				569.54	
			f) Contractor's profit @ 10%				626.50	
			Rate perm				6891.48	
						say	6891.00	
13.5 D (q)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (F) Case II				4737.00	
			d) formwork					
			Add 12 per cent of cost of material, labour and machinery (a+b+c) for Formwork		12.00		568.44	
			Add 2 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		2.00		94.74	
			e) Overhead charges @ 20%				1080.04	
			f) Contractor's profit @ 10%				648.02	
			Rate perm				7128.24	
						say	7128.00	
13.5 D		(r)	Height above 10m					
			Same as Item 12.8 (F) with the following changes: (i) Add 4 per cent of cost of material, labour and machinery excluding form work to cater for extra lift. (ii) The provision of form work shall be 15 per cent instead of 3.50 per cent of cost of material, labour and machinery					
		Case I	Using concrete Mixer					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (F) Case I				4996.00	
			d) formwork					
			Add 15 per cent of cost of material, labour and machinery (a+b+c) for Formwork		15.00		749.40	
			Add 4 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		4.00		199.84	
			e) Overhead charges @ 20%				1189.05	
			f) Contractor's profit @ 10%				713.43	
			Rate perm				7847.72	
						say	*7848.00*	
13.5 D (r)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (F) Case II				4737.00	
			d) formwork					
			Add 15 per cent of cost of material, labour and machinery (a+b+c) for Formwork		15.00		710.55	
			Add 4 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		4.00		189.48	
			e) Overhead charges @ 20%				1127.41	
			f) Contractor's profit @ 10%				676.44	
			Rate perm				7440.88	
						say	*7441.00*	
13.5		E	RCC Grade M20					
		(p)	Height upto 5m					
			Same as Item 12.8 (C) upto 5 m height, except for formwork which shall be 10 per cent instead of 4 per cent of cost of material, labour and machinery.					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (C) Case I				4519.00	
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		451.90	
			e) Overhead charges @ 20%				994.18	
			f) Contractor's profit @ 10%				596.51	
			Rate perm				6561.59	
						say	*6562.00*	
13.5 E (p)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (C) Case II				4262.00	
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		426.20	
			e) Overhead charges @ 20%				937.64	
			f) Contractor's profit @ 10%				562.58	
			Rate perm				6188.42	
						say	*6188.00*	
13.5 E		(q)	Height 5m to 10m					
			For height, upto 10m, add 2 per cent of cost as above excluding formwork. For cost of formwork add 12 per cent of cost of material, labour and machinery instead of 4 per cent .					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (C) Case I				4519.00	
			d) formwork					
			Add 12 per cent of cost of material, labour and machinery (a+b+c) for Formwork		12.00		542.28	
			Add 2 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		2.00		90.38	
			e) Overhead charges @ 20%				1030.33	
			f) Contractor's profit @ 10%				618.20	
			Rate perm				6800.19	
						say	*6800.00*	
13.5 E (q)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (C) Case II				4262.00	
			d) formwork					
			Add 12 per cent of cost of material, labour and machinery (a+b+c) for Formwork		12.00		511.44	
			Add 2 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		2.00		85.24	
			e) Overhead charges @ 20%				971.74	
			f) Contractor's profit @ 10%				583.04	
			Rate perm				6413.46	
						say	*6413.00*	
13.5 E		(r)	Height above 10m					
			Same as Item 12.8 (C) with the following changes: (i) Add 4 per cent of cost of material, labour and machinery excluding form work to cater for extra lift. (ii) The provision of form work shall be 15 per cent instead of 4 per cent of cost of material, labour and machinery.					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (C) Case I				4519.00	
			d) formwork					
			Add 15 per cent of cost of material, labour and machinery (a+b+c) for Formwork		15.00		677.85	
			Add 4 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		4.00		180.76	
			e) Overhead charges @ 20%				537.76	
			f) Contractor's profit @ 10%				591.54	
			Rate perm				6506.91	
						say	*6507.00*	
13.5 E (r)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (C) Case II				4262.00	
			d) formwork					
			Add 15 per cent of cost of material, labour and machinery (a+b+c) for Formwork		15.00		639.30	
			Add 4 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		4.00		170.48	
			e) Overhead charges @ 20%				1014.36	
			f) Contractor's profit @ 10%				608.61	
			Rate perm				6694.75	
						say	6695.00	
13.5		F	RCC Grade M25					
		(p)	Height upto 5m					
			Same as Item 12.8 (E) upto 5m height, excluding formwork. For cost of formwork, add 10 per cent of cost of material, labour and machinery instead of 3.75 per cent .					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (E) Case I				4945.00	
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		494.50	
			e) Overhead charges @ 20%				1087.90	
			f) Contractor's profit @ 10%				652.74	
			Rate perm				7180.14	
						say	7180.00	
13.5 F (p)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (E) Case II				4687.00	
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		468.70	
			e) Overhead charges @ 20%				1031.14	
			f) Contractor's profit @ 10%				618.68	
			Rate perm				6805.52	
						say	6806.00	
13.5 F		(q)	Height 5m to 10m					
			For height, upto 10m, add 1.8 per cent of cost as above excluding formwork. For cost of formwork add 11.8 per cent of cost of material, labour and machinery					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (E) Case I				4945.00	
			d) formwork					
			Add 11.8 per cent of cost of material, labour and machinery (a+b+c) for Formwork		11.80		583.51	
			Add 1.8 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		1.80		89.01	
			e) Overhead charges @ 20%				1123.50	
			f) Contractor's profit @ 10%				674.10	
			Rate perm				7415.13	
						say	7415.00	
13.5 F (q)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (E) Case II				4687.00	
			d) formwork					
			Add 11.8 per cent of cost of material, labour and machinery (a+b+c) for Formwork		11.80		553.07	
			Add 1.8 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		1.80		84.37	
			e) Overhead charges @ 20%				1064.89	
			f) Contractor's profit @ 10%				638.93	
			Rate perm				7028.25	
						say	7028.00	
13.5 F		(r)	Height above 10m					
			For height, above 10m, add 4 per cent of cost as above excluding formwork. For cost of formwork add 15 per cent of cost of material, labour and machinery					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (E) Case I				4945.00	
			d) formwork					
			Add 15 per cent of cost of material, labour and machinery (a+b+c) for Formwork		15.00		741.75	
			Add 4 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		4.00		197.80	
			e) Overhead charges @ 20%				1176.91	
			f) Contractor's profit @ 10%				706.15	
			Rate perm				7767.61	
						say	7768.00	
13.5 F (r)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (E) Case II				4687.00	
			d) formwork					
			Add 15 per cent of cost of material, labour and machinery (a+b+c) for Formwork		15.00		703.05	
			Add 4 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		4.00		187.48	
			e) Overhead charges @ 20%				1115.51	
			f) Contractor's profit @ 10%				669.30	
			Rate perm				7362.34	
						say	7362.00	
13.5		G	RCC Grade M30					
		(p)	Height upto 5m					
			Same as Item 12.8 (G) upto 5m height, excluding formwork. For cost of formwork, add 10 per cent of cost of material, labour and machinery instead of 3.5 per cent .					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (G) Case I				4970.00	
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		497.00	
			e) Overhead charges @ 15%				820.05	
			f) Contractor's profit @ 10%				628.71	
			Rate perm				6915.76	
						say	6916.00	
13.5 G (p)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (G) Case II				4714.00	
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		471.40	
			e) Overhead charges @ 20%				777.81	
			f) Contractor's profit @ 10%				596.32	
			Rate perm				6559.53	
						say	6560.00	
13.5 G		(q)	Height 5m to 10m					
			For height, upto 10m, add 1.6 per cent of cost as above excluding formwork. For cost of formwork add 11.5 per cent of cost of material, labour and machinery					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (G) Case I				4970.00	
			d) formwork					
			Add 11.5 per cent of cost of material, labour and machinery (a+b+c) for Formwork		11.50		571.55	
			Add 1.6 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		1.60		79.52	
			e) Overhead charges @ 20%				843.16	
			f) Contractor's profit @ 10%				646.42	
			Rate perm				7110.65	
						say	7111.00	
13.5 G (q)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (G) Case II				4714.00	
			d) formwork					
			Add 11.5 per cent of cost of material, labour and machinery (a+b+c) for Formwork		11.50		542.11	
			Add 1.6 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		1.60		75.42	
			e) Overhead charges @ 20%				1066.31	
			f) Contractor's profit @ 10%				639.78	
			Rate perm				7037.62	
						say	7038.00	
13.5 G		(r)	Height above 10m					
			For height, above 10m, add 3.5 per cent of cost as above excluding formwork. For cost of formwork add 14 per cent of cost of material, labour and machinery					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (G) Case I				4970.00	
			d) formwork					
			Add 14 per cent of cost of material, labour and machinery (a+b+c) for Formwork		14.00		695.80	
			Add 3.5 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		3.50		173.95	
			e) Overhead charges @ 20%				875.96	
			f) Contractor's profit @ 10%				671.57	
			Rate perm				7387.28	
						say	7387.00	
13.5 G (r)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (G) Case II				4714.00	
			d) formwork					
			Add 14 per cent of cost of material, labour and machinery (a+b+c) for Formwork		14.00		659.96	
			Add 3.5 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		3.50		164.99	
			e) Overhead charges @ 20%				1107.79	
			f) Contractor's profit @ 10%				664.67	
			Rate perm				7311.41	
						say	7311.00	
13.5		H	RCC Grade M35					
		(p)	Height upto 5m					
			Same as Item 12.8 (H) upto 5m height, excluding formwork. For cost of formwork, add 10 per cent of cost of material, labour and machinery instead of 3 per cent .					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (H) Case I				5086.00	
			d) formwork					
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		508.60	
			e) Overhead charges @ 20%				1118.92	
			f) Contractor's profit @ 10%				671.35	
			Rate perm				7384.87	
						say	7385.00	
13.5 H (p)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (H) Case II				4831.00	
			d) formwork					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Add 10 per cent of cost of material, labour and machinery (a+b+c) for Formwork		10.00		483.10	
			e) Overhead charges @ 20%				1062.82	
			f) Contractor's profit @ 10%				637.69	
			Rate perm				7014.61	
						say	*7015.00*	
13.5 H		(q)	Height 5m to 10m					
			For height, upto 10m, add 1.4 per cent of cost as above excluding formwork. For cost of formwork add 11 per cent of cost of material, labour and machinery .					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (H) Case I				5086.00	
			d) formwork					
			Add 11 per cent of cost of material, labour and machinery (a+b+c) for Formwork		11.00		559.46	
			Add 1.4 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		1.40		71.20	
			e) Overhead charges @ 20%				1143.33	
			f) Contractor's profit @ 10%				686.00	
			Rate perm				7546.00	
						say	*7546.00*	
13.5 H (q)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (H) Case II				4831.00	
			d) formwork					
			Add 11 per cent of cost of material, labour and machinery (a+b+c) for Formwork		11.00		531.41	
			Add 1.4 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		1.40		67.63	
			e) Overhead charges @ 20%				1086.01	
			f) Contractor's profit @ 10%				651.61	
			Rate perm				7167.66	
						say	*7168.00*	
13.5 H		(r)	Height above 10m					
			For height, above 10m, add 3 per cent of cost as above excluding formwork. For cost of formwork add 13 per cent of cost of material, labour and machinery					
		Case I	Using concrete Mixer					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (H) Case I				5086.00	
			d) formwork					
			Add 13 per cent of cost of material, labour and machinery (a+b+c) for Formwork		13.00		661.18	
			Add 3 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		3.00		152.58	
			e) Overhead charges @ 20%				1179.95	
			f) Contractor's profit @ 10%				707.97	
			Rate perm				7787.68	
						say	*7788.00*	
13.5 H (r)		Case II	With Batching Plant, Transit Mixer and Concrete Pump					
			Per Cum Basic Cost of Labour, Material & Machinery (a+b+c) of Item 12.8 (H) Case II				4831.00	
			d) formwork					
			Add 13 per cent of cost of material, labour and machinery (a+b+c) for Formwork		13.00		628.03	
			Add 3 per cent of cost of material, Labour and machinery excluding formwork to cater for extra lift		3.00		144.93	
			e) Overhead charges @ 20%				1120.79	
			f) Contractor's profit @ 10%				672.48	
			Rate perm				7397.23	
						say	*7397.00*	
	Note		The basic components of this analysis are the same as those of items 13.8 (A to H). The only changes are as under:					
			a) Ramps/Stairs: Extra expenditure on structures which are more than 5 m high @ 2 per cent of cost for height upto 10 m and 4 per cent for heights above 10 m will be involved for approaching the work spot by providing higher ramp/stair case for use by the working parties.					
			b) The above mentioned percentages have been suitably modified for different categories as cost for various categories varies, whereas effort for access for same height will be similar. As the cost of richer concrete is comparatively more, the percentage to be added has been reduced to maintain the same cost for extra efforts.					
13.6	Section 1600 & 2200		Supplying, fitting and placing HYSD bar reinforcement in sub-structure complete as per drawing and Technical Specifications					
			Output: MT					
			Taking output = 1 MT					
			a) Material					
			HYSD bars including 5 per cent overlaps and wastage	tonne	1.05	49198.00	51657.90	M-082
			Binding wire	kg	6.00	45.80	274.80	M-072
			b) Labour for cutting, bending, shifting to site, tying and placing in position					
			Mate	day	0.34	275.00	93.50	L-12
			Blacksmith	day	2.00	245.00	490.00	L-02
			Mazdoor	day	6.50	245.00	1592.50	L-13
			c) Overhead charges @ 20%				10821.74	
			d) Contractor's profit @ 10%				6493.04	
			Rate perm				71423.48	
						say	*71423.00*	
13.7	1600 & 2200		Supplying, fitting and placing Mild steel reinforcement complete in sub-structure as per drawing and Technical Specification					
			Unit = MT					
			Taking output = 1 MT					
			a) Material					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			MS bars including 5 per cent overlaps and wastage	tonne	1.05	47198.00	49557.90	M-126
			Binding wire	kg	6.00	45.80	274.80	M-072
			b) Labour for straightening, cutting, bending, shifting to site, tying and placing in position					
			Mate	day	0.28	275.00	77.00	L-12
			Blacksmith	day	1.50	245.00	367.50	L-02
			Mazdoor	day	5.50	245.00	1347.50	L-13
			c) Overhead charges @ 20%				10324.94	
			d) Contractor's profit @ 10%				6194.96	
			Rate perm				68144.60	
						say	*68145.00*	
13.8	2706 & 2200		Providing weep holes in Brick masonry/Plain/ Reinforced concrete abutment, wing wall/ return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing foce. Complete as per drawing and Technical Specifications					
			Unit = Nos.					
			Taking output = 30 Nos.					
			a) Material					
			AC pipe 100 mm dia. (including wastage @ 5 per cent)	metre	31.50	145.00	4567.50	M-056
			Average length of weep hole is taken as one metre for the purpose of estimating.					
			MS clamp	each.	30.00	20.00	600.00	M-123
			collar for AC pipe (average) taking 10% of above pipe rate	each.	10.00	20.00	200.00	M-056/10
			Cement mortar 1:3 (Rate as in Item 12.6)	cum	0.05	5350.00	267.50	Item 12.6 (A)
			b) Labour					
			Mate	day	0.03	275.00	8.25	L-12
			Mason	day	0.50	245.00	122.50	L-11
			Mazdoor	day	0.25	245.00	61.25	L-13
			c) Overhead charges @ 20%				1165.40	
			d) Contractor's profit @ 10%				699.24	
			Cost for 30 m				7691.64	
			Rate per m				256.39	
						say	*256.00*	
	Note		1. In case of stone masonry, the size of the weep hole shall be 150 mm x 80 mm or circular with 150 mm diameter.					
			2. For structure in stone masonry, the weep holes shall be deemed to be included in the item of stone masonry work and shall not be paid separately.					
13.9	710.1.4. of IRC:78 & 2200		Back filling behind abutment, wing wall and return wall complete as per drawing and Technical Specification					
			Unit = cum					
			Taking output = 10 cum					
		A	Granular material					
			a) Labour					
			Mate	day	0.28	275.00	77.00	L-12
			Mazdoor	day	7.00	245.00	1715.00	L-13
			b) Material					
			Granular material	cum	12.00	112.00	1344.00	M-009
			c) Machinery					
			Plate compactor/power rammer	hour	2.50	250.00	625.00	P&M-086
			Water Tanker	hour	0.05	374.00	18.70	P&M-060
			d) Overhead charges @ 20%				377.97	
			e) Contractor's profit @ 10%				415.77	
			Cost for 10 cum of granular backfill				4573.44	
			Rate per cum				457.34	
						say	*457.00*	
13.9		B	Sandy material					
			a) Labour					
			Mate	day	0.28	275.00	77.00	L-12
			Mazdoor for filling, watering, ramming etc.	day	7.00	245.00	1715.00	L-13
			b) Material					
			Sand	cum	12.00	1184.68	14216.16	M-006
			c) Machinery					
			Plate compactor/power rammer	hour	2.50	250.00	625.00	P&M-086
			Water Tanker	hour	0.06	374.00	22.44	P&M-060
			d) Overhead charges @ 20%				3331.12	
			e) Contractor's profit @ 10%				1998.67	
			Cost for 10 cum of sandy backfill				21985.39	
			Rate per cum				2198.54	
						say	*2199.00*	
13.10	710.1.4. of IRC:78 and 2200		Providing and laying of Filter media with granular materials/stone crushed aggregates satisfying the requirements laid down in clause 2504.2.2. of MoRTH specifications to a thickness of not less than 600 mm with smaller size towards the soil and bigger size towards the wall and provided over the entire surface behind abutment, wing wall and return wall to the full height compacted to a firm condition complete as per drawing and Technical Specification.					
			Unit = cum					
			Taking output = 10 cum.					
			a) Labour					
			Mate	day	0.32	275.00	88.00	L-12
			Mazdoor for filling, watering, ramming etc.	day	7.00	245.00	1715.00	L-13
			Mazdoor (Skilled)	day	1.00	245.00	245.00	L-15
			b) Material					
			Filter media of stone aggregate conforming to clause 2504.2.2. of MoRTH specifications.	cum	12.00	465.00	5580.00	M-012
			c) Machinery					
			Water Tanker of 6 KL capacity	hour	0.06	374.00	22.44	P&M-060

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			d) Overhead charges @ 20%				1530.09	
			e) Contractor's profit @ 10%				918.05	
			cost for 10 cum of Fiter Media				10098.58	
			Rate per cum				1009.86	
						say	*1010.00*	
13.11	2000, 1000 & 2200		Supplying, fitting and fixing in position true to line and level cast steel rocker bearing conforming to IRC: 83(Pt.-1) section IX and clause 2003 of MoRTH specifications complete including all accessories as per drawing and Technical Specifications.					
			Unit: one tonne capacity					
			Considering a 250 tonne capacity bearing for this analysis					
			a) Labour					
			Mate	day	0.06	275.00	16.50	L-12
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			Mazdoor	day	1.00	245.00	245.00	L-13
			b) Material					
			Cast steel rocker bearing assembly of 250 tonne design load capacity duly painted complete with all its components as per drawing and specifications	each.	1.00	70000.00	70000.00	M-065
			Add 1 per cent of cost of bearing assembly for foundation anchorage bolts, lifting arrangements, grease and other consumables.				700.00	
			c) Overhead charges @ 20%				7108.40	
			d) Contractor's profit @ 10%				7819.24	
			cost for 250 tonnes capacity bearing				86011.64	
			Rate per tonne capacity				344.05	
						say	*344.00*	
13.12	2000 , 1000 & 2200		Supplying, fitting and fixing in position true to line and level forged steel roller bearing conforming to IRC: 83(Pt.-1) section IX and clause 2003 of MoRTH specifications complete including all accessories as per drawing and Technical Specifications.					
			Unit: one tonne capacity					
			Considering a 250 tonne capacity bearing for this analysis					
			a) Labour					
			Mate	day	0.06	275.00	16.50	L-12
			Mazdoor	day	1.00	245.00	245.00	L-13
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			b) Material					
			Forged steel roller bearing of 250 tonne design load capacity duly painted complete with all its components as per drawing and specifications	each.	1.00	3000.00	3000.00	M-067
			Add 1 per cent of cost of bearing assembly for foundation anchorage bolts, lifting arrangements, grease and other consumables.				30.00	
			c) Overhead charges @ 20%				341.40	
			d) Contractor's profit @ 10%				375.54	
			cost for 250 tonnes capacity bearing				4130.94	
			Rate per tonne capacity				16.52	
						say	*17.00*	
13.13	2000 & 2200		Supplying, fitting and fixing in position true to line and level sliding plate bearing with PTFE surface sliding on stainless steel complete including all accessories as per drawing and Technical Specifications and BS: 5400, section 9.1 & 9.2 (for PTFE) and clause 2004 of MoRTH Specifications.					
			Unit: one tonne capacity					
			Considering a 80 tonne capacity bearing for this analysis					
			a) Labour					
			Mate	day	0.06	275.00	16.50	L-12
			Mazdoor	day	1.00	245.00	245.00	L-13
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			b) Material					
			PTFE sliding plate bearing assembly of 80 tonnes design load capacity duly painted complete with all its components as per drawing and Technical Specifications	each.	1.00	70000.00	70000.00	M-069
			Add 1 per cent for foundation anchorage bolts and consumables.				700.00	
			c) Overhead charges @ 20%				7108.40	
			d) Contractor's profit @ 10%				7819.24	
			cost for 80 tonnes capacity bearing				86011.64	
			Rate per tonne capacity				1075.15	
						say	*1075.00*	
13.14	2000 & 2200		Supplying, fitting and fixing in position true to line and level elastomeric bearing conforming to IRC: 83 (Part-II) section IX and clause 2005 of MoRTH specifications complete including all accessories as per drawing and Technical Specifications.					
			Unit: one cubic centimetre					
			Considering an elastomeric bearing of size 500 x 400 x 96 mm for this analysis.					
			Overall volume - 19200 cu.cm					
			Volume of 6 nos. 488 x 388 x 4 mm size reinforcing steel plates = 4545 cu.cm.					
			Hence volume of elastometer = 14655 cu.cm.					
			a) Labour					
			Mate	day	0.06	275.00	16.50	L-12
			Mazdoor	day	1.00	245.00	245.00	L-13
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			b) Material					
			Elastomeric bearing assembly consisting of 7 layers of elastomer bonded to 6 nos. internal reinforcing steel laminates by the process of vulcanisation, complete with all components as per drawing and Technical Specifications.	each.	1.00	8000.00	8000.00	M-066
			Add 1 per cent of cost of bearing assembly for foundation anchorage bolts and consumables.				80.00	
			c) Overhead charges @ 20%				846.40	
			d) Contractor's profit @ 10%				931.04	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			cost for 19200cc of elastomeric bearing				10241.44	
			Rate per cc of elastomeric bearing				0.53	
						say	*0.53*	
13.15	2000 & 2200		Supplying, fitting and fixing in position true to line and level sliding plate bearing with stainless steel plate sliding on stainless steel plate with mild steel matrix complete including all accessories as per drawing and Technical Specifications.					
			Unit: one tonne capacity					
			Considering the sliding bearing of 80 tonnes design capacity for this analysis.					
			a) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mazdoor	day	0.75	245.00	183.75	L-13
			Mazdoor (Skilled)	day	0.35	245.00	85.75	L-15
			b) Material					
			Supply of sliding plate bearing of 80 tonne design capacity complete as per drawings and Technical Specifications.	each.	1.00	70000.00	70000.00	M-070
			Add 1 per cent of cost of bearing assembly for foundation anchorage bolts and consumables.				700.00	
			c) Overhead charges @ 20%				7098.05	
			d) Contractor's profit @ 10%				7807.86	
			cost for 80 tonnes of capacity bearing				85886.41	
							1073.58	
						say	*1074.00*	
13.16	2000 & 2200		Supplying, fitting and fixing in position true to line and level POT-PTFE bearing consisting of a metal piston supported by a disc or unreinforced elastomer confined within a metal cylinder, sealing rings, dust seals, PTFE surface sliding against stainless steel mating surface, complete assembly to be of cast steel/fabricated structural steel, metal and elastomer elements to be as per IRC: 83 part-I & II respectively and other parts conforming to BS: 5400, section 9.1 & 9.2 and clause 2006 of MoRTH Specifications complete as per drawing and approved Technical Specifications.					
			Unit: one tonne capacity			387.20		
			Considering a Pot bearing assembly of 250 tonne capacity for this analysis.					
			a) Labour					
			Mate	day	0.08	275.00	22.00	L-12
			Mazdoor	day	1.50	245.00	367.50	L-13
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			b) Material					
			Pot type bearing assembly consisting of a metal piston supported by a disc, PTFE pads providing sliding surfaces against stainless steel mating together with cast steel assemblies/fabricated structural steel assemblies duly painted with all components as per clause 2006 and complete as per drawings and Technical Specifications.	each.	1.00	70000.00	70000.00	M-068
			Add 1 per cent of cost of bearing assembly for foundation anchorage bolts and consumables.				700.00	
			c) Overhead charges @ 20%				7121.20	
			d) Contractor's profit @ 10%				7833.32	
			cost for 250 tonnes capacity bearing				86166.52	
			Rate per tonne capacity				344.67	
						say	*345.00*	

CHAPTER-14								
SUPER-STRUCTURE								
Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
14.1	1500 &1600 1700		Furnishing and Placing Reinforced/ Prestressed cement concrete in super-structure as per drawing and Technical Specification					
		A	RCC Grade M20					
		Case I	Using Concrete Mixer					
			Unit = 1 cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	5.12	7598.00	38901.76	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum		67095.00			
			For formwork and staging add the following:					
14.1A Case I		(i)	For solid slab super-structure, 20-30 per cent of (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				67095.00	
			d) Formwork and staging 20 per cent of (a+b+c)				13419.00	
			e) Overhead charges @ 20%				16102.80	
			f) Contractor's profit @ 10%				9661.68	
			Cost for 15 cum				106278.48	
			Rate per cum				7085.23	
						say	*7085.00*	
14.1A Case I (i)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				67095.00	
			d) Formwork and staging 25 per cent of (a+b+c)				16773.75	
			e) Overhead charges @ 20%				16773.75	
			f) Contractor's profit @ 10%				10064.25	
			Cost for 15 cum				110706.75	
			Rate per cum				7380.45	
						say	*7380.00*	
14.1A Case I (i)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				67095.00	
			d) Formwork and staging 30 per cent of (a+b+c)				20128.50	
			e) Overhead charges @ 20%				17444.70	
			f) Contractor's profit @ 10%				10466.82	
			Cost for 15 cum				115135.02	
			Rate per cum				7675.67	
						say	*7676.00*	
14.1A Case I		(ii)	For T-beam & slab, 25-35 per cent of (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				67095.00	
			d) Formwork and staging 25 per cent of (a+b+c)				16773.75	
			e) Overhead charges @ 20%				16773.75	
			f) Contractor's profit @ 10%				10064.25	
			Cost for 15 cum				110706.75	
			Rate per cum				7380.45	
						say	*7380.00*	
14.1A Case I (ii)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				67095.00	
			d) Formwork and staging 30 per cent of (a+b+c)				20128.50	
			e) Overhead charges @ 20%				17444.70	
			f) Contractor's profit @ 10%				10466.82	
			Cost for 15 cum				115135.02	
			Rate per cum				7675.67	
						say	*7676.00*	
14.1A Case I (ii)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				67095.00	
			d) Formwork and staging 35 per cent of (a+b+c)				23483.25	
			e) Overhead charges @ 20%				18115.65	
			f) Contractor's profit @ 10%				10869.39	
			Cost for 15 cum				119563.29	
			Rate per cum				7970.89	
						say	*7971.00*	
14.1A		Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	40.92	7598.00	310910.16	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051

			b) Labour					
			Mate	day	0.84	275.00	231.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	18.00	245.00	4410.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Transit Mixer 4 cum capacity lead upto1 Km	hour	15.00	660.00	9900.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	3000.00	3.00	9000.00	Lead =10 km & P&M-050
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum		513858.00			
			For formwork and staging add the following:					
14.1A Case II		(i)	For solid slab super-structure, 20-30 per cent of (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				513858.00	
			d) Formwork and staging 20 per cent of (a+b+c)				102771.60	
			e) Overhead charges @ 20%				123325.92	
			f) Contractor's profit @ 10%				73995.55	
			Cost for 120 cum				813951.07	
			Rate per cum				6782.93	
						say	*6783.00*	
14.1A Case II (i)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				513858.00	
			d) Formwork and staging 25 per cent of (a+b+c)				128464.50	
			e) Overhead charges @ 20%				128464.50	
			f) Contractor's profit @ 10%				77078.70	
			Cost for 120 cum				847865.70	
			Rate per cum				7065.55	
						say	*7066.00*	
14.1A Case II (i)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				513858.00	
			d) Formwork and staging 30 per cent of (a+b+c)				154157.40	
			e) Overhead charges @ 20%				133603.08	
			f) Contractor's profit @ 10%				80161.85	
			Cost for 120 cum				881780.33	
			Rate per cum				7348.17	
						say	*7348.00*	
14.1A Case II		(ii)	For T-beam & slab, 25-35 per cent of (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				513858.00	
			d) Formwork and staging 25 per cent of (a+b+c)				128464.50	
			e) Overhead charges @ 20%				128464.50	
			f) Contractor's profit @ 10%				77078.70	
			Cost for 120 cum				847865.70	
			Rate per cum				7065.55	
						say	*7066.00*	
14.1A Case II (ii)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				513858.00	
			d) Formwork and staging 30 per cent of (a+b+c)				154157.40	
			e) Overhead charges @ 20%				133603.08	
			f) Contractor's profit @ 10%				80161.85	
			Cost for 120 cum				881780.33	
			Rate per cum				7348.17	
						say	*7348.00*	
14.1A Case II (ii)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				513858.00	
			d) Formwork and staging 35 per cent of (a+b+c)				179850.30	
			e) Overhead charges @ 20%				138741.66	
			f) Contractor's profit @ 10%				83245.00	
			Cost for 120 cum				915694.96	
			Rate per cum				7630.79	
						say	*7631.00*	
14.1		B	RCC Grade M25					
		Case I	Using Concrete Mixer					
			Unit = 1 cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	5.99	7598.00	45512.02	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.86	275.00	236.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum		73705.00			

		For formwork and staging add the following:					
14.1B Case I	(i)	For solid slab super-structure, 20-30 per cent of (a+b+c)					
	(p)	Height upto 5m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				73705.00	
		d) Formwork and staging 20 per cent of (a+b+c)				14741.00	
		e) Overhead charges @ 20%				17689.20	
		f) Contractor's profit @ 10%				10613.52	
		Cost for 15 cum				116748.72	
		Rate per cum				7783.25	
					say	*7783.00*	
14.1B Case I (i)	(q)	Height 5m to 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				73705.00	
		d) Formwork and staging 25 per cent of (a+b+c)				18426.25	
		e) Overhead charges @ 20%				18426.25	
		f) Contractor's profit @ 10%				11055.75	
		Cost for 15 cum				121613.25	
		Rate per cum				8107.55	
					say	*8108.00*	
14.1B Case I (i)	(r)	Height above 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				73705.00	
		d) Formwork and staging 30 per cent of (a+b+c)				22111.50	
		e) Overhead charges @ 20%				19163.30	
		f) Contractor's profit @ 10%				11497.98	
		Cost for 15 cum				126477.78	
		Rate per cum				8431.85	
					say	*8432.00*	
14.1B Case I	(ii)	For T-beam & slab, 25-35 per cent of (a+b+c)					
	(p)	Height upto 5m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				73705.00	
		d) Formwork and staging 25 per cent of (a+b+c)				18426.25	
		e) Overhead charges @ 20%				18426.25	
		f) Contractor's profit @ 10%				11055.75	
		Cost for 15 cum				121613.25	
		Rate per cum				8107.55	
					say	*8108.00*	
14.1B Case I (ii)	(q)	Height 5m to 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				73705.00	
		d) Formwork and staging 30 per cent of (a+b+c)				22111.50	
		e) Overhead charges @ 20%				19163.30	
		f) Contractor's profit @ 10%				11497.98	
		Cost for 15 cum				126477.78	
		Rate per cum				8431.85	
					say	*8432.00*	
14.1B Case I (ii)	(r)	Height above 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				73705.00	
		d) Formwork and staging 35 per cent of (a+b+c)				25796.75	
		e) Overhead charges @ 20%				19900.35	
		f) Contractor's profit @ 10%				11940.21	
		Cost for 15 cum				131342.31	
		Rate per cum				8756.15	
					say	*8756.00*	
14.1B	Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
		Unit = cum					
		Taking output = 120 cum					
		a) Material					
		Cement	tonne	47.95	7598.00	364324.10	M-081
		Coarse sand	cum	54.20	1184.68	64209.66	M-004
		20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
		10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
		b) Labour					
		Mate	day	0.84	275.00	231.00	L-12
		Mason	day	3.00	245.00	735.00	L-11
		Mazdoor	day	18.00	245.00	4410.00	L-13
		c) Machinery					
		Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
		Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
		Loader	hour	6.00	624.00	3744.00	P&M-017
		Transit Mixer (capacity 4.0 cu.m)					
		Transit Mixer 4 cum capacity lead upto1 Km	hour	15.00	172.00	2580.00	P&M-049
		Lead beyond 1 Km, L - lead in Kilometer	tonne.km	3000.00	3.00	9000.00	Lead =10 km & P&M-050
		Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum		560188.00			
		For formwork and staging add the following:					
14.1B Case II	(i)	For solid slab super-structure, 20-30 per cent of (a+b+c)					
	(p)	Height upto 5m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				560188.00	
		d) Formwork and staging 20 per cent of (a+b+c)				112037.60	
		e) Overhead charges @ 20%				134445.12	
		f) Contractor's profit @ 10%				80667.07	
		Cost for 120 cum				887337.79	

		Rate per cum				7394.48	
					say	*7394.00*	
14.1B Case II (i)	(q)	Height 5m to 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				560188.00	
		d) Formwork and staging 25 per cent of (a+b+c)				140047.00	
		e) Overhead charges @ 20%				140047.00	
		f) Contractor's profit @ 10%				84028.20	
		Cost for 120 cum				924310.20	
		Rate per cum				7702.59	
					say	*7703.00*	
14.1B Case II (i)	(r)	Height above 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				560188.00	
		d) Formwork and staging 30 per cent of (a+b+c)				168056.40	
		e) Overhead charges @ 20%				145648.88	
		f) Contractor's profit @ 10%				87389.33	
		Cost for 120 cum				961282.61	
		Rate per cum				8010.69	
					say	*8011.00*	
14.1B Case II	(ii)	For T-beam & slab, 25-35 per cent of (a+b+c)					
	(p)	Height upto 5m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				560188.00	
		d) Formwork and staging 25 per cent of (a+b+c)				140047.00	
		e) Overhead charges @ 20%				140047.00	
		f) Contractor's profit @ 10%				84028.20	
		Cost for 120 cum				924310.20	
		Rate per cum				7702.59	
					say	*7703.00*	
14.1B Case II (ii)	(q)	Height 5m to 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				560188.00	
		d) Formwork and staging 30 per cent of (a+b+c)				168056.40	
		e) Overhead charges @ 20%				145648.88	
		f) Contractor's profit @ 10%				87389.33	
		Cost for 120 cum				961282.61	
		Rate per cum				8010.69	
					say	*8011.00*	
14.1B Case II (ii)	(r)	Height above 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				560188.00	
		d) Formwork and staging 35 per cent of (a+b+c)				196065.80	
		e) Overhead charges @ 20%				151250.76	
		f) Contractor's profit @ 10%				90750.46	
		Cost for 120 cum				998255.02	
		Rate per cum				8318.79	
					say	*8319.00*	
14.1	C	RCC Grade M 30					
	Case I	Using Concrete Mixer					
		Unit = 1 cum					
		Taking output = 15 cum					
		a) Material					
		Cement	tonne	6.10	7598.00	46347.80	M-081
		Coarse sand	cum	6.75	1184.68	7996.59	M-005
		20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
		10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
		b) Labour					
		Mate	day	0.90	275.00	247.50	L-12
		Mason	day	1.50	245.00	367.50	L-11
		Mazdoor	day	21.00	245.00	5145.00	L-13
		c) Machinery					
		Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
		Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum		74797.00			
		For formwork and staging add the following:					
14.1C Case I	(i)	For solid slab super-structure, 20-30 per cent of (a+b+c)					
	(p)	Height upto 5m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				74797.00	
		d) Formwork and staging 20 per cent of (a+b+c)				14959.40	
		e) Overhead charges @ 20%				17951.28	
		f) Contractor's profit @ 10%				10770.77	
		Cost for 15 cum				118478.45	
		Rate per cum				7898.56	
					say	*7899.00*	
14.1C Case I (i)	(q)	Height 5m to 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				74797.00	
		d) Formwork and staging 25 per cent of (a+b+c)				18699.25	
		e) Overhead charges @ 20%				18699.25	
		f) Contractor's profit @ 10%				11219.55	
		Cost for 15 cum				123415.05	
		Rate per cum				8227.67	
					say	*8228.00*	
14.1C Case I (i)	(r)	Height above 10m					

		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				74797.00	
		d) Formwork and staging 30 per cent of (a+b+c)				22439.10	
		e) Overhead charges @ 20%				19447.22	
		f) Contractor's profit @ 10%				11668.33	
		Cost for 15 cum				128351.65	
		Rate per cum				8556.78	
					say	*8557.00*	
14.1C Case I	(ii)	For T-beam & slab, 25-35 per cent of (a+b+c)					
	(p)	Height upto 5m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				74797.00	
		d) Formwork and staging 25 per cent of (a+b+c)				18699.25	
		e) Overhead charges @ 20%				9349.63	
		f) Contractor's profit @ 10%				10284.59	
		Cost for 15 cum				113130.46	
		Rate per cum				7542.03	
					say	*7542.00*	
14.1C Case I (ii)	(q)	Height 5m to 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				74797.00	
		d) Formwork and staging 30 per cent of (a+b+c)				22439.10	
		e) Overhead charges @ 20%				19447.22	
		f) Contractor's profit @ 10%				11668.33	
		Cost for 15 cum				128351.65	
		Rate per cum				8556.78	
					say	*8557.00*	
14.1C Case I (ii)	(r)	Height above 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				74797.00	
		d) Formwork and staging 35 per cent of (a+b+c)				26178.95	
		e) Overhead charges @ 20%				20195.19	
		f) Contractor's profit @ 10%				12117.11	
		Cost for 15 cum				133288.25	
		Rate per cum				8885.88	
					say	*8886.00*	
14.1C	Case II	Using Batching Plant, Transit Mixer and Concrete Pump.					
		Unit = cum					
		Taking output = 120 cum					
		a) Material					
		Cement	tonne	48.79	7598.00	370706.42	M-081
		Coarse sand	cum	54.60	1184.68	64683.53	M-004
		20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
		10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
		b) Labour					
		Mate	day	0.88	275.00	242.00	L-12
		Mason	day	3.00	245.00	735.00	L-11
		Mazdoor	day	19.00	245.00	4655.00	L-13
		c) Machinery					
		Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
		Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
		Loader	hour	6.00	624.00	3744.00	P&M-017
		Transit Mixer (capacity 4.0 cu.m)					
		Transit Mixer 4 cum capacity lead upto1 Km	hour	15.00	660.00	9900.00	P&M-049
		Lead beyond 1 Km, L - lead in Kilometer	tonne.km	3000.00	3.00	9000.00	Lead =10 km & P&M-050
		Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum		574621.00			
		For formwork and staging add the following:					
14.1C Case II	(i)	For solid slab super-structure, 20-30 per cent of (a+b+c)					
	(p)	Height upto 5m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				574621.00	
		d) Formwork and staging 20 per cent of (a+b+c)				114924.20	
		e) Overhead charges @ 20%				68954.52	
		f) Contractor's profit @ 10%				75849.97	
		Cost for 120 cum				834349.69	
		Rate per cum				6952.91	
					say	*6953.00*	
14.1C Case II (i)	(q)	Height 5m to 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				574621.00	
		d) Formwork and staging 25 per cent of (a+b+c)				143655.25	
		e) Overhead charges @ 20%				143655.25	
		f) Contractor's profit @ 10%				86193.15	
		Cost for 120 cum				948124.65	
		Rate per cum				7901.04	
					say	*7901.00*	
14.1C Case II (i)	(r)	Height above 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				574621.00	
		d) Formwork and staging 30 per cent of (a+b+c)				172386.30	
		e) Overhead charges @ 20%				149401.46	
		f) Contractor's profit @ 10%				89640.88	
		Cost for 120 cum				986049.64	
		Rate per cum				8217.08	
					say	*8217.00*	
14.1C Case II	(ii)	For T-beam & slab, 25-35 per cent of (a+b+c)					

		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				574621.00	
			d) Formwork and staging 25 per cent of (a+b+c)				143655.25	
			e) Overhead charges @ 20%				143655.25	
			f) Contractor's profit @ 10%				86193.15	
			Cost for 120 cum				948124.65	
			Rate per cum				7901.04	
						say	*7901.00*	
14.1C Case II (ii)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				574621.00	
			d) Formwork and staging 30 per cent of (a+b+c)				172386.30	
			e) Overhead charges @ 20%				149401.46	
			f) Contractor's profit @ 10%				89640.88	
			Cost for 120 cum				986049.64	
			Rate per cum				8217.08	
						say	*8217.00*	
14.1C Case II (ii)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				574621.00	
			d) Formwork and staging 35 per cent of (a+b+c)				201117.35	
			e) Overhead charges @ 20%				155147.67	
			f) Contractor's profit @ 10%				93088.60	
			Cost for 120 cum				1023974.62	
			Rate per cum				8533.12	
						say	*8533.00*	
14.1		D	RCC/PSC Grade M35					
		Case I	Using Concrete Mixer.					
			Unit = 1 cum					
			Taking output = 15 cum					
			a) Material					
			Cement	tonne	6.33	7598.00	48095.34	M-081
			Coarse sand	cum	6.75	1184.68	7996.59	M-005
			20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
			10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
			b) Labour					
			Mate	day	0.90	275.00	247.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	21.00	245.00	5145.00	L-13
			c) Machinery					
			Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
			Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum		76544.00			
			For formwork and staging add the following:					
14.1D Case I		(i)	For solid slab super-structure, 18-28 per cent of (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				76544.00	
			d) Formwork and staging 18 per cent of (a+b+c)				13777.92	
			e) Overhead charges @ 20%				18064.38	
			f) Contractor's profit @ 10%				10838.63	
			Cost for 15 cum				119224.93	
			Rate per cum				7948.33	
						say	*7948.00*	
14.1D Case I (i)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				76544.00	
			d) Formwork and staging 23 per cent of (a+b+c)				17605.12	
			e) Overhead charges @ 20%				18829.82	
			f) Contractor's profit @ 10%				11297.89	
			Cost for 15 cum				124276.84	
			Rate per cum				8285.12	
						say	*8285.00*	
14.1D Case I (i)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				76544.00	
			d) Formwork and staging 28 per cent of (a+b+c)				21432.32	
			e) Overhead charges @ 20%				19595.26	
			f) Contractor's profit @ 10%				11757.16	
			Cost for 15 cum				129328.74	
			Rate per cum				8621.92	
						say	*8622.00*	
14.1D Case I		(ii)	For T-beam & slab, 23-33 per cent of (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				76544.00	
			d) Formwork and staging 23 per cent of (a+b+c)				17605.12	
			e) Overhead charges @ 20%				18829.82	
			f) Contractor's profit @ 10%				11297.89	
			Cost for 15 cum				124276.84	
			Rate per cum				8285.12	
						say	*8285.00*	
14.1D Case I (ii)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				76544.00	
			d) Formwork and staging 28 per cent of (a+b+c)				21432.32	
			e) Overhead charges @ 20%				19595.26	

			f) Contractor's profit @ 10%				11757.16	
			Cost for 15 cum				129328.74	
			Rate per cum				8621.92	
						say	*8622.00*	
14.1D Case I (ii)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				76544.00	
			d) Formwork and staging 33 per cent of (a+b+c)				25259.52	
			e) Overhead charges @ 20%				20360.70	
			f) Contractor's profit @ 10%				12216.42	
			Cost for 15 cum				134380.65	
			Rate per cum				8958.71	
						say	*8959.00*	
14.1D Case I		(iii)	For box girder and balanced cantilever, 38-58 per cent of cost of concrete.					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				76544.00	
			d) Formwork and staging 38 per cent of (a+b+c)				29086.72	
			e) Overhead charges @ 20%				21126.14	
			f) Contractor's profit @ 10%				12675.69	
			Cost for 15 cum				139432.55	
			Rate per cum				9295.50	
						say	*9296.00*	
14.1D Case I (iii)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				76544.00	
			d) Formwork and staging 48 per cent of (a+b+c)				36741.12	
			e) Overhead charges @ 20%				22657.02	
			f) Contractor's profit @ 10%				13594.21	
			Cost for 15 cum				149536.36	
			Rate per cum				9969.09	
						say	*9969.00*	
14.1D Case I (iii)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				76544.00	
			d) Formwork and staging 58 per cent of (a+b+c)				44395.52	
			e) Overhead charges @ 20%				24187.90	
			f) Contractor's profit @ 10%				14512.74	
			Cost for 15 cum				159640.17	
			Rate per cum				10642.68	
						say	*10643.00*	
		Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	50.64	7598.00	384762.72	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			b) Labour					
			Mate	day	0.88	275.00	242.00	L-12
			Mason	day	3.00	245.00	735.00	L-11
			Mazdoor	day	19.00	245.00	4655.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Transit Mixer 4 cum capacity lead upto1 Km	hour	15.00	660.00	9900.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	3000.00	3.00	9000.00	Lead =10 km & P&M-050
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum		587966.00			
			For formwork and staging add the following:					
14.1D Case II		(i)	For solid slab super-structure, 18-28 per cent of (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				587966.00	
			d) Formwork and staging 18 per cent of (a+b+c)				105833.88	
			e) Overhead charges @ 20%				138759.98	
			f) Contractor's profit @ 10%				83255.99	
			Cost for 120 cum				915815.84	
			Rate per cum				7631.80	
						say	*7632.00*	
14.1D Case II (i)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				587966.00	
			d) Formwork and staging 23 per cent of (a+b+c)				135232.18	
			e) Overhead charges @ 20%				144639.64	
			f) Contractor's profit @ 10%				86783.78	
			Cost for 120 cum				954621.60	
			Rate per cum				7955.18	
						say	*7955.00*	
14.1D Case II (i)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				587966.00	
			d) Formwork and staging 28 per cent of (a+b+c)				164630.48	

	e) Overhead charges @ 20%				150519.30	
	f) Contractor's profit @ 10%				90311.58	
	Cost for 120 cum				993427.35	
	Rate per cum				8278.56	
				say	*8279.00*	
14.1D Case II	(ii)	For T-beam & slab, 23-33 per cent of (a+b+c)					
	(p)	Height upto 5m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				587966.00	
		d) Formwork and staging 23 per cent of (a+b+c)				135232.18	
		e) Overhead charges @ 20%				144639.64	
		f) Contractor's profit @ 10%				86783.78	
		Cost for 120 cum				954621.60	
		Rate per cum				7955.18	
					say	*7955.00*	
14.1D Case II (ii)	(q)	Height 5m to 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				587966.00	
		d) Formwork and staging 28 per cent of (a+b+c)				164630.48	
		e) Overhead charges @ 20%				150519.30	
		f) Contractor's profit @ 10%				90311.58	
		Cost for 120 cum				993427.35	
		Rate per cum				8278.56	
					say	*8279.00*	
14.1D Case II (ii)	(r)	Height above 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				587966.00	
		d) Formwork and staging 33 per cent of (a+b+c)				194028.78	
		e) Overhead charges @ 20%				156398.96	
		f) Contractor's profit @ 10%				93839.37	
		Cost for 120 cum				1032233.11	
		Rate per cum				8601.94	
					say	*8602.00*	
14.1D Case II	(iii)	For box girder and balanced cantilever, 38-58 per cent of cost of concrete.					
	(p)	Height upto 5m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				587966.00	
		d) Formwork and staging 38 per cent of (a+b+c)				223427.08	
		e) Overhead charges @ 20%				162278.62	
		f) Contractor's profit @ 10%				97367.17	
		Cost for 120 cum				1071038.87	
		Rate per cum				8925.32	
					say	*8925.00*	
14.1D Case II (iii)	(q)	Height 5m to 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				587966.00	
		d) Formwork and staging 48 per cent of (a+b+c)				282223.68	
		e) Overhead charges @ 20%				174037.94	
		f) Contractor's profit @ 10%				104422.76	
		Cost for 120 cum				1148650.38	
		Rate per cum				9572.09	
					say	*9572.00*	
14.1D Case II (iii)	(r)	Height above 10m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				587966.00	
		d) Formwork and staging 58 per cent of (a+b+c)				341020.28	
		e) Overhead charges @ 20%				185797.26	
		f) Contractor's profit @ 10%				111478.35	
		Cost for 120 cum				1226261.89	
		Rate per cum				10218.85	
					say	*10219.00*	
14.1	E	PSC Grade M-40					
	Case 1	Using concrete mixer.					
		Unit = 1 cum					
		Taking output = 15 cum					
		a) Material					
		Cement	tonne	6.45	7598.00	49007.10	M-081
		Coarse sand	cum	6.75	1184.68	7996.59	M-005
		20 mm Aggregate	cum	8.10	974.52	7893.61	M-053
		10 mm Aggregate	cum	5.40	774.52	4182.41	M-051
		Admixture @ 0.4 per cent of cement	kg	25.80	61.20	1578.96	M-180
		b) Labour					
		Mate	day	0.96	275.00	264.00	L-12
		Mason	day	2.00	245.00	490.00	L-11
		Mazdoor	day	22.00	245.00	5390.00	L-13
		c) Machinery					
		Concrete mixer (cap. 0.40/0.28 cum)	hour	6.00	172.00	1032.00	P&M-009
		Generator 33 KVA	hour	6.00	264.00	1584.00	P&M-079
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum		79419.00			
		For formwork and staging add the following:					
14.1E Case I	(i)	For solid slab super-structure, 20-30 per cent of (a+b+c)					
	(p)	Height upto 5m					
		Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				79419.00	
		d) Formwork and staging 20 per cent of (a+b+c)		20.00		15883.80	
		e) Overhead charges @ 20%				19060.56	
		f) Contractor's profit @ 10%				11436.34	
		Cost for 15 cum				125799.70	
		Rate per cum				8386.65	

						say	*8387.00*	
14.1E Case I (i)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				79419.00	
			d) Formwork and staging 25 per cent of (a+b+c)				19854.75	
			e) Overhead charges @ 20%				19854.75	
			f) Contractor's profit @ 10%				11912.85	
			Cost for 15 cum				131041.35	
			Rate per cum				8736.09	
						say	*8736.00*	
14.1E Case I (i)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				79419.00	
			d) Formwork and staging 30 per cent of (a+b+c)				23825.70	
			e) Overhead charges @ 20%				20648.94	
			f) Contractor's profit @ 10%				12389.36	
			Cost for 15 cum				136283.00	
			Rate per cum				9085.53	
						say	*9086.00*	
14.1E Case I		(ii)	For T-beam & slab, 25-35 per cent of (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				79419.00	
			d) Formwork and staging 25 per cent of (a+b+c)				19854.75	
			e) Overhead charges @ 20%				19854.75	
			f) Contractor's profit @ 10%				11912.85	
			Cost for 15 cum				131041.35	
			Rate per cum				8736.09	
						say	*8736.00*	
14.1E Case I (ii)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				79419.00	
			d) Formwork and staging 30 per cent of (a+b+c)				23825.70	
			e) Overhead charges @ 20%				20648.94	
			f) Contractor's profit @ 10%				12389.36	
			Cost for 15 cum				136283.00	
			Rate per cum				9085.53	
						say	*9086.00*	
14.1E Case I (ii)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 15 cum				79419.00	
			d) Formwork and staging 35 per cent of (a+b+c)				27796.65	
			e) Overhead charges @ 20%				21443.13	
			f) Contractor's profit @ 10%				12865.88	
			Cost for 15 cum				141524.66	
			Rate per cum				9434.98	
						say	*9435.00*	
14.1E		Case II	Using Batching Plant, Transit Mixer and Concrete Pump					
			Unit = cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	51.60	7598.00	392056.80	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			Admixture @ 0.4 per cent of cement	kg	206.40	61.20	12631.68	M-180
			b) Labour					
			Mate	day	0.94	275.00	258.50	L-12
			Mason	day	3.50	245.00	857.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Transit Mixer 4 cum capacity lead upto1 Km	hour	15.00	660.00	9900.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	3000.00	3.00	9000.00	Lead =10 km & P&M-050
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum		608276.00			
			For formwork and staging add the following:					
14.1E Case II		(i)	For solid/voided slab super-structure, 18-28 per cent of (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				608276.00	
			d) Formwork and staging 18 per cent of (a+b+c)				109489.68	
			e) Overhead charges @ 20%				143553.14	
			f) Contractor's profit @ 10%				86131.88	
			Cost for 120 cum				947450.70	
			Rate per cum				7895.42	
						say	*7895.00*	
14.1E Case II (i)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				608276.00	
			d) Formwork and staging 23 per cent of (a+b+c)				139903.48	
			e) Overhead charges @ 20%				149635.90	
			f) Contractor's profit @ 10%				89781.54	

			Cost for 120 cum				987596.91	
			Rate per cum				8229.97	
						say	*8230.00*	
14.1E Case II (i)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				608276.00	
			d) Formwork and staging 28 per cent of (a+b+c)				170317.28	
			e) Overhead charges @ 20%				155718.66	
			f) Contractor's profit @ 10%				93431.19	
			Cost for 120 cum				1027743.13	
			Rate per cum				8564.53	
						say	*8565.00*	
14.1E Case II		(ii)	For T-beam & slab, 23-33 per cent of (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				608276.00	
			d) Formwork and staging 23 per cent of (a+b+c)				139903.48	
			e) Overhead charges @ 20%				149635.90	
			f) Contractor's profit @ 10%				89781.54	
			Cost for 120 cum				987596.91	
			Rate per cum				8229.97	
						say	*8230.00*	
14.1E Case II (ii)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				608276.00	
			d) Formwork and staging 28 per cent of (a+b+c)				170317.28	
			e) Overhead charges @ 20%				155718.66	
			f) Contractor's profit @ 10%				93431.19	
			Cost for 120 cum				1027743.13	
			Rate per cum				8564.53	
						say	*8565.00*	
14.1E Case II (ii)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				608276.00	
			d) Formwork and staging 33 per cent of (a+b+c)				200731.08	
			e) Overhead charges @ 20%				161801.42	
			f) Contractor's profit @ 10%				97080.85	
			Cost for 120 cum				1067889.35	
			Rate per cum				8899.08	
						say	*8899.00*	
14.1E Case II		(iii)	For cast-in-situ box girder, segment construction and balanced cantilever, 38-58 per cent of cost of concrete.					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				608276.00	
			d) Formwork and staging 38 per cent of (a+b+c)				231144.88	
			e) Overhead charges @ 20%				167884.18	
			f) Contractor's profit @ 10%				100730.51	
			Cost for 120 cum				1108035.56	
			Rate per cum				9233.63	
						say	*9234.00*	
14.1E Case II (iii)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				608276.00	
			d) Formwork and staging 48 per cent of (a+b+c)				291972.48	
			e) Overhead charges @ 20%				180049.70	
			f) Contractor's profit @ 10%				108029.82	
			Cost for 120 cum				1188327.99	
			Rate per cum				9902.73	
						say	*9903.00*	
14.1E Case II (iii)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				608276.00	
			d) Formwork and staging 58 per cent of (a+b+c)				352800.08	
			e) Overhead charges @ 20%				192215.22	
			f) Contractor's profit @ 10%				115329.13	
			Cost for 120 cum				1268620.43	
			Rate per cum				10571.84	
						say	*10572.00*	
14.1F		F	PSC Grade M-45					
			Unit = 1 cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	55.80	7598.00	423968.40	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			Admixture @ 0.4 per cent of cement	kg	223.20	61.20	13659.84	M-180
			b) Labour					
			Mate	day	0.94	275.00	258.50	L-12
			Mason	day	3.50	245.00	857.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Transit Mixer 4 cum capacity lead upto1 Km	hour	15.00	660.00	9900.00	P&M-049

			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	3000.00	3.00	9000.00	Lead =10 km & P&M-050
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum		641216.00			
			For formwork and staging add the following:					
14.1F		(i)	For solid slab/voided slab super-structure, 16-26 per cent of cost of concrete (a+b+c)					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				641216.00	
			d) Formwork and staging 16 per cent of (a+b+c)				102594.56	
			e) Overhead charges @ 20%				148762.11	
			f) Contractor's profit @ 10%				89257.27	
			Cost for 120 cum				981829.94	
			Rate per cum				8181.92	
						say	*8182.00*	
14.1F (i)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				641216.00	
			d) Formwork and staging 21 per cent of (a+b+c)				134655.36	
			e) Overhead charges @ 20%				155174.27	
			f) Contractor's profit @ 10%				93104.56	
			Cost for 120 cum				1024150.20	
			Rate per cum				8534.58	
						say	*8535.00*	
14.1F (i)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				641216.00	
			d) Formwork and staging 26 per cent of (a+b+c)				166716.16	
			e) Overhead charges @ 20%				161586.43	
			f) Contractor's profit @ 10%				96951.86	
			Cost for 120 cum				1066470.45	
			Rate per cum				8887.25	
						say	*8887.00*	
14.1F		(ii)	For T-beam & slab including launching of precast girders by launching truss upto 40 m span, 21-31 per cent of cost of concrete.					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				641216.00	
			d) Formwork and staging 21 per cent of (a+b+c)				134655.36	
			e) Overhead charges @ 20%				155174.27	
			f) Contractor's profit @ 10%				93104.56	
			Cost for 120 cum				1024150.20	
			Rate per cum				8534.58	
						say	*8535.00*	
14.1F (ii)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				641216.00	
			d) Formwork and staging 26 per cent of (a+b+c)				166716.16	
			e) Overhead charges @ 20%				161586.43	
			f) Contractor's profit @ 10%				96951.86	
			Cost for 120 cum				1066470.45	
			Rate per cum				8887.25	
						say	*8887.00*	
14.1F (ii)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				641216.00	
			d) Formwork and staging 31 per cent of (a+b+c)				198776.96	
			e) Overhead charges @ 20%				167998.59	
			f) Contractor's profit @ 10%				100799.16	
			Cost for 120 cum				1108790.71	
			Rate per cum				9239.92	
						say	*9240.00*	
14.1F		(iii)	For cast-in-situ box girder, segmental construction and balanced cantilever, 36-56 per cent of cost of concrete.					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				641216.00	
			d) Formwork and staging 36 per cent of (a+b+c)				230837.76	
			e) Overhead charges @ 20%				174410.75	
			f) Contractor's profit @ 10%				104646.45	
			Cost for 120 cum				1151110.96	
			Rate per cum				9592.59	
						say	*9593.00*	
14.1F (iii)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				641216.00	
			d) Formwork and staging 46 per cent of (a+b+c)				294959.36	
			e) Overhead charges @ 20%				187235.07	
			f) Contractor's profit @ 10%				112341.04	
			Cost for 120 cum				1235751.48	
			Rate per cum				10297.93	
						say	*10298.00*	
14.1F (iii)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				641216.00	
			d) Formwork and staging 56 per cent of (a+b+c)				359080.96	
			e) Overhead charges @ 20%				200059.39	
			f) Contractor's profit @ 10%				120035.64	
			Cost for 120 cum				1320391.99	
			Rate per cum				11003.27	
						say	*11003.00*	

14.1		G	PSC Grade M-50					
			Unit = 1 cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	58.80	7598.00	446762.40	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			Admixture @ 0.4 per cent of cement	kg	235.20	61.20	14394.24	M-180
			b) Labour					
			Mate	day	0.94	275.00	258.50	L-12
			Mason	day	3.50	245.00	857.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Transit Mixer 4 cum capacity lead upto1 Km	hour	15.00	660.00	9900.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	3000.00	3.00	9000.00	Lead =10 km & P&M-050
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum		664744.00			
			For formwork and staging add the following:					
14.1G		(i)	For cast-in-situ box girder, segmental construction and balanced cantilever, 35-55 per cent of cost of concrete					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				664744.00	
			d) Formwork and staging 35 per cent of (a+b+c)				232660.40	
			e) Overhead charges @ 20%				179480.88	
			f) Contractor's profit @ 10%				107688.53	
			Cost for 120 cum				1184573.81	
			Rate per cum				9871.45	
						say	*9871.00*	
14.1G (i)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				664744.00	
			d) Formwork and staging 45 per cent of (a+b+c)				299134.80	
			e) Overhead charges @ 20%				192775.76	
			f) Contractor's profit @ 10%				115665.46	
			Cost for 120 cum				1272320.02	
			Rate per cum				10602.67	
						say	*10603.00*	
14.1G (i)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				664744.00	
			d) Formwork and staging 55 per cent of (a+b+c)				365609.20	
			e) Overhead charges @ 20%				206070.64	
			f) Contractor's profit @ 10%				123642.38	
			Cost for 120 cum				1360066.22	
			Rate per cum				11333.89	
						say	*11334.00*	
14.1		H	PSC Grade M- 55					
			Unit = 1 cum					
			Taking output = 120 cum					
			a) Material					
			Cement	tonne	63.50	7598.00	482473.00	M-081
			Coarse sand	cum	54.00	1184.68	63972.72	M-004
			20 mm Aggregate	cum	64.80	974.52	63148.90	M-053
			10 mm Aggregate	cum	43.20	774.52	33459.26	M-051
			Admixture @ 0.4 per cent of cement	kg	254.00	61.20	15544.80	M-180
			b) Labour					
			Mate	day	0.94	275.00	258.50	L-12
			Mason	day	3.50	245.00	857.50	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Batching Plant @ 20 cum/hour	hour	6.00	1656.00	9936.00	P&M-002
			Generator 100 KVA	hour	6.00	562.00	3372.00	P&M-080
			Loader	hour	6.00	624.00	3744.00	P&M-017
			Transit Mixer (capacity 4.0 cu.m)					
			Transit Mixer 4 cum capacity lead upto1 Km	hour	15.00	660.00	9900.00	P&M-049
			Lead beyond 1 Km, L - lead in Kilometer	tonne.km	3000.00	3.00	9000.00	Lead =10 km & P&M-050
			Concrete Pump	hour	6.00	173.00	1038.00	P&M-007
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum		701605.00			
			For formwork and staging add the following:					
14.1H		(i)	For cast-in-situ box girder, segmental construction and balanced cantilever, 35-55 per cent of cost of concrete					
		(p)	Height upto 5m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				701605.00	
			d) Formwork and staging 35 per cent of (a+b+c)				245561.75	
			e) Overhead charges @ 20%				189433.35	
			f) Contractor's profit @ 10%				113660.01	
			Cost for 120 cum				1250260.11	
			Rate per cum				10418.83	
						say	*10419.00*	
14.1H (i)		(q)	Height 5m to 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				701605.00	

			d) Formwork and staging 45 per cent of (a+b+c)				315722.25	
			e) Overhead charges @ 20%				203465.45	
			f) Contractor's profit @ 10%				122079.27	
			Cost for 120 cum				1342871.97	
			Rate per cum				11190.60	
						say	*11191.00*	
14.1H (i)		(r)	Height above 10m					
			Basic Cost of Labour, Material & Machinery (a+b+c) for 120 cum				701605.00	
			d) Formwork and staging 55 per cent of (a+b+c)				385882.75	
			e) Overhead charges @ 20%				217497.55	
			f) Contractor's profit @ 10%				130498.53	
			Cost for 120 cum				1435483.83	
			Rate per cum				11962.37	
						say	*11962.00*	
		Note	1.Where ever concrete is carried out using batching plant, transit mixer, concrete pump, admixers conforming IS: 9103 @ 0.4 per cent of weight of cement may be added for achieving desired slump of concrete.					
			2. Cement provided for various components of the super structure is for estimating purpose only. Actual quantity of cement will be as per approved mix design. Similarly, the provision for coarse and fine aggregates is for estimating purpose and the exact quantity shall be as per the mix design.					
			3. The items like needle and surface vibrators are part of minor T & P which is already covered under the overhead charges. As such these items have not been added separately in the rate analysis.					
14.2	1600		Supplying, fitting and placing HYSD bar reinforcement in super-structure complete as per drawing and technical specifications					
			Unit = 1 MT					
			Taking output = 1 MT					
			a) Material					
			HYSD bars including 5 per cent for laps and wastage	tonne	1.05	49198.00	51657.90	M-082
			Binding wire	Kg	8.00	45.80	366.40	M-072
			b) Labour for cutting, bending, tying and placing in position					
			Mate	day	0.44	275.00	121.00	L-12
			Blacksmith	day	3.00	245.00	735.00	L-02
			Mazdoor	day	8.00	245.00	1960.00	L-13
			Basic Cost of Labour & Material (a+b)		54841.00			
			c) Overhead charges @ 20%				10968.06	
			d) Contractor's profit @ 10%				6580.84	
			Rate per MT				72389.20	
						say	*72389.00*	
14.3	1800		High tensile steel wires/strands including all accessories for stressing, stressing operations and grouting complete as per drawing and Technical Specifications					
			Unit = 1 MT					
			Taking output = 0.377 MT					
			Details of cost for 12T13 strand 40 m long cable (weight = 0.377 MT)					
			a) Material					
			H.T. Strand @ 9.42 kg/m including 2 per cent for wastage and extra length for jacking	tonne	0.39	63898.00	24600.73	M-119
			Sheathing duct ID 66 mm along with 5 per cent extra length 40 x 1.05 = 42 m.	metre	42.00	100.00	4200.00	M-165
			Tube anchorage set complete with bearing plate, permanent wedges etc	each	2.00	12000.00	24000.00	M-187
			Cement for grouting including 3 per cent wastage @ 3.00 kg/m = 3 x 1.03 x 40 = 123.60 kg (say, = 125 kg)	tonne	0.125	7598.00	949.75	M-081
			Add 0.50 per cent cost of material for Spacers, Insulation tape and miscellaneous items				2687.52	
			b) Labour					
			i) For making and fixing cables, anchorages					
			Mate	day	0.16	275.00	44.00	L-12
			Blacksmith	day	1.00	245.00	245.00	L-02
			Mazdoor	day	3.00	245.00	735.00	L-13
			ii) For prestressing					
			Mate/Supervisor	day	0.05	275.00	13.75	L-12
			Prestressing operator / Fitter	day	0.25	270.00	67.50	L-08
			Mazdoor	day	1.00	245.00	245.00	L-13
			iii) For grouting					
			Mate/Supervisor	day	0.05	275.00	13.75	L-12
			Mason	day	0.25	245.00	61.25	L-11
			Mazdoor	day	1.00	245.00	245.00	L-13
			c) Machinery					
			Stressing jack with pump	hour	2.50	150.00	375.00	P&M-040
			Grouting pump with agitator	hour	1.00	800.00	800.00	M-111
			Generator 33 KVA.	hour	3.50	264.00	924.00	P&M-079
			d) Overhead charges @ 20%				753.85	
			e) Contractor's profit @ 10%				452.31	
			Cost for 0.377 MT				61413.41	
			Rate per MT				162900.30	
						say	*162900.00*	
		Note	Cost of HT steel has been taken for delivery at site. Hence carriage has not been considered.					
14.4	2702		Providing and laying Cement concrete wearing coat M-30 grade including reinforcement complete as per drawing and Technical Specifications					
			Unit = 1 cum					
			Taking output = 1 cum					
			a) Material					
			Cement concrete M30 Grade Refer relevant item of concrete in Item 14.1 excluding formwork	cum	1.00	7899.00	7899.00	Item 14.1(C)
			HYSD bar reinforcement Rate as per item No 14.2(Excluding OH & CP)	tonne	0.075	72389.00	5429.18	Item 14.2 A
			b) Labour					

			Mazdoor for cleaning deck slab concrete surface.	day	0.15	245.00	36.75	L-13
			c) Overhead charges @ 20%				2672.99	
			d) Contractor's profit @ 10%				1603.79	
			Rate per cum				17641.70	
						say	*17642.00*	
14.5	515 & 2702		Mastic Asphalt					
			Providing and laying 12 mm thick mastic asphalt wearing course on top of deck slab excluding prime coat with paving grade bitumen meeting the requirements given in table 500-29, prepared by using mastic cooker and laid to required level and slope after cleaning the surface, including providing antiskid surface with bitumen precoated fine grained hard stone chipping of 9.5 mm nominal size at the rate of 0.005cum per 10 sqm and at an approximate spacing of 10 cm center to center in both directions, pressed into surface when the temperature of surfaces not less than 100 deg. C, protruding 1 mm to 4 mm over mastic surface, all complete as per clause 515.					
			Unit = sqm					
			Taking output = 72.46 sqm (2 tonnes)(0.869 cum) assuming a density of 2.3 tonnes/cum.					
			a) Labour					
			Mate	day	0.49	275.00	134.75	L-12
			Mazdoor	day	11.00	245.00	2695.00	L-13
			Mazdoor (Skilled)	day	1.25	245.00	306.25	L-15
			b) Machinery					
			Mechanical broom @ 1250 sqm per hour	hour	0.06	276.00	16.56	P&M-031
			Air compressor 250 cfm	hour	0.06	257.00	15.42	P&M-001
			Mastic cooker 1 tonne capacity	hour	6.00	50.00	300.00	P&M-030
			Bitumen boiler 1500 litres capacity	hour	6.00	140.00	840.00	P&M-005
			Tractor for towing and positioning of mastic cooker and bitumen boiler	hour	1.00	280.00	280.00	P&M-053
			c) Material					
			Base mastic (without coarse aggregates) = 60 per cent					
			Coarse aggregate(3.35mm to 9.5 mm size) = 40 per cent .					
			Proportion of material required for mastic asphalt with coarse aggregates (based on mix design done by CRRI for a specific case)					
			i) Bitumen 80/100 or 60/70 or 30/40 @ 10.2 per cent by weight of mix. 2 x 10.2/100 = 0.204	tonne	0.204	43209.95	8814.83	M-074
			ii) Crusher stone dust @ 31.9 per cent by weight of mix = 2 x 31.9/100 = 0.638 tonnes = 0.638/1.625 = 0.39	cum	0.39	599.52	233.81	M-021
			iii) Lime stone dust filler with calcium carbonate content not less than 80 per cent by weight @ 17.92 per cent by weight of mix = 2 x 17.92/100 = 0.36	tonne	0.36	4055.00	1459.80	M-188
			iv) Coarse aggregates 9.5 mm to 3.35 mm size @ 40 per cent by weight of mix = 2 x 40/100 = 0.8 MT = 0.8/1.456 = 0.55	cum	0.55	774.52	425.99	M-051
			v) Pre-coated stone chips of 9.5 mm nominal size for skid resistance = 72.46x0.005/10 = 0.036	cum	0.036	774.52	27.88	M-142
			vi) Bitumen for coating of chips @ 2 per cent by weight = 0.036 x 1.456 x 2/100 = 0.001048MT = 1.05kg	kg	1.05	43.21	45.37	M-074/1000
			d) Overhead charges @ 20%				3119.13	
			e) Contractor's profit @ 10%				1871.48	
			Cost for 72.46 sqm				20586.27	
			Rate per sqm				284.11	
						say	*284.00*	
		Note	1.The rates for 6 mm or any other thickness may be worked out on pro-rata basis.					
			2. Where tack coat is required to be provided before laying mastic asphalt, the same is required to be measured and paid separately.					
			3.The quantities of binder, filler and aggregates are for estimating purpose. Exact quantities shall be as per mix design.					
			4.This rate analysis is based on design made by CRRI for a specific case and is meant for estimating purposes only. Actual design is required to be done for each case.					
			5.The quantity of bitumen works out 17 per cent of the mastic asphalt blocks without aggregates and falls within the standards laid down by MoRTH Specifications.					
14.6	2703, 1500, 1600 & 1700		Construction of precast RCC railing of M30 Grade, aggregate size not exceeding 12 mm, true to line and grade, tolerance of vertical RCC post not to exceed 1 in 500, centre to centre spacing between vertical post not to exceed 2000 mm, leaving adequate space between vertical post for expansion, complete as per approved drawings and technical specifications.					
			Unit = 1 RM					
			Taking output = 2 x 24 m span = 48 m					
			a) Material					
			Cement concreteM30 Grade Refer relevant item of concrete in Item 14.1(C) by using batching plant, excluding formwork i.e. per cum basic cost (a+b+c)	cum	4.09	4788.51	19594.58	Item 14.1(C)
			No. of vertical posts = (12 + 2)2 = 28 Nos., External area of vertical post 0.25x0.275 = 0.069sqm, Concrete in Vertical posts = 0.069 x 28 = 1.932 cum, Hand rail in 3 tiers = 3 x 24 = 72 m, External area = 0.170 x 0.175 = 0.03 sqm, Concrete in hand rails = 0.03 x 72 = 2.16 cum, Total Concrete = 1.932 + 2.16 = 4.092 cum. (Refer MoRTH SD / 202).					
			Add 5 per cent of above cost for form work for casting in casting yard.				979.73	
			HYSD bar reinforcement Rate as per item No 14.2(Excluding OH & CP)	tonne	0.87	54841.00	47437.47	Item 14.2 A
			Refer MoRTH SD / 202.					
			Add 5 per cent of (a) for handling and fixing of precast panels in position				3400.59	
			b) Overhead charges @ 20%				14282.47	
			c) Contractor's profit @ 10%				8569.48	
			Rate for 48 m				94264.31	
			Rate per metre				1963.84	
						say	*1964.00*	

		Note	1.Quantities of material have been adopted from standard plans of MoRTH vide drawing no. SD/202.					
			2.48 m length is the total linear length adding both sides of 24 m span.					
14.7	2703, 1500, 1600 & 1700		Construction of RCC railing of M30 Grade in-situ with 20 mm nominal size aggregate, true to line and grade, tolerance of vertical RCC post not to exceed 1 in 500, centre to centre spacing between vertical post not to exceed 2000 mm, leaving adequate space between vertical post for expansion, complete as per approved drawings and technical specifications.					
			Unit = 1 RM					
			Taking output = 2 x 24 m span = 48 m.					
			a) Material					
			Cement concreteM30 Grade Refer relevant item of concrete in Item 14.1(C) by using batching plant, excluding formwork i.e. per cum basic cost (a+b+c)	cum	4.092	4788.51	19594.58	Item 14.1(C)
			No. of vertical posts = (12 + 2)2 = 28 Nos., External area of vertical post 0.25x0.275 = 0.069sqm, Concrete in vehicle posts = 0.069 x 28 = 1.932 cum, Hand rail in 3 tiers = 3 x 24 = 72 m, External area = 0.170 x 0.175 = 0.03 sqm, Concrete in hand rails = 0.03 x 72 = 2.16 cum, Total Concrete = 1.932 + 2.16 = 4.092 cum. (Refer MoRTH SD / 202).					
			Add 12 per cent of above cost for form work.				2351.35	
			HYSD bar reinforcement Rate as per item No 14.2(Excluding OH & CP)	tonne	0.87	54841.00	47437.47	Item 14.2 A
			refer MoRTH SD / 202.					
			b) Overhead charges @ 20%				13876.68	
			c) Contractor's profit @ 10%				8326.01	
			Rate for 48 m				91586.08	
			Rate per metre				1908.04	
						say	*1908.00*	
		Note	1. Quantities of material have been adopted from standard plans of MoRTH vide drawing no. SD/202.					
			2. 48 m length is the total linear length adding both sides of 24 m span.					
14.8	2703.2 & 1900		Providing, fitting and fixing mild steel railing complete as per drawing and Technical Specification					
			Unit = 1 RM					
			Taking output = 2 x 50 m span = 100 m					
			a) Material:					
			1) ISMC 100 = 2.806 x 1.05 = 2.946 MT	tonne	2.95	38000.00	111948.00	M-179
			2) MS Flat = 0.964 x 1.05 = 1.012 MT	tonne	1.01	36000.00	36432.00	M-179
			3) MS bars = 0.17 x 1.05 = 0.180 MT	tonne	0.18	40000.00	7200.00	M-179
			4) MS bolts, nuts and washers	tonne	0.15	36000.00	5400.00	M-130*1000
			Add @ 5 per cent of cost of material for painting one shop coat with red oxide primer and three coats of synthetic enamel paint and consumables to safeguard against weathering and corrosion.				8049.00	
			Add for cost of concrete for fixing vertical posts in the performed recess @ 1 per cent of cost of				1609.80	
			Add for electricity charges, welding and drilling equipment, electrodes and other consumables @ 1 per cent of cost of material.				1609.80	
			b) Labour					
			Mate	day	2.80	275.00	770.00	L-12
			Mazdoor (Skilled)	day	30.00	245.00	7350.00	L-15
			Mazdoor	day	40.00	245.00	9800.00	L-13
			c) Overhead charges @ 20%				38033.72	
			d) Contractor's profit @ 10%				22820.23	
			Cost for 100 m steel railing				251022.55	
			Rate per metre				2510.23	
						say	*2510.00*	
14.9	2705		Drainage Spouts complete as per drawing and Technical specification					
			Unit = 1 No.					
			Taking output = 1 No.					
			a) Material					
			Corrosion resistant Structural steel including 5 per cent wastage	Kg	4.00	61.20	244.79	M-087/1000
			GI pipe 100mm dia	metre	0.60	540.00	324.00	M-056
			GI bolt 10 mm Dia	each	0.60	6.50	3.90	M-110
			Galvanised MS flat clamp	each	2.00	9.00	18.00	M-101
			b) Labour					
			For fabrication					
			Mate	day	0.02	275.00	5.50	L-12
			Skilled (Blacksmith, welder etc.)	day	0.02	245.00	4.90	L-02
			Mazdoor	day	0.02	245.00	4.90	L-13
			For fixing in position					
			Mate	day	0.01	275.00	2.75	L-12
			Mason	day	0.01	245.00	2.45	L-11
			Mazdoor	day	0.20	245.00	49.00	L-13
			Add @ 5 per cent of cost of material and labour for electrodes, cutting gas, sealant, anti-corrosive bituminous paint, mild steel grating etc.				33.01	
			c) Overhead charges @ 20%				138.64	
			d) Contractor's profit @ 10%				83.18	
			Rate per metre				915.03	
						say	*915.00*	
		Note	1. In case of viaducts in urban areas, the drainage spouts should be connected with suitably located pipelines to discharge the surface run-off to drains provided at ground level.					
			2. In case of bridges, sufficient length of G.I Pipe shall be provided to ensure that there is no splashing of water from the drainage spout on the structure.					
14.10	2700		PCC M15 Grade leveling course below approach slab complete as per drawing and Technical specification					
			Unit = 1 cum					
			Taking output = 1 cum					

			Material					
			Concrete, Rate as per item No. 12.8 (A) excluding formworks	cum	1.00	5690.00	5690.00	Item 12.8 (A)
			Rate per cum			say	5690.00	
14.11	1500,1600,1700 & 2704		Reinforced cement concrete approach slab including reinforcement and formwork complete as per drawing and Technical specification					
			Unit = 1 cum					
			Taking output = 1 cum					
			a) Material					
			Cement concreteM30 Grade Refer relevant item of concrete in item 12.8(G)by using batching plant, excluding formwork i.e. per cum basic cost (a+b+c) (Excluding OH & CP)	cum	1.00	4970.00	4970.00	Item 12.8 (G)
			(Refer relevant item of concrete in item No. 13.8 (G) except that form work may be added at the rate of 2 per cent of cost against 3.5 per cent provided in the foundation concrete.				99.40	
			HYSD bar reinforcement Rate as per item No 14.2(Excluding OH & CP)	tonne	0.05	49198.00	2459.90	Item 14.2 A
			b) Overhead charges @ 20%				1505.86	
			c) Contractor's profit @ 10%				903.52	
			Rate per cum				9938.68	
						say	9939.00	
		Note	The grade of reinforced cement concrete may be adopted as M30 for severe conditions and M25 for moderate conditions.					
14.12	1600		Providing anti-corrosive treatment to HYSD reinforcement with Fusion Bonded Epoxy Coating (FBEC)					
			Unit = 1 MT					
			Taking output = 1 MT					
			To be taken as per the prevailing market rates.					
		Note	Contractors generally do not have expertise for this item . The job is therefore, got done from specialised firms who have the expertise in the field of construction chemicals. The prevailing rate in the market is required to be ascertained from the market and added in the cost estimate. Detailed guidelines in this regard have been issued by MoRTH vide their circular no. RW/NH-34041/44/91-S&R dated 21.3.2000.					
14.13	1800 & 2300		Precast - pretensioned Girders					
			Providing, precasting, transportation and placing in position precast pretensioned concrete girders as per drawing and technical specifications					
			Unit = 1 cum					
			Taking output = 1 cum					
			Grade of concrete - M40					
			a) Material					
			Cement	tonne	0.47	7598.00	3571.06	M-081
			Coarse sand	cum	0.45	1184.68	533.11	M-004
			20 mm Aggregate	cum	0.54	974.52	526.24	M-053
			10 mm Aggregate	cum	0.36	774.52	278.83	M-051
			Admixture @ 0.4 per cent of cement	Kg	1.88	61.20	115.06	M-180
			HYSD steel .	tonne	0.10	49198.00	4919.80	M-082
			HT strand with 5 per cent as wastage and extra length for anchoring	tonne	0.06	63898.00	3833.88	M-119
			LDO for steam curing	Litre	37.00	55.00	2035.00	M-122
			Add consumables such as binding wire, foam, packing tape, shuttering oil, HDPE pipe for unbonding of strand, bolt & nuts etc @ 1 per cent of material cost				158.13	
			b) Labour					
			(i) Cutting, bending, making reinforcement cage, placing in position, binding etc. complete					
			Taking quantity of steel 100 Kg/cum of concrete including laps and wastage					
			Mate	day	0.06	275.00	16.50	L-12
			Mazdoor (Skilled)	day	0.35	245.00	85.75	L-15
			Mazdoor	day	1.40	245.00	343.00	L-13
			(ii) Cable cutting and threading in position including binding by insulation tape with HDPE pipes etc., prestessing and cutting of extra length of HT strand after de-stressing.					
			Taking quantity of HT strand 60 Kg/cum					
			Mate	day	0.02	275.00	5.50	L-12
			Mazdoor (Skilled)	day	0.14	245.00	34.30	L-15
			Mazdoor	day	0.50	245.00	122.50	L-13
			(iii) Erection and dismantling of shuttering					
			Taking shuttering area 10 sqm/cum of concrete					
			Mate	day	0.12	275.00	33.00	L-12
			Mazdoor (Skilled)	day	1.00	245.00	245.00	L-15
			Mazdoor	day	2.00	245.00	490.00	L-13
			(iv) Concreting by Batching plant and stationary concrete pump					
			Mate	day	0.03	275.00	8.25	L-12
			Mazdoor (Skilled)	day	0.05	245.00	12.25	L-15
			Mazdoor	day	0.60	245.00	147.00	L-13
			(v) Steam curing and manual curing					
			Mate	day	0.01	275.00	2.75	L-12
			Mazdoor	day	0.35	245.00	85.75	L-13
			(vi) Handling of precast girder, stacking in stockyard and again loading in trailor					
			Mate	day	0.01	275.00	2.75	L-12
			Mazdoor	day	0.25	245.00	61.25	L-13
			(vii) Placement of girders in position over pier caps including placement of sand jacks, channel, levelling etc.					
			Mate	day	0.01	275.00	2.75	L-12
			Mazdoor (Skilled)	day	0.06	245.00	14.70	L-15
			Mazdoor	day	0.24	245.00	58.80	L-13
			c) Machinery					
			i) At casting yard					
			Generator 100 KVA	hour	0.05	562.00	28.10	P&M-080

			Batching Plant @ 20 cum/hour	hour	0.05	1656.00	82.80	P&M-002
			Transit Mixer 4 cum capacity	hour	0.10	660.00	66.00	P&M-049
			Concrete Pump stationary	hour	0.05	173.00	8.65	P&M-007
			Crane 35 tonne capacity	hour	0.10	577.00	57.70	P&M-012
			Trailor 30 tonne capacity	hour	0.10	1000.00	100.00	P&M-089
			Loader	hour	0.05	624.00	31.20	P&M-017
			ii) For transportation and placement at site					
			Crane 35 tonne capacity	hour	0.15	577.00	86.55	P&M-012
			Trailer 30 tonne capacity for transporting to site.	tonne.km	2.5xL	1000.00	25000.00	Lead =10 km & P&M-090
			(L - Lead in Kilometer)					
			Trailor 30 tonne capacity during placement.	hour	0.15	1000.00	150.00	P&M-089
			Cost of formwork, steam curing arrangement, pretensioning arrangement etc @ 5 per cent of cost material, labour and machinery				905.87	
			d) Overhead charges @ 20%				8851.95	
			e) Contractor's profit @ 10%				5311.17	
			Rate per cum				58422.89	
						say	*58423.00*	
14.14	1700 & 1800		Providing and fixing Helical pipes in voided concrete slabs					
			Unit = 1 RM					
			Taking output = 1 RM					
			a) Material					
			Helical pipes 600mm diameter	metre	1.00	150.00	150.00	M-117
			Tie rods 20mm diameter	each	1.00	50.00	50.00	M-183
			Consumables for sealing joints etc.@ 5 per cent of cost of material				10.00	
			b) Labour					
			Mate	day	0.01	275.00	2.75	L-12
			Fitter	day	0.05	270.00	13.50	L-08
			Mazdoor	day	0.20	245.00	49.00	L-13
			c) Overhead charges @ 20%				55.05	
			d) Contractor's profit @ 10%				33.03	
			Rate per cum				363.33	
						say	*363.00*	
14.15	800		Crash Barriers					
			The rate analysis for rigid crash barrier in reinforced cement concrete, semi-rigid crash barrier with metal beam and flexible crash barrier with wire ropes have been made and included in chapter-8 on Traffic and Transportation.					
14.16	800		Painting on concrete surface					
			Providing and applying 2 coats of water based cement paint to unplastered concrete surface after cleaning the surface of dirt, dust, oil, grease, efflorescence and applying paint @ of 1 litre for 2 sqm.					
			Unit = sqm					
			Taking output = 10 sqm					
			a) Labour					
			Mate	day	0.01	275.00	2.75	L-12
			Painter	day	0.25	250.00	62.50	L-18
			Mazdoor (Skilled)	day	0.25	245.00	61.25	L-15
			b) Material					
			Water based paint of approved quality for cement concrete surface	Litres	5.00	65.00	325.00	M-190
			c) Overhead charges @ 20%				90.30	
			d) Contractor's profit @ 10%				54.18	
			Cost for 10 sqm				595.98	
			Rate per sqm				59.60	
						say	*60.00*	
14.17	2604		Burried Joint					
			Providing and laying a burried expansion joint, expansion gap being 20 mm, covered with 12 mm thick, 200 mm wide galvanised weldable structural steel plate as per IS: 2062, placed symmetrical to centre line of the joint, resting freely over the top surface of the deck concrete, welding of 8 mm dia. 100 mm long galvanised nails spaced 300 mm c/c along the centre line of the plate, all as specified in clause 2604.					
			Unit = Running meter					
			Taking output = 12 m					
			a) Labour					
			Mate	day	0.02	275.00	5.50	L-12
			Mazdoor	day	0.40	245.00	98.00	L-13
			Mazdoor (Skilled)	day	0.20	245.00	49.00	L-15
			b) Material					
			Galvanised M.S plate 200 mm wide,12 mm thick @ 94.20 kg/sqm including 5 per cent wastage	kg	237.50	46.00	10925.00	M-060/1000
			Add 1 per cent of cost of steel plate cutting, welding consumables and galvanised nails.				109.25	
			c) Overhead charges @ 20%				2237.35	
			d) Contractor's profit @ 10%				1342.41	
			Cost for 12 m				14766.51	
			Rate per m				1230.54	
						say	*1231.00*	
		Note	Guidelines laid down vide the MoRTH circular No. RW/NH-34059/1/96-S&R dated 30.11.2000 and subsequent corrigendum dated 25.01.2001 may be reffered for expansion joints.					
14.18	2605		Filler joint					
		(i)	Providing & fixing 2 mm thick corrugated copper plate in expansion joint complete as per drawing & Technical Specification.					
			Unit = Running meter					
			Taking output = 12 m					
			a) Labour					
			Cutting, bending, carrying & fixing etc.					
			Mate	day	0.04	275.00	11.00	L-12

			Mazdoor	day	0.50	245.00	122.50	L-13
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			b) Material					
			Copper plate - 12m long x 250 mm wide	kg	55.00	400.00	22000.00	M-086
			Area = 12 x 0.25 = 3 sqm					
			Weight = 3 x 0.002 x 8900 = 53.4 kg					
			Wastage @ 2.5 per cent = 1.33 kg/54.73 kg say = 55 kg.					
			c) Overhead charges @ 20%				4451.20	
			d) Contractor's profit @ 10%				2670.72	
			Cost for 12 m				29377.92	
			Rate per m				2448.16	
						say	*2448.00*	
14.18		(ii)	Providing & fixing 20 mm thick compressible fibre board in expansion joint complete as per drawing & Technical Specification.					
			Unit = Running meter					
			Taking output = 12 m					
			a) Labour					
			For carrying, placing & fixing.					
			Mate	day	0.008	275.00	2.20	L-12
			Mazdoor	day	0.10	245.00	24.50	L-13
			Mazdoor (Skilled)	day	0.10	245.00	24.50	L-15
			b) Material					
			20 mm thick compressible fibre board 12 m long x 30cm deep.	sqm	3.60	508.00	1828.80	M-084
			Area = 12 x 0.3 = 3.6 sqm					
			c) Overhead charges @ 20%				376.00	
			d) Contractor's profit @ 10%				225.60	
			Cost for 12 m				2481.60	
			Rate per m				206.80	
						say	*207.00*	
14.18		(iii)	Providing and fixing in position 20 mm thick premoulded joint filler in expansion joint for fixed ends of simply supported spans not exceeding 10 m to cater for a horizontal movement upto 20 mm, covered with sealant complete as per drawing and technical specifications.					
			Unit = Running meter					
			Taking output = 12 m					
			a) Labour					
			Mate	day	0.01	275.00	2.75	L-12
			Mazdoor	day	0.20	245.00	49.00	L-13
			Mazdoor (Skilled)	day	0.10	245.00	24.50	L-15
			b) Material					
			Premoulded joint filler 12 m long,20 mm thick and 300 mm deep.	sqm	3.60	591.60	2129.76	M-141
			c) Overhead charges @ 20%				441.20	
			d) Contractor's profit @ 10%				264.72	
			Cost for 12 m				2911.93	
			Rate per m				242.66	
						say	*243.00*	
14.18		(iv)	Providing and filling joint sealing compound as per drawings and technical specifications with coarse sand and 6 per cent bitumen by weight					
			Unit = Running meter					
			Taking output = 12 m					
			12m long x 100 mm wide x 10mm deep recess					
			a) Labour					
			Mate	day	0.02	275.00	5.50	L-12
			Mazdoor	day	0.50	245.00	122.50	L-13
			Mazdoor (Skilled)	day	0.10	245.00	24.50	L-15
			b) Material					
			Sand	cum	0.012	1184.68	14.22	M-005
			Volume 12 x 0.1 x 0.01 = 0.012 cum					
			Weight 0.012 x 1400 = 16.8kg					
			Bitumen	cum	0.001	43209.95	43.21	M-074
			16.8 x 0.06 = 1 kg					
			c) Overhead charges @ 20%				41.99	
			d) Contractor's profit @ 10%				25.19	
			Cost for 12 m				277.10	
			Rate per m				23.09	
						say	*23.00*	
		Note	For arriving at the final rate of filler joints per m					
			length and per cm depth of joint filling compound,					
			the rates at Sl. No. i), ii), iii) & iv) shall be added					
14.19	2600		Asphaltic Plug joint					
			Providing and laying of asphaltic plug joint to provide for horizontal movement of 25 mm and vertical movement of 2 mm, depth of joint varying from 75 mm to 100 mm, width varying from 500 mm to 750 mm (in traffic direction), covered with a closure plate of 200mm x 6mm of weldable structural steel conforming to IS: 2062, asphaltic plug to consist of polymer modified bitumen binder, carefully selected single size aggregate of 12.5 mm nominal size and a heat resistant foam caulking/backer rod, all as per approved drawings and specifications.					
			Unit = Running meter					
			Taking output = 12 m					
			a) Labour					
			Mate	day	0.052	275.00	14.30	L-12
			Mazdoor	day	1.00	245.00	245.00	L-13
			Mazdoor (Skilled)	day	0.30	245.00	73.50	L-15
			b) Material					
			Crushed stone aggregate 12.5 mm nominal size	cum	0.75	774.52	580.89	M-052
			Polymer modified bitumen	kg	77.50	31.53	2443.77	M-078/ 1000
		2.4	Galvanised structural steel plate 200 mm wide,6 mm thick, 12 m long (2.4 sqm) @ 47.10 kg/sqm including 5 per cent wastage	kg	113.00	45.00	5085.00	M-103

			Add 1 per cent for welding and foam caulking/backer rod and other incidentals.				84.42	
			c) Machinery					
			Mastic cooker 1 tonne capacity	hour	1.00	50.00	50.00	P&M-030
			Smooth 3-wheeled steel roller 8-10 capacity	hour	0.50	386.00	193.00	P&M-044
			d) Overhead charges @ 20%				1753.98	
			e) Contractor's profit @ 10%				1052.39	
			Cost for 12 m asphalt plug joint				11576.25	
			Rate per m				964.69	
						say	*965.00*	
		Note	The nominal size of aggregates shall be 12.5 mm for depth of joint upto 75 mm and 20 mm for joints of depth more than 75 mm.					
14.20	2606		Elastomeric Slab Steel Expansion Joint					
			Providing and laying of an elastomeric slab steel expansion joint, catering to right or skew (less than 20 deg., moderately curved with maximum horizontal movement upto 50 mm, complete as per approved drawings and standard specifications to be installed by the manufacturer/supplier or their authorised representative ensuring compliance to the manufacturer's instructions for installation and clause 2606 of MoRTH specifications for road & bridge works.					
			Unit = Running meter					
			Taking output = 12 m					
			a) Labour					
			Mate	day	0.06	275.00	16.50	L-12
			Mazdoor	day	1.00	245.00	245.00	L-13
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			b) Material					
			Supply of elastomeric slab seal expansion joint assembly manufactured by using chloroprene, elastomer for elastomeric slab unit conforming to clause 915.1 of IRC: 83 (part II), complete as per approved drawings and standard specification conforming to clause 2606 of MoRT&H Specification	metre	12.00	12000.00	144000.00	M-093
			Add 5 per cent of cost of material for anchorage reinforcement, welding and other incidentals.				7200.00	
			c) Overhead charges @ 20%				30316.80	
			d) Contractor's profit @ 10%				18190.08	
			Cost for 12 m				200090.88	
			Rate per m				16674.24	
						say	*16674.00*	
14.21	2600		Compression Seal Joint					
			Providing and laying of compression seal joint consisting of steel armoured nosing at two edges of the joint gap suitably anchored to the deck concrete and a preformed chloroprene elastomer or closed cell foam joint sealer compressed and fixed into the joint gap with special adhesive binder to cater for a horizontal movement upto 40 mm and vertical movement of 3 mm.					
			Unit = Running meter					
			Taking output = 12 m					
			a) Labour					
			Mate	day	0.036	275.00	9.90	L-12
			Mazdoor	day	0.60	245.00	147.00	L-13
			Mazdoor (Skilled)	day	0.30	245.00	73.50	L-15
			b) Material					
			1. Galvanised angle sections 100mm x 100mm of 12mm thickness weldable structural steel as per IS: 2062, 2 nos. of 12 m length each @ 17.7 kg/m and 5 per cent wastage.	kg	446.00	45.00	20070.00	M-103
			Add 5 per cent of cost of above for structural steel for anchorage, welding and other incidentals.				1015.02	
			Preformed continuous chloroprene elastomer or closed cell foam sealing element with high tear strength, vulcanised in a single operation for the full length of a joint to ensure water tightness.	metre	12.00	13000.00	156000.00	M-143
			Add 1 per cent of cost of sealing element for lubricant-cum-adhesive and other consumables.				1560.00	
			c) Overhead charges @ 20%				35775.08	
			d) Contractor's profit @ 10%				21465.05	
			Cost for 12 m				236115.55	
			Rate per m				19676.30	
						say	*19676.00*	
		Note	1. The installation shall be done by the manufacturer or his authorised representative to the satisfaction of the Engineer.					
			2. The concreting for joining the expansion joint assembly with the deck has not been included in this analysis as the same is catered in the quantities of RCC deck.					
			3. The anchoring bars of the expansion joint assembly shall be welded to the main reinforcement of the deck.					
14.22	2607		Strip Seal Expansion Joint					
			Providing and laying of a strip seal expansion joint catering to maximum horizontal movement upto 70 mm, complete as per approved drawings and standard specifications to be installed by the manufacturer/supplier or their authorised representative ensuring compliance to the manufacturer's instructions for installation.					
			Unit = Running meter					
			Taking output = 12 m					
			a) Labour					
			Mate	day	0.05	275.00	13.75	L-12
			Mazdoor	day	1.00	245.00	245.00	L-13
			Mazdoor (Skilled)	day	0.25	245.00	61.25	L-15
			b) Material					
			Supply of complete assembly of strip seal expansion joint comprising of edge beams, anchorage, strip seal element and complete accessories as per approved specifications and drawings.	metre	12.00	11500.00	138000.00	M-178
			Add 5 per cent of cost of material for anchorage reinforcement, welding and other incidentals.				6916.00	

			c) Overhead charges @ 20%				29047.20	
			d) Contractor's profit @ 10%				17428.32	
			Cost for 12 m				191711.52	
			Rate per m				15975.96	
						say	*15976.00*	
		Note	1. The installation shall be done by the manufacturer or his authorised representative to the satisfaction of the Engineer.					
			2. The concreting for joining the expansion joint assembly with the deck has not been included in this analysis as the same is catered in the quantities of RCC deck.					
14.23	2600		Modular Strip / Box Seal Joint					
			Providing and laying of a modular strip Box seal expansion joint including anchorage catering to a horizontal movement beyond 70 mm and upto 140mm, complete as per approved drawings and standard specifications to be installed by the manufacturer/supplier or their authorised representative ensuring compliance to the manufacturer's instructions for installation.					
			Unit = Running meter					
			Taking output = 12 m					
			a) Labour					
			Mate	day	0.056	275.00	15.40	L-12
			Mazdoor	day	1.00	245.00	245.00	L-13
			Mazdoor (Skilled)	day	0.40	245.00	98.00	L-15
			b) Material					
			Supply of a modular strip/box seal joint assembly comprising of edge beams, central beam,2 modules chloroprene seal, anchorage elements, support and control system, all steel sections protected against corrosion and installed by the manufacturer or his authorised representative.	metre	12.00	5400.00	64800.00	M-127
			c) Overhead charges @ 20%				13031.68	
			d) Contractor's profit @ 10%				7819.01	
			Cost for 12 m Modular strip/box seal joint				86009.09	
			Rate per m				7167.42	
						say	*7167.00*	
		Note	1. The installation shall be done by the manufacturer or his authorised representative to the satisfaction of the Engineer.					
			2. The concreting for joining the expansion joint assembly with the deck has not been included in this analysis as the same is catered in the quantities of RCC deck.					
			3. The anchoring bars of the expansion joint assembly shall be welded to the main reinforcement of the deck.					
14.24	2600		Modular Strip / Box Seal Joint					
			Providing and laying of a modular strip box seal expansion joint catering to a horizontal movement beyond 140mm and upto 210mm, complete as per approved drawings and standard specifications to be installed by the manufacturer/supplier or their authorised representative ensuring compliance to the manufacturer's instructions for installation.					
			Unit = Running meter					
			Taking output = 12 m					
			a) Labour					
			Mate	day	0.07	275.00	19.25	L-12
			Mazdoor	day	1.25	245.00	306.25	L-13
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			b) Material					
			Supply of a modular box/box seal joint assembly containing 3 modules/cells and comprising of edge beams, two central beams, chloroprene seal, anchorage elements, support and control system, all steel sections protected against corrosion and installed by the manufacturer or his authorised representative.	metre	12.00	6500.00	78000.00	M-128
			c) Overhead charges @ 20%				15689.60	
			d) Contractor's profit @ 10%				9413.76	
			Cost for 12 m Modular strip/box seal joint				103551.36	
			Rate per m				8629.28	
						say	*8629.00*	
		Note	1. The installation shall be done by the manufacturer or his authorised representative to the satisfaction of the Engineer.					
			2. The concreting for joining the expansion joint assembly with the deck has not been included in this analysis as the same is catered in the quantities of RCC deck.					
			3. The anchoring bars of the expansion joint assembly shall be welded to the main reinforcement of the deck.					

CHAPTER - 15								
RIVER TRAINING AND PROTECTION WORKS								
Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
15.1	2503		Providing and laying boulders apron on river bed for protection against scour with stone boulders weighing not less than 40 kg each complete as per drawing and Technical specification.					
		A	Boulder Laid Dry Without Wire Crates.					
			Unit = cum					
			Taking output = 1 cum					
			a) Material					
			Stone	cum	1.00	677.02	677.02	M-003
			Stone Spalls	cum	0.20	974.52	194.90	M-008
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mason	day	0.35	245.00	85.75	L-11
			Mazdoor *	day	0.75	245.00	183.75	L-13
			c) Overhead charges @ 10%				115.24	
			d) Contractor's profit @ 10%				126.77	
			Rate per cum				1394.43	
						say	*1394.00*	
		*	Including excavation for trimming for preparation of bed.					
		Note	Nominal excavation required for preparation of bed has been taken into account while making provision for labour.					
15.2	2503		Boulder Apron Laid in Wire Crates					
			Providing and laying of boulder apron laid in wire crates made with 4mm dia GI wire conforming to IS: 280 & IS:4826 in 100mm x 100mm mesh (weaved diagonally) including 10 per cent extra for laps and joints laid with stone boulders weighing not less than 40 kg each.					
			Unit = cum					
			Taking output = 3 mx1.5mx1.25m = 5.63 cum					
			a) Material					
			4mm GI wire crates woven in mesh size of 100 mm x 100 mm.	sqm	22.00	150.00	3300.00	M-102
			Stone	cum	5.63	799.52	4501.30	M-003
			Stone Spalls	cum	1.13	974.52	1101.21	M-008
			b) Labour					
			Mate	day	0.18	275.00	49.50	L-12
			Mazdoor (Skilled)	day	1.50	245.00	367.50	L-15
			Mazdoor	day	*3.00	245.00	735.0	L-13
			c) Overhead charges @ 10%				1005.5	
			d) Contractor's profit @ 10%				1106.00	
			Cost for 5.63 cum				12165.95	
			Rate per cum				2160.91	
						say	*2161.00*	
		*	Including excavation for trimming for preparation of bed.					
		Note	Readymade woven wire crate rolls have been considered in the rate analysis. In case readymade rolls are not available, GI wire 4mm dia. @ 32 kg per 10 sqm may be provided. In that case 2 per cent of the cost of GI wire may be added for weaving the wire crates.					
15.3	2503		Cement Concrete Blocks (size 0.5 x 0.5 x 0.5 m)					
			Providing and laying of apron with cement concrete blocks of size 0.5x0.5x0.5 m cast in-situ and made with nominal mix of M-15 grade cement concrete with a minimum cement content of 250 kg/cum as per IRC: 21-2000.					
			Unit = cum					
			Taking out put = 1 cum					
			Concrete Grade M15 Rate as per item No. 12.8 (A) including OH & CP	cum	1.00	5690.00	5690.00	Item 12.8 (A)
			Add 2 per cent of cost to account for excavation for preparation of bed, nominal surface reinforcement and filling of granular material in recesses between				113.80	
			Rate per cum				5803.80	
						say	*5804.00*	
15.4	2504		Providing and laying Pitching on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per drawing and Technical specifications					
		A	Stone/Boulder					
			Unit = cum					
			Taking output = 1 cum					
			a) Material					
			Stone weighing not less than 40kg	cum	1.00	677.02	677.02	M-003
			Stone spalls of minimum 25 mm size	cum	0.20	974.52	194.90	M-008
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mason	day	0.35	245.00	85.75	L-11
			Mazdoor	day	0.75	245.00	183.75	L-13
			c) Overhead charges @ 10%				115.24	
			d) Contractor's profit @ 10%				126.77	
			Rate per cum				1394.43	
						say	*1394.00*	
15.4		B	Cement Concrete Blocks of size 0.3x0.3 x0.3 m cast in cement concrete of Grade M15					
			Unit = cum					
			Taking output = 1 cum					
			Concrete Grade M15 Rate as per item No. 12.8 (A)	cum	1.00	5690.00	5690.00	Item 12.8 (A)
			Add 2 per cent of cost to account for nominal surface reinforcement and filling of granular material in recesses between blocks.				113.80	
			Rate per cum				5803.80	
						say	*5804.00*	
15.5	2504		Providing and laying Filter material underneath pitching in slopes complete as per drawing and Technical specification					
			Unit = cum					
			Taking output = 1 cum					
			a) Material					
			Graded stone aggregate of required size	cum	1.20	974.52	1169.42	M-012
			b) Labour					
			Mate	day	0.05	275.00	13.75	L-12
			Mazdoor (Skilled)	day	0.25	245.00	61.25	L-15
			Mazdoor *	day	1.00	245.00	245.00	L-13
			c) Overhead charges @ 10%				148.94	
			d) Contractor's profit @ 10%				163.84	
			Rate per cum				1802.20	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
						say	*1802.00*	
			Includes Mazdoor required for trimming of slope to proper profile and preparation of bed.					
15.6	700 & 2504		Geotextile Filter					
			Laying of a geotextile filter between pitching and embankment slopes on which pitching is laid to prevent escape of the embankment material through the voids of the stone pitching/cement concrete blocks as well as to allow free movement of water without creating any uplift head on the pitching.					
			Unit = sqm					
			Taking output = 10 sqm.					
			a) Labour					
			Mate	day	0.02	275.00	5.50	L-12
			Mazdoor	day	0.30	245.00	73.50	L-13
			Mazdoor (Skilled)	day	0.10	245.00	24.50	L-15
			b) Material					
			Permeable synthetic geotextile including 5 per cent for overlap and wastage	sqm	11.00	103.00	1133.00	M-181
			c) Overhead charges @ 10%				123.65	
			d) Contractor's profit @ 10%				136.02	
			Cost for 10 sqm				1496.17	
			Rate per sqm				149.62	
						say	*150.00*	
15.7	2504.4		Toe protection					
			A toe wall for toe protection can either be in dry rubble masonry in case of dry rubble pitching or pitching with stones in wire crates or it can be in PCC M15 nominal mix if cement concert block have been used for pitching . Rates for toe wall can be adopted from respective clauses depending upon approved design. The rate for excavation for foundation, dry rubble masonry and PCC M15 have been analysed and given in respective chapters.					
15.8	2505		Providing and laying Flooring complete as per drawing and Technical specifications laid over cement concert bedding.					
		A	Rubble stone laid in cement mortar 1:3					
			Unit = cum					
			Taking output = 1 cum					
			a) Cement mortor 1:3 (Rate as in Item 12.6 sub-analysis) excluding OH & CP	cum	0.33	5350.00	1765.50	Item 12.6 (A)
			b) Add for cement concrete bedding (M15 Nominal mix) vide Item 12.8 (A) excluding OH & CP . Quantity shall be adopted as per design (Assume Rubble stone Flooring thickness 300mm and cement concrete bedding thickness 100mm)	cum	0.33	5690.00	1877.70	Item 12.8 (A)
			Add 1 per cent of cost to account for excavation for preparation of bed.				36.43	
			c) Material					
			Stone	cum	1.00	799.52	799.52	M-003
			Stone Spalls	cum	0.20	974.52	194.90	M-008
			d) Labour					
			Mate	day	0.08	275.00	22.00	L-12
			Mason	day	0.50	245.00	122.50	L-11
			Mazdoor (for laying stones, filling of quarry spalls)	day	1.50	245.00	367.50	L-13
			c) Overhead charges @ 10%				327.19	
			d) Contractor's profit @ 10%				359.91	
			Rate per cum				5873.16	
						say	*5873.00*	
		*	Includes cement mortar for laying and filling of joints.					
15.8		B	Cement Concrete blocks Grade M15					
			Concrete Grade M15 block. (Rate as per item No. 12.8 (A) including OH & CP.	cum	1.00	5690.00	5690.00	Item 12.8 (A)
			Add for cement concrete bedding (M15 Nominal mix) vide Item 12.8 (A) including OH & CP. Quantity shall be adopted as per design (Assume Cement Concrete blocks thickness 300mm and cement concrete bedding thickness 100mm)	cum	0.33	5690.00	1877.70	Item 12.8 (A)
			Add 1 per cent of cost to account for excavation for preparation of bed.				75.68	
			Rate per cum				7643.38	
						say	*7643.00*	
15.9	2506		Dry Rubble Flooring					
			Construction of dry rubble flooring at cross drainage works for relatively less important works.					
			Unit = cum					
			Taking output = 1 cum					
			a) Material					
			Stone	cum	1.00	799.52	799.52	M-003
			Stone Spalls	cum	0.20	974.52	194.90	M-008
			b) Labour					
			Mate	day	0.10	275.00	27.50	L-12
			Mason	day	0.50	245.00	122.50	L-11
			mazdoor	day	1.50	245.00	367.50	L-13
			Add 1 per cent of (b) for trimming and preparation of base.				5.18	
			c) Overhead charges @ 10%				151.71	
			d) Contractor's profit @ 10%				166.88	
			Rate per cum				1835.69	
						say	*1836.00*	
15.10	2507.2		Curtain wall complete as per drawing and Technical specification					
		A	Stone masonry in cement mortar (1:3)					
			Coursed rubble masonry (1st sort)	cum	1.00	4521.00	4521.00	Item 12.7 (A)
			Rate same as per item No. 12.7 (A) including OH & CP					
			Rate per cum			*say*	*4521.00*	
			or					
15.10		B	Cement concrete Grade M15					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Concrete Grade M15 Rate as per item No. 12.8 (A) including OH & CP	cum	1.00	5690.00	5690.00	Item 12.8 (A)
			Rate per cum			say	5690.00	
		Note	Other items like excavation for foundation, filling behind wall, filter media, weep holes etc. shall be added separately as per approved design.					
15.11	2507.2		Flexible Apron :Construction of flexible apron 1 m thick comprising of loose stone boulders weighing not less than 40 kg beyond curtain wall.					
			Unit = cum					
			Taking Output = 1 cum					
			a) Material					
			Stone	cum	1.00	799.52	799.52	M-003
			Stone Spalls	cum	0.20	974.52	194.90	M-008
			b) Labour					
			Mate	day	0.05	275.00	13.75	L-12
			Mason	day	0.25	245.00	61.25	L-11
			Mazdoor	day	1.00	245.00	245.00	L-13
			Add 1 per cent of cost of (a+b) for trimming and preparation of bed.				13.14	
			c) Overhead charges @ 10%				132.76	
			d) Contractor's profit @ 10%				146.03	
			Rate per cum				1606.36	
						say	1606.00	
15.12	2503.3		Gabian Structure for Retaining Earth					
			Providing and construction of a gabian structure for retaining earth with segments of wire crates of size 7 m x 3 m x 0.6 m each divided into 1.5 m compartments by cross netting, made from 4 mm galvanised steel wire @ 32 kg per 10 sqm having minimum tensile strength of 300 Mpa conforming to IS:280 and galvanizing coating conforming to IS:4826, woven into mesh with double twist, mesh size not exceeding 100 x 100 mm, filled with boulders with least dimension of 200 mm, all loose ends to be tied with 4 mm galvanised steel wire.					
			Unit = cum					
			Taking output = 7 x 3 x 0.6 = 12.60 cum					
			a) Labour					
			Mate	day	0.28	275.00	77.00	L-12
			Mazdoor	day	5.00	245.00	1225.00	L-13
			Mazdoor (Skilled)	day	2.00	245.00	490.00	L-15
			b) Material					
			Galvanised steel wire crates of mesh size 100 mm x 100 mm woven with 4mm dia. GI wire in rolls of required size.	sqm	61.00	50.00	3050.00	M-102
			Stone boulders with least dimension of 200 mm	cum	12.60	799.52	10073.95	M-003
			Stone spalls of minimum size 25 mm	cum	2.52	974.52	2455.79	M-008
			c) Overhead charges @ 10%				1737.17	
			d) Contractor's profit @ 10%				1910.89	
			Cost for 12.60 cum				21019.81	
			Rate per cum				1668.24	
						say	1668.00	
		Note	Readymade woven wire crate rolls have been considered in the rate analysis. In case readymade rolls are not available, GI wire 4mm dia. @ 32 kg per 10 sqm may be provided. In that case 2 per cent of the cost of GI wire may be added for weaving the wire crates.					
15.13	2503.3		Gabian Structure for Erosion Control, River Training Works and Protection works					
			Providing and constructing gabian structures for erosion control, river training works and protection works with wire crates of size 2 m x 1 m x 0.3 m each divided into 1m compartments by cross netting, made from 4 mm galvanised steel wire @ 32 kg per 10 sqm having minimum tensile strength of 300 Mpa conforming to IS:280 and galvanizing coating conforming to IS:4826, woven into mesh with double twist, mesh size not exceeding 100 mm x 100 mm, filled with boulders with least dimension of 200 mm, all loose ends to be securely tied with 4 mm galvanised steel wire.					
			Unit = cum					
			Taking output = 2 x 1 x 0.3 x 10 Nos. = 6.00 cum					
			a) Labour					
			Mate	day	0.14	275.00	38.50	L-12
			Mazdoor	day	2.50	245.00	612.50	L-13
			Mazdoor (Skilled)	day	1.00	245.00	245.00	L-15
			b) Material					
			Galvanised steel wire crates of mesh size 100 mm x 100 mm woven with 4mm dia. GI wire in rolls of required size to cover 6.00 cum.	sqm	65.00	45.00	2925.00	M-102
			Stone boulders with least dimension of 200 mm	cum	6.00	799.52	4797.12	M-003
			Stone spalls of minimum size 25 mm	cum	1.20	974.52	1169.42	M-008
			c) Overhead charges @ 10%				978.75	
			d) Contractor's profit @ 10%				1076.63	
			Cost for 6.00 cum				11842.93	
			Rate per cum				1973.82	
						say	1974.00	
		Note	Readymade woven wire crate rolls have been considered in the rate analysis. In case readymade rolls are not available, GI wire 4mm dia. @ 32 kg per 10 sqm may be provided. In that case 2 per cent of the cost of GI wire may be added for weaving the wire crates.					

CHAPTER-16
REPAIR AND REHABILITATION

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
16.1	2809		Removal of existing cement concrete wearing coat including its disposal complete as per Technical Specification without causing any detrimental effect to any part of the bridge structure and removal of dismantled material with all lifts and lead upto 1000 m					
			Unit = Sq m (Thickness 75 mm)					
			Taking output = 10 sqm					
			a) Labour					
			Mate	day	0.06	275.00	16.50	L-12
			Mazdoor	day	1.00	245.00	245.00	L-13
			b) Machinery					
			Air Compressor 250 cfm with pneumatic breaker/jack hammer along with accessories.	hour	1.00	257.00	257.00	P&M-001
			Tractor-trolley.	hour	0.50	280.00	140.00	P&M-053
			c) Overhead charges @ 10%				65.85	
			d) Contractor's profit @ 10%				72.44	
			Cost for 10 sqm				796.79	
			Rate per sqm				79.68	
						say	*80.00*	
16.2	2809		Removal of existing asphaltic wearing coat comprising of 50 mm thick asphaltic concert laid over 12 mm thick mastic asphalt including disposal with all lift and lead upto 1000 m.					
			Unit = Sq m					
			Taking output = 10 sqm					
			a) Labour					
			Mate	day	0.03	275.00	8.25	L-12
			Mazdoor	day	0.75	245.00	183.75	L-13
			b) Machinery					
			Air Compressor 250 cfm with pneumatic breaker.	hour	0.75	257.00	192.75	P&M-001
			Tractor-trolley.	hour	0.40	280.00	112.00	P&M-053
			c) Overhead charges @ 10%				49.68	
			d) Contractor's profit @ 10%				54.64	
			Cost for 10 sqm				601.07	
			Rate per sqm				60.11	
						say	*60.00*	
16.3	2807		Guniting concrete surface with cement mortar applied with compressor after cleaning surface and spraying with epoxy complete as per Technical Specification					
			Unit = Sq m					
			Taking output = 1 sqm					
			Assuming thickness 25 mm					
			a) Material					
			Cement	kg	16.00	7.60	121.57	M-081/1000
			Graded sand	cum	0.04	1184.68	47.39	M-005
			Wire mesh 50mm x 50mm size of 3mm wire	kg	2.00	35.00	70.00	M-192
			Epoxy	kg	0.67	500.00	335.00	M-095
			Accelerator compound for guniting @ 4 per cent of weight of cement	kg	0.64	20.00	12.80	M-180
			Add 2 per cent of cost of material for miscellaneous consumables like nozzles, wire brush, cotton waste etc.				11.74	
			b) Labour					
			Mate	day	0.01	275.00	2.75	L-12
			Mason	day	0.04	245.00	9.80	L-11
			Mazdoor	day	0.14	245.00	34.30	L-13
			c) Machinery					
			Compressor with guniting equipment along with accessories	hour	0.10	257.00	25.70	P&M-076
			d) Overhead charges @ 10%				67.10	
			e) Contractor's profit @ 10%				73.81	
			Rate per sqm = (a+b+c+d+e)				811.96	
						say	*812.00*	
16.4	2800		Providing and inserting nipples with approved fixing compound after drilling holes for grouting as per Technical Specifications including subsequent cutting/removal and sealing of the hole as necessary of nipples after completion of grouting with Cement/Epoxy					
			Unit = Number					
			Taking output = 1 No.					
			a) Material					
			Nipples	each	1.00	10.00	10.00	M-129
			Cement, fixing compound and consumables @ 15 per cent of cost of nipple				1.50	
			b) Labour					
			Mate	day	0.01	275.00	2.75	L-12
			Mazdoor (Skilled) labour for drilling	day	0.08	245.00	19.60	L-15
			Mazdoor (Skilled) labour for fixing nipple and sealing inlets	day	0.08	245.00	19.60	L-15
			Mazdoor for cutting and removing of nipples	day	0.04	245.00	9.80	L-13
			Add 10 per cent of labour cost for drilling holes etc				5.18	
			c) Overhead charges @ 10%				6.84	
			d) Contractor's profit @ 10%				7.53	
			Rate per No				82.79	
						say	*83.00*	
16.5	2806		Sealing of cracks/porous concrete by injection process through nipples/Grouting complete as per Technical Specification.					
		A	Cement Grout					
			Unit = kg					
			Taking output = 1 kg					
			a) Material					
			Cement including 10 per cent wastage	kg	1.10	7.60	8.36	M-081/1000
			Admixtures (anti shrinkage compound) @ 20 per cent of cost of cement				1.67	
			b) Labour					
			Mate	day	0.08	275.00	22.00	L-12
			Mazdoor (Skilled)	day	0.10	245.00	24.50	L-15
			Mazdoor	day	0.10	245.00	24.50	L-13
			c) Machinery					
			Grout pump with agitator and accessories	hour	0.10	800.00	80.00	M-111
			c) Overhead charges @ 10%				16.10	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			d) Contractor's profit @ 10%				17.71	
			Rate per kg				113.82	
						say	114.00	
		B	Cement Mortar (1:1) Grouting					
			Unit = kg					
			Taking output = 1 kg					
			a) Material					
			Cement including 10 per cent wastage	kg	0.55	7.60	4.18	M-081/1000
			Sand including 10 per cent wastage	kg	0.55	0.79	0.43	M-005/1500
			Admixtures (anti shrinkage compound) @ 20 per cent of cost of cement				0.84	
			b) Labour					
			Mate	day	0.08	275.00	22.00	L-12
			Mazdoor (Skilled)	day	0.10	245.00	24.50	L-15
			Mazdoor	day	0.10	245.00	24.50	L-13
			c) Machinery					
			Grout pump with agitator and accessories	hour	0.10	800.00	80.00	M-111
			d) Overhead charges @ 10%				15.64	
			e) Contractor's profit @ 10%				17.21	
			Rate per kg				189.30	
						say	189.00	
16.6	2800		Patching of damaged concrete surface with polymer concrete and curing compounds, initiator and promoter, available in present formulations, to be applied as per instructions of manufacturer and as approved by the Engineer.					
			Unit = sqm					
			Taking output = 10 sqm for an average thickness of 25mm.					
			a) Labour					
			Mate	day	0.06	275.00	16.50	L-12
			Mazdoor (Skilled)	day	0.75	245.00	183.75	L-15
			Mazdoor	day	0.75	245.00	183.75	L-13
			b) Material					
			Pre-packed polymer concrete based on epoxy system complete with curing compound, intiator and promoter including 5 per cent wastage.	kg	315.00	10.00	3150.00	M-145
			c) Machinery					
			Grout pump with agitator and accessories	hour	2.00	800.00	1600.00	M-111
			d) Overhead charges @ 10%				513.40	
			e) Contractor's profit @ 10%				564.74	
			Cost for 10 sqm				6212.14	
			Rate per sqm				621.21	
						say	621.00	
		Note	This item is a proprietory item available in market as pre-packed polymer concrete and is required to be applied as per instructions of the manufacturer.					
16.7	2803		Sealing of crack / porous concrete with Epoxy Grout by injection through nipples complete as per clause 2803.1.					
			Unit = kg					
			Taking output = 1 kg					
			a) Material					
			Epoxy including 10 per cent wastage	kg	1.10	500.00	550.00	M-095
			b) Labour					
			Mate	day	0.08	275.00	22.00	L-12
			Mazdoor (Skilled)	day	0.10	245.00	24.50	L-15
			Mazdoor	day	0.10	245.00	24.50	L-13
			c) Machinery					
			Epoxy Injection gun	hour	0.10	150.00	15.00	P&M-078
			d) Overhead charges @ 10%				63.60	
			e) Contractor's profit @ 10%				69.96	
			Rate per kg				769.56	
						say	770.00	
16.8	2804		Applying epoxy mortar over leached, honey combed and spalled concrete surface and exposed steel reinforcement complete as per Technical Specification					
			Unit = sqm					
			Taking output = 10 sqm					
			Assume average 10mm thickness of epoxy mortar					
			a) Material					
			Epoxy resin-hardener mix for prime coat	kg	2.50	500.00	1250.00	M-098
			Epoxy mortar	kg	2.20	250.00	550.00	M-096
			Epoxy resin -hardener mix for seal coat.	kg	2.00	500.00	1000.00	M-098
			Add 3 per cent cost of material for other consumables like acetone etc and to cover wastage.				84.00	
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			Mazdoor	day	0.50	245.00	122.50	L-13
			c) Overhead charges @ 10%				314.00	
			d) Contractor's profit @ 10%				345.40	
			Cost for 10 sqm				3799.40	
			Rate per sqm				379.94	
						say	380.00	
16.9	2807		Removal of defective concrete, cleaning the surface thoroughly, applying the shotcrete mixture mechanically with compressed air under pressure, comprising of cement, sand, coarse aggregates, water and quick setting compound in the proportion as per clause 2807.1., sand and coarse aggregates conforming to IS: 383 and table 1 of IS: 9012 respectively, water cement ratio ranging from 0.35 to 0.50, density of gunite not less than 2000 kg/cum, strength not less than 25 Mpa and workmanship conforming to clause 2807.6.					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			unit: sqm					
			Taking output = 10 sqm, 40 mm average thickness.					
			a) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mazdoor	day	0.50	245.00	122.50	L-13
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			b) Machinery					
			Air compressor 250 cfm	hour	1.00	257.00	257.00	P&M-001
			Shotcreteing equipment	hour	1.00	100.00	100.00	P&M-076
			water tanker 6 KL capacity	hour	0.02	374.00	7.48	P&M-060
			c) Material					
			Cement	kg	120.00	7.60	911.76	M-081/1000
			Sand	cum	0.15	1184.68	177.70	M-005
			Coarse aggregate of size 4.75mm	cum	0.15	774.52	116.18	M-024
			Quick setting compound	kg	2.50	30.00	75.00	M-147
			Water	KL	0.10	30.00	3.00	M-189
			d) Overhead charges @ 10%				190.41	
			e) Contractor's profit @ 10%				209.45	
			Cost for 10 sqm				2303.99	
			Rate per sqm				230.40	
						say	*230.00*	
16.10	2800		Applying pre-packed cement based polymer mortar of strength 45 Mpa at 28 days for replacement of spalled concrete					
			Unit = sqm					
			Taking output = 10 sqm					
			Assumed thickness - 10 mm					
			a) Material					
			Acrylic polymer bonding coat	Litre	1.40	1000.00	1400.00	M-057
			pre-packed cement based polymer mortar of strength 45 Mpa at 28 days	kg	12.00	200.00	2400.00	M-145
			Add 3 per cent of (a) above for wastage.				114.00	
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			Mazdoor	day	0.50	245.00	122.50	L-13
			c) Overhead charges @ 10%				417.00	
			d) Contractor's profit @ 10%				458.70	
			Cost for 10 sqm				5045.70	
			Rate per sqm				504.57	
						say	*505.00*	
16.11	2805		Eproxy bonding of new concrete to old concrete					
			Unit = sqm					
			Taking output = 10 sqm					
			a) Material					
			Epoxy resin with pot life not less than 60-90 minutes and satisfying testing as per clause 2803.9	kg	8.00	500.00	4000.00	M-098
			Add 3 per cent of (a) above for wastage.				120.00	
			b) Labour					
			Mate	day	0.04	275.00	11.00	L-12
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			Mazdoor	day	0.50	245.00	122.50	L-13
			c) Overhead charges @ 10%				437.60	
			d) Contractor's profit @ 10%				481.36	
			Cost for 10 sqm				5294.96	
			Rate per sqm				529.50	
						say	*529.00*	
16.12	2810		Providing external prestressing with high tensile steel wires/strands including drilling for passage of prestessing steel, all accessories for stressing and stressing operation and grouting complete as per drawing and Technical Specification					
			Span assumed: 25 m					
			No. of cables: 4 no.					
			No. of anchorages : 8 no.					
			Unit = MT					
			Taking output = 1 MT					
			Assume 12.7mm dia. Strand in 12T13 system. Weight-9.42 kg/m of cable.					
			a) Material					
			HTS strand including 5 per cent wastage and extra length for jacking	tonne	1.05	63898.00	67092.90	M-119
			HDPE pipes 75mm dia including 5 per cent wastage	metre	112.00	153.00	17136.00	M-114
			Cement for grouting	kg	400.00	7.60	3039.20	M-081/1000
			Tube anchorage set complete with bearing plate, permanent wedges etc	each	8.00	12000.00	96000.00	M-187
			Epoxy	kg	6.00	500.00	3000.00	M-095
			MS plates for deviator (where deviator blocks are not provided)	tonne	2.10	40000.00	84000.00	M-179
			Add 20 per cent cost of material for other materials like lead sheet, sleeves, deviator fixtures etc.				54053.62	
			b) Labour					
			i) For making holes in the structure .					
			Mate	day	0.24	275.00	66.00	L-12
			Mazdoor Semi-skilled)	day	3.00	245.00	735.00	L-14
			Mazdoor	day	3.00	245.00	735.00	L-13
			ii) For making and fixing anchorages for cables and placement of cables .					
			Mate	day	0.44	275.00	121.00	L-12
			Blacksmith	day	3.00	245.00	735.00	L-02
			Mazdoor	day	8.00	245.00	1960.00	L-13
			iii) For prestressing					
			Mate/Supervisor	day	0.13	275.00	35.75	L-12
			Fitter	day	0.70	270.00	189.00	L-08
			Mazdoor	day	2.65	245.00	649.25	L-13

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			iv) For grouting					
			Mate/Supervisor	day	0.13	275.00	35.75	L-12
			Mason	day	0.70	245.00	171.50	L-11
			Mazdoor	day	2.65	245.00	649.25	L-13
			c) Machinery					
			Stressing jack with pump	hour	4.00	150.00	600.00	P&M-040
			Grouting pump with agitator	hour	1.35	800.00	1080.00	M-111
			d) Overhead charges @ 10%				33208.42	
			e) Contractor's profit @ 10%				36529.26	
			Rate per MT				401821.91	
						say	*401822.00*	
16.13	2810		Providing external prestressing with high tensile steel wires/strands including drilling for passage of prestessing steel, all accessories for stressing and stressing operation and grouting complete as per drawing and Technical Specification					
			Span assumed: 50 m					
			No. of cables: 4 no.					
			No. of anchorages : 8 no.					
			Unit = MT					
			Taking output = 3.10 MT					
			Assume 12.7mm dia. Strand in 19T13 system. Weight-14.73 kg/m of cable.					
			a) Material					
			HTS strand including 5 per cent wastage and extra length for jacking	tonne	3.10	63898.00	198083.80	M-119
			HDPE pipes 90mm dia including 5 per cent wastage	metre	224.00	153.00	34272.00	M-115
			Cement for grouting	tonne	1.01	7598.00	7673.98	M-081
			Tube anchorage set complete with bearing plate, permanent wedges etc	each	8.00	12000.00	96000.00	M-187
			Epoxy	kg	10.00	500.00	5000.00	M-095
			MS plates for deviator (where deviator blocks are not provided)	tonne	7.00	40000.00	280000.00	M-179
			Add 20 per cent cost of material for other materials like lead sheet, sleeves, deviator fixtures etc.				124205.96	
			b) Labour					
			i) For making holes in the structure .					
			Mate	day	0.08	275.00	22.00	L-12
			Mazdoor Semi-skilled)	day	8.00	245.00	1960.00	L-14
			Mazdoor	day	8.00	245.00	1960.00	L-13
			ii) For making and fixing anchorages for cables and placement of cables .					
			Mate	day	1.28	275.00	352.00	L-12
			Blacksmith	day	7.00	245.00	1715.00	L-02
			Mazdoor	day	25.00	245.00	6125.00	L-13
			iii) For prestressing					
			Mate/Supervisor	day	0.20	275.00	55.00	L-12
			Fitter	day	1.00	270.00	270.00	L-08
			Mazdoor	day	4.00	245.00	980.00	L-13
			iv) For grouting					
			Mate/Supervisor	day	0.26	275.00	71.50	L-12
			Mason	day	1.50	245.00	367.50	L-11
			Mazdoor	day	5.00	245.00	1225.00	L-13
			c) Machinery					
			Stressing jack with pump	hour	7.00	150.00	1050.00	P&M-040
			Grouting pump with agitator	hour	3.00	800.00	2400.00	M-111
			d) Overhead charges @ 10%				76378.87	
			e) Contractor's profit @ 10%				84016.76	
			Cost for 3.10 MT				924184.37	
			Rate per MT				298123.99	
						say	*298124.00*	
16.14	2810		Providing external prestressing with high tensile steel wires/strands including drilling for passage of prestessing steel, all accessories for stressing and stressing operation and grouting complete as per drawing and Technical Specification					
			Span assumed: 100 m					
			No. of cables: 6 no.					
			No. of anchorages : 12 no.					
			Unit = MT					
			Taking output = 9.28 MT					
			Assume 12.7mm dia. Strand in 19T13 system. Weight-14.73 kg/m of cable.					
			a) Material					
			HTS strand including 5 per cent wastage and extra length for jacking	tonne	9.28	63898.00	592973.44	M-119
			HDPE pipes 90 mm dia including 5 per cent	metre	672.00	153.00	102816.00	M-115
			Cement for grouting	tonne	3.04	7598.00	23097.92	M-081
			Tube anchorage set complete with bearing plate, permanent wedges etc	each	12.00	12000.00	144000.00	M-187
			Epoxy	kg	14.00	500.00	7000.00	M-095
			MS plates for deviator (where deviator blocks are not provided)	tonne	20.00	40000.00	800000.00	M-179
			Add 20 per cent cost of material for other materials like lead sheet, sleeves, deviator fixtures etc.				333977.47	
			b) Labour					
			i) For making holes in the structure .					
			Mate	day	1.72	275.00	473.00	L-12
			Mazdoor Semi-skilled)	day	18.00	245.00	4410.00	L-14
			Mazdoor	day	25.00	245.00	6125.00	L-13
			ii) For making and fixing anchorages for cables and placement of cables .					
			Mate	day	4.00	275.00	1100.00	L-12
			Blacksmith	day	20.00	245.00	4900.00	L-02
			Mazdoor	day	80.00	245.00	19600.00	L-13
			iii) For prestressing					
			Mate/Supervisor	day	0.30	275.00	82.50	L-12
			Fitter	day	1.50	270.00	405.00	L-08

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Mazdoor	day	6.00	245.00	1470.00	L-13
			iv) For grouting					
			Mate/Supervisor	day	1.00	275.00	275.00	L-12
			Mason	day	5.00	245.00	1225.00	L-11
			Mazdoor	day	20.00	245.00	4900.00	L-13
			c) Machinery					
			Stressing jack with pump	hour	10.00	150.00	1500.00	P&M-040
			Grouting pump with agitator	hour	10.00	800.00	8000.00	M-111
			d) Overhead charges @ 10%				205833.03	
			e) Contractor's profit @ 10%				226416.34	
			Cost for 9.28 MT				2490579.70	
			Rate per MT				254140.79	
						say	254141.00	
16.15	2808		Replacement of Bearings complete as per Technical Specification					
			Unit = No					
			Taking output = 3 No.					
			Lifting of superstructure span by jacking up from below i.e. by placing the jacks on pier/abutment caps for span length of 30m.					
			a) Lifting of span					
			i) Hire charges for jack of 40 tonne lifting capacity.	Day	3.00	300.00	900.00	P&M-084
			Mate	day	0.64	275.00	176.00	L-12
			Mazdoor (Skilled)	day	4.00	245.00	980.00	L-15
			Mazdoor	day	12.00	245.00	2940.00	L-13
			v) Wooden packing	cum	0.15	12000.00	1800.00	M-195
			b) Replacement of bearing					
			Cost of bearing.	each	3.00	8000.00	24000.00	M-065
			c) Overhead charges @ 10%				3079.60	
			d) Contractor's profit @ 10%				3387.56	
			Cost of repair of 3 bearings				37263.16	
			Rate of repair per bearing				12421.05	
						say	12421.00	
	Note		The work entails replacement of all the bearings on one side of the span.					
16.16	2808		Rectification of Bearings as per Technical Specifications					
			Unit = 1 No					
			Taking output = 3 No.					
			a) Lifting of superstructure span by jacking up from below i.e. by placing the jacks on pier/abutment caps for span length of 30m.					
			i) Hire charges for jack of 40 tonne lifting capacity.	each	3.00	300.00	900.00	P&M-084
			ii) Mate	day	0.64	275.00	176.00	L-12
			iii) Mazdoor (Skilled)	day	4.00	275.00	1100.00	L-15
			iv) Mazdoor	day	12.00	245.00	2940.00	L-13
			v) Wooden packing	cum	0.15	12000.00	1800.00	M-195
			b) Cost of parts to be replaced for 3 bearings.	each	3.00	3500.00	10500.00	M-064
			c) Overhead charges @ 10%				1741.60	
			d) Contractor's profit @ 10%				1915.76	
			Cost of repair of 3 bearings				21073.36	
			Rate of repair per bearing				7024.45	
						say	7024.00	
		Note	The rectification of 3 bearings included in this analysis are on the same side of the span.					
16.17			Replacement of Expansion Joints complete as per drawings					
			Unit -1 RM					
			Taking output = 12 RM					
			a) Material					
			Epoxy for bonding new concrete to old concrete @ 0.8 kg/sqm	kg	9.60	500.00	4800.00	M-095
			M-30 grade cement concrete excluding OH & CP (Rate as per items 14.1 C (i)	cum	3.60	7899.00	28436.40	Item 14.1(C)
			b) Labour					
			Removal of old expansion joint including breaking of concrete, cutting of lugs and shifting of broken material etc.					
			Mate	day	0.26	275.00	71.50	L-12
			Mazdoor	day	6.00	245.00	1470.00	L-13
			Mazdoor (Skilled)	day	0.50	245.00	122.50	L-15
			c) Overhead charges @ 10%				3490.04	
			d) Contractor's profit @ 10%				3839.04	
			Cost for replacement of 12 RM				42229.48	
			Rate per RM				3519.12	
						say	3519.00	
		Note	The rate for the installation of new expansion joints may be taken from the chapter on superstructure. Broken concrete will have to be replaced which has been included in this analysis.					
16.18			Replacement of Damaged Concrete Railing.					
			Unit = RM					
			Taking output = 10 RM					
			a) Labour					
			Labour for dismantling old railing and disposal of dismantled material.					
			Mate	day	0.20	275.00	55.00	L-12
			Mazdoor	day	5.00	245.00	1225.00	L-13
			b) Machinery					
			Tractor-trolley for disposal of dismantled material	hour	1.00	280.00	280.00	P&M-053
			c) Overhead charges @ 10%				156.00	
			d) Contractor's profit @ 10%				171.60	
			Cost for 10 m				1887.60	
			Rate per metre				188.76	
						say	189.00	
		Note	The rate for the provision of new railing may be adopted from the chapter on superstructure.					
16.19			Replacement of Crash Barrier.					
			Unit = RM					

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
			Taking output = 10 M					
			a) Labour					
			Labour for dismantling old railing and disposal of dismantled material.					
			Mate	day	0.40	275.00	110.00	L-12
			Mazdoor	day	10.00	245.00	2450.00	L-13
			b) Machinery					
			Tractor-trolley for disposal of dismantled material	hour	1.00	280.00	280.00	P&M-053
			c) Overhead charges @ 10%				284.00	
			d) Contractor's profit @ 10%				312.40	
			Cost for 10 m				3436.40	
			Rate per metre				343.64	
						say	*344.00*	
		Note	The rate for the construction of new crash barrier may be adopted from chapter 8 on Traffic and Transportation.					
16.20			Replacement of Damaged Mild Steel Railing					
			Unit = RM					
			Taking output = 10 M					
			a) Labour					
			Labour for dismantling old railing and disposal of dismantled material.					
			Mate	day	0.16	275.00	44.00	L-12
			Mazdoor	day	4.00	245.00	980.00	L-13
			b) Machinery					
			Tractor-trolley for disposal of dismantled material	hour	1.00	280.00	280.00	P&M-053
			c) Overhead charges @ 10%				130.40	
			d) Contractor's profit @ 10%				143.44	
			Cost for 10 m				1577.84	
			Rate per metre				157.78	
						say	*158.00*	
16.21			Repair of Crash Barrier					
			Repair of concrete crash barrier with cement concert of M-30 grade by cutting and trimming the damaged portion to a regular shape, cleaning the area to be repaired thoroughly, applying cement concert after erection of proper form work.					
			Unit = Running meter.					
			Taking output = 10 M.					
			It is assumed that damage is to the extent of 10 per cent of the volume of concrete .This will require 0.30 cum of concrete.					
			a) Manpower*					
			Mate	day	0.04	275.00	11.00	L-12
			Mazdoor	day	1.00	245.00	245.00	L-13
		*	For dismantling and trimming the surface to a regular shape and removal of damaged material.					
			b) Material					
			M-30 grade cement concrete excluding OH & CP (Rate as per items 14.1 C (i)	cum	0.30	7899.00	2369.70	Item 14.1(C)
			This may be priced based on the rate given the chapter of superstructure.					
			c) Overhead charges @ 10%				25.60	
			d) Contractor's profit @ 10%				28.16	
			Cost for 10 m				2679.46	
			Rate per m				267.95	
						say	*268.00*	
16.22			Repair of RCC Railing					
			Carrying out repair of RCC M30 railing to bring it to the original shape.					
			Unit = Running meter.					
			Taking output = 10 M.					
			It is assumed that damage is to the extent of 10 per cent .					
			a) Material					
			M-30 grade cement concrete excluding OH & CP (Rate as per items 14.1 C (i)	cum	0.10	7899.00	789.90	Item 14.1(C)
			HYSD bar reinforcement Rate as per item No 14.2(Excluding OH & CP)	tonne	0.01	72389.00	941.06	Item 14.2 A
			b) Labour*					
			Mate	day	0.016	275.00	4.40	L-12
			mazdoor	day	0.20	245.00	49.00	L-13
		*	For dismantling and trimming the surface to a regular shape and removal of damaged material.					
			c) Overhead charges @ 10%				5.34	
			d) Contractor's profit @ 10%				5.87	
			Cost for 10 m				1795.57	
			Rate per m				179.56	
						say	*180.00*	
16.23			Repair of Steel Railing					
			Repair of steel railing to bring it to the original shape					
			It is assumed that the damage to the steel railing is to the extent of 10 per cent .					
			Unit = Running meter.					
			Taking output = 10 M.					
			a) Material					
			Mild steel ISMC series	kg	29.00	47.20	1368.74	M-179/1000
			Flat iron	kg	10.00	51.20	511.98	M-179/1000
			MS Bolt and nuts	kg	1.00	37.00	37.00	M-130
			Add 5 per cent of cost of material for painting.				95.89	
			b) Labour					
			Mate	day	0.016	275.00	4.40	L-12
			Mazdoor (Skilled)	day	0.20	245.00	49.00	L-15
			Mazdoor	day	0.20	245.00	49.00	L-13
			c) Overhead charges @ 10%				211.60	
			d) Contractor's profit @ 10%				232.76	
			Cost of repair for10m				2560.37	
			Cost of meter				256.04	

Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
						say	*256.00*	

NON COVERED ITEMS IN MoRTH DATA

S.No.	Description	Details	Unit	Qty.	Rate /Code	Cost (Rs)
1.00	2.00	3.00	4.00	5.000		
17.01	Provide Concrete Kerb-Type I for median and directional island in accordance with drawings and Technical Specification Clause 408					
	Details of cost for Type I		10.00	m		
	Excavation		m3	0.563	140.00	78.75
	M-15 concrete for foundation		m3		5,690.00	-
	M20 concrete for pre cast kerb		m3	0.381	6,218.00	2,370.61
	carriage and fixing extra centring		LS			237.06
		Grand Total				2,686.42
		Rate per m				**268.64**
17.02	Provide Concrete Kerb-Type II for Carriage Way in accordance with drawings and Technical Specification Clause 408					
	Details of cost for Type I		10.00	m		
	Excavation		m3	0.263	140.00	36.75
	M-30 concrete		m3	0.238	6,824.00	1,620.70
	carriage and fixing extra centring		%	0.200		324.14
		Grand Total				1,981.59
		Rate per m				**198.16**
17.03	RCC Marker posts for Burried Culverts as per tech Spec cl. 800					
	Detail of cost of		1.00	No.		
	Excavation	0.4x0.4x0.5	m3	0.080	140.00	11.20
	RCC M20	0.4x0.4x1	m3	0.160	6,218.00	994.88
	Steel	10dia=4x1.1	T	0.007	71284.00	498.99
	Painting	4x0.4x0.5	m2	0.080	64.00	5.12
		Total				1,510.19
		Rate per each post				**1,510.19**
17.04	RCC Guard Posts (precast) as per Drg No U/T/6/10					
	Detail of cost of		1.00	No		
	Excavation		m3	0.091	140.00	12.76
	PCC M15		m3	0.079	5,690.00	449.51
	RCC M20 Post (precast)		m3	0.036	6,218.00	223.85
	Steel bars		T	0.005	71284.00	335.03
	Enamel Painting		m2	0.360	64.00	23.04
		G Total				1,044.19
		Rate per each				1,044.19
17.05	Un-Coursed Rubble stone masonry in cement morter 1:6 in foundations and sub structures as per Tech. Spec.					
	Detail of cost of		5.00	m3		
	Material					
	Stone boulders		m3	5.000	677.02	3,385.10
	Bond stones		each	35.000	13.69136	479.20
	Cement Mortar 1:6		cum	1.550	4004.00	6,206.20
	Labour					-
	mate		each	0.500	275	137.50
	Mason		each	6.000	245	1,470.00
	Majdoor		each	6.000	245	1,470.00
		Over head	%	10.000		1,314.80
		CP	%	10.000		1,446.28
		G Total				**15,909.08**
		Rate per cum				**3,181.82**
17.06	Provide and lay 150mm dia PVC pipe under footpath as service pipe as per Tech spec.					
	Detail of cost of	12m length of pipe				
	Materials					
	PVC 150mm dia pipe with coller		m	12.000	264	3,168.00
	Labour					
	Plumber		each	0.100	275	27.50
	Mazdoor		each	0.200	245	49.00
		Over head	%	10.000		324.45
		CP	%	10.000		356.90
		G Total				**3,925.85**
		Rate per m				**327.15**
17.07	Provide and fix Tar paper bearing after smoothening the surface with grinding stone as per Drawings and Tech Spec.					
	Detail of cost of		10.00	m2		
	Material					
	Tar paper		m2	10.000	91.6	916.00
	Grinding stone		No	0.500	316	158.00
	Labour					-
	Skilled mazdoor		each	1.000	275	275.00
	Mazdoor		each	0.500	245	122.50
		Over head	%	20.000		294.30
		CP	%	10.000		176.58
		G Total				**1,942.38**
		Rate per sqm				**194.24**
17.08	Bus bay and Truck Lay Bys as per Drawing No_____ and _____					
	Bus Bay					
	Detail of cost of		1.00	No		
	GSB (To be paid under Road item)		m3	8.620	1395.00	12,024.90
	Cement concrete M15		m3	2.640	5,690.00	15,021.60
	PVC pipe 150mm dia of 2m length		m	6.000	264	1,584.00
	15mm thick Plastering in C.M. 1:3		m2	32.300	124.00	4,005.20
	Kerb		m	38.000	268.64	10,208.41
	Labour for fixing pipes					-
	Plumber		each	0.150	275	41.25
	Mazdoor		each	0.150	245	36.75
	Painting as per drawing with Thermoplast paint		m2	31.500	320.00	10,080.00
	Painting to kerbs as per drawing		m2	7.130	64.00	456.32
		G Total				**53,458.43**
		Rate per No.				**53,458.43**
17.09 a	Provide Temporary diversion as per Tech spec (with pipes) at C/D Locations as per Tech Spec Cl 112 Approach to Temp Structure					
	Detail of cost of		100.00	m		
	Materials					
	Earth work to embankment		m3	652.500	244.00	159,210.00

	GSB		m3	247.500	1395.00	345,262.50
	MSS		m2	550.000	158.00	86,900.00
	Maintain					-
	Water tank		hr.	20.000	374	7,480.00
	Roller		hr.	15.000	386	5,790.00
		Add for traff	%	2.000		12,092.85
	Dismantling	350per m x	LS			30,836.77
		G Total				647,572.12
		Rate per m				6,475.72
b	Structure With Pipes					
	Detail of cost of		100.00	m		
	Materials					
	Borrow to fill		m3	930.000	244.00	226,920.00
	Bed for Pipe		m3	250.000	244.00	61,000.00
	GSB		m3	248.000	247.500	61,380.00
	MSS		m2	550.000	158.00	86,900.00
	Hume pipe 1200mm (50% of Cost Considered)		m	50.000	2670	133,500.00
	Stone Masonry head walls and wing walls		m3	83.000	3,181.82	264,090.68
	Maintain					-
	Water tank		hr.	20.000	374	7,480.00
	Roller		hr.	15.000	386	5,790.00
		Add for traff	%	2.000		16,941.21
	Dismantling	350per m x	LS			1,694.12
		G Total				865,696.01
		Per Meter				8,656.96
	Provide and maintain Temporary including structure					
		With Structure (30% of "B" above)				2,597.09
		Without Structure (70% of "A"above)				4,533.00
		Rate per m				**7,130.09**
17.10	Geotextile and filter media under Gabion matteresses as per tech Spec					
	Detail of cost of		10.00	m2		
	Materials					
	Graded sone		m3	1.500	874.52	1,311.78
	geotextile		m2	10.000	103	1,030.00
	Labour					-
	Mazdoor		each	11.600	245	2,842.00
		Over head	%	20.000		1,036.76
		CP	%	10.000		622.05
		G Total				6,842.59
		Rate per sqm				684.26
17.11	Road Humps with BC as per Tech.Spec.Cl.509		Each			
	Bituminous Concrete		cum	0.288	9220.50	**2,655.50**
		Rate per each				**2,655.50**
17.12	Rumble Strips with MSS as per Tech.Spec.Cl.512		Each			
	MSS, 20mm thick ave.		sqm	11.000	158.00	1,738.00
	for Painting		sqm	11.000	320.00	3,520.00
		Rate per each				**5,258.00**
17.13	Diagonal/Chevron Marking as per Tech.Spec.Cl.800		Each			
	Thermoplastic Painting		sqm	6.500	320.00	**2,080.00**
17.14	Stop line/lettering in intersections as per Tech.Spec.Cl.800		Each			
a	Thermoplastic Painting line		sqm	2.800	320.00	896.00
		Rate per each				**896.00**
b	Lettering, (2 sqm/letter)		sqm	3.500	320.00	1,120.00
		Rate per each				**1,120.00**
17.15	Directional Arrows as per Tech.Spec.Cl.800		Each			
	Thermoplastic Painting (NHSR, P99/(I) 15)		sqm	1.800	320.00	576.00
		Rate per each				**576.00**
17.16	Rigid Concrete Delineators		Each			
	Cement concrete M 20		cum	0.020	6203.00	124.06
	Steel reinforcement		mt	0.001	71284.00	71.28
	Cement concrete M 15		cum	0.090	5,690.00	512.10
	Plastering, in CM 1:3, 12 mm th.		sqm	0.460	124.00	57.04
	Painting and writing letters		each	1.000	0.40	0.40
	Retro-Reflective sheeting		sqm	0.010	4917	49.17
	Fixing of reflector sheeting		LS			40.00
		Rate per each				**854.05**
17.17	Traffic Sign Boards as per Tech.Spec.Cl.801 and drawings					
a	Mandatory/Regulatory traffic signs Type IX					
(i)	Octagonal 900 x 900		Each	1.000	4720	4,720.00
		Overheads 10%				472.00
		CP 10%				519.20
	Excavation		Cum	0.216	140	30.24
	PCC M-15		Cum	0.120	5690	682.80
	Painting on Steel Surface with primer		Sqm	0.430	56	24.08
	Laboure					
	Mate		No	0.010	275	2.75
	Mazdoor		No	0.250	245	61.25
	MS Steel Angle		Kg	19.000	51.198	972.76
	Fixtures					19.46
		Overheads 10%				105.62
		CP 10%				127.80
		Rate per each				**7,737.96**
(ii)	Circular 600 dia. Type IX		Each	1.000	1994	1,994.00
		Overheads 10%				199.40
		CP 10%				219.34
	Excavation		Cum	0.216	140	30.24
	PCC M-15		Cum	0.120	5690	682.80
	Painting on Steel Surface with primer		Sqm	0.430	56	24.08
	Laboure					
	Mate		No	0.010	275	2.75
	Mazdoor		No	0.250	245	61.25
	MS Steel Angle		Kg	19.000	51.198	972.76
	Fixtures					19.46
		Overheads 10%				105.62
		CP 10%				127.80
		Rate per each				**4,439.50**
b	Informatory road traffic signs Type IX					
(i)	Rectangular 1200 x 900		Sqm	1.000	6915	6,915.00
		Overheads 10%				691.50
		CP 10%				760.65

	Excavation		Cum	0.432	140	60.48
	PCC M-15		Cum	0.240	5690	1,365.60
	Painting on Steel Surface with primer		Sqm	0.860	56	48.16
	Laboure					-
	Mate		No	0.020	275	5.50
	Mazdoor		No	0.500	245	122.50
	MS Steel Angle		Kg	38.000	51.198	1,945.52
	Fixtures					38.91
		Overheads 10%				211.24
		CP 10%				255.60
					Total	4,053.52
						3,685.02
		Rate per each				**12,052.17**
(ii)	Rectangular 900 x 450 Type IX		Each	1.000	3700	3,700.00
		Overheads 10%				370.00
		CP 10%				407.00
		Rate per each				**4,477.00**
(iii)	Rectangular 600 x 800 Type IX		Each	1.000	2978	2,978.00
		Overheads 10%				297.80
		CP 10%				327.58
	Excavation		Cum	0.216	140	30.24
	PCC M-15		Cum	0.120	5690	682.80
	Painting on Steel Surface with primer		Sqm	0.430	56	24.08
	Laboure					
	Mate		No	0.010	275	2.75
	Mazdoor		No	0.250	245	61.25
	MS Steel Angle		Kg	19.000	51.198	972.76
	Fixtures					19.46
		Overheads 10%				105.62
		CP 10%				127.80
		Rate per each				**5,630.14**
(iv)	State Route Marker (450 x 600) Type IX		Each	1.000	1610	1,610.00
		Overheads 10%				161.00
		CP 10%				177.10
	Excavation		Cum	0.216	140	30.24
	PCC M-15		Cum	0.120	5690	682.80
	Painting on Steel Surface with primer		Sqm	0.430	56	24.08
	Laboure					-
	Mate		No	0.010	275	2.75
	Mazdoor		No	0.250	245	61.25
	MS Steel Angle		Kg	19.000	51.198	972.76
	Fixtures					19.46
		Overheads 10%				105.62
		CP 10%				127.80
		Rate per each				**3,974.86**
c	Cautionary / Warning Signs (Triangular 900 side) Type IX		Each	1.000	2054	2,054.00
		Overheads 10%				205.40
		CP 10%				225.94
	Excavation		Cum	0.216	140	30.24
	PCC M-15		Cum	0.120	5690	682.80
	Painting on Steel Surface with primer		Sqm	0.430	56	24.08
	Laboure					-
	Mate		No	0.010	275	2.75
	Mazdoor		No	0.250	245	61.25
	MS Steel Angle		Kg	19.000	51.198	972.76
	Fixtures					19.46
		Overheads 10%				105.62
		CP 10%				127.80
		Rate per each				**4,512.10**
d	Chevron direction sign boards (400 x 550) Type IX					
			Each	1.000	1320	1,320.00
		Overheads 10%				132.00
		CP 10%				145.20
	Excavation		Cum	0.216	140	30.24
	PCC M-15		Cum	0.120	5690	682.80
	Painting on Steel Surface with primer		Sqm	0.430	56	24.08
	Laboure				0	-
	Mate		No	0.010	275	2.75
	Mazdoor		No	0.250	245	61.25
	MS Steel Angle		Kg	19.000	51.198	972.76
	Fixtures					19.46
		Overheads 10%				105.62
		CP 10%				127.80
		Rate per each				**3,623.96**
e	Object markers Type IX					
			Each	1.000	355	355.00
		Overheads 10%				35.50
		CP 10%				39.05
	Excavation		Cum	0.216	140	30.24
	PCC M-15		Cum	0.120	5690	682.80
	Painting on Steel Surface with primer		Sqm	0.430	56	24.08
	Laboure					
	Mate		No	0.010	275	2.75
	Mazdoor		No	0.250	245	61.25
	MS Steel Angle		Kg	19.000	51.198	972.76
	Fixtures					19.46
		Overheads 10%				105.62
		CP 10%				127.80
		Rate per each				**2,456.31**
f	advanced direction/destination / reaaurance / place identification sign boards with aluminimum alloy sheet, sheeting type IX (1200X1000) Out put 1Sqm					
			Sqm	1.200	6915	8,298.00
		Overheads 10%				829.80
		CP 10%				912.78
	Excavation		Cum	0.432	140	60.48
	PCC M-15		Cum	0.240	5690	1,365.60
	Painting on Steel Surface with primer		Sqm	0.860	56	48.16
	Laboure				275	-
	Mate		No	0.020	245	4.90
	Mazdoor		No	0.500	245	122.50
	MS Steel Angle		Kg	38.000	51.198	1,945.52
	Fixtures					38.91
		Overheads 10%				211.18
		CP 10%				255.53
						4,052.79
						3,377.32

		Rate per Sqm				**13,417.90**
17.18	Raised reflective pavement markers as per drawing No._____		Each	1.000	190	190.00
		Overheads 10%				19.00
		CP 10%				20.90
		Rate per each				**229.90**
17.19	Barricades (tubular steel railing) as per Tech.Spec.Cl.808 and drawing No._____		Out put	2Rmtr		
a	Footpath barricades					
	Market rate for supply and fabrication		Rmt	2.000	1200	2,400.00
	Excavation in all soils		cum	0.070	140.00	9.80
	PCC M 15		cum	0.070	5690	398.30
	Painting with enamel paint		sqm	1.900	56.00	106.40
	Add 10% on market rate					240.00
		Grand Total				3,154.50
		Rate per m				**1,577.25**
b	Median Barricades					
	Market rate for supply and fabrication		mtr	2.000	2066	4,132.00
	Excavation in all soils		cum	0.070	140.00	9.80
	PCC M 15		cum	0.070	5690	398.30
	Painting with enamel paint		sqm	2.900	56.00	162.40
	CP & OH on materials		%			413.20
						5,115.70
		Rate per m				2,557.85
17.20	Mastic Asphalt Wearing Coat, 25mm th over existing CDs and Bridges slabs as per Tech.Spec.Cl.2702, and 515					
	Rate for		70.00	Sqm		
	Labour					
	Mate		each	1.000	275	275.00
	Mazdoor		each	22.920	245	5,615.40
	Mazdoor skilled		each	2.600	275	715.00
	Machinery					-
	Mechanical broom		hr	0.060	276	16.56
	Compressor 250 cfm		hr	0.060	257	15.42
	Mastic cooker		hr	12.000	50	600.00
	Bitumen boiler		hr	12.000	140	1,680.00
	Tractor		hr	2.000	280	560.00
	Materials					-
	Bitumen 85/25		MT	0.425	50351.335	21,399.32
	Crusher dust		cum	0.810	599.52	485.61
	Lime stone dust		MT	0.750	4055	3,041.25
	Coarse aggregate 3.35 to 9.5mm		cum	1.146	774.52	887.60
	Pre coated stone chips13.2 nom.size		cum	0.075	774.52	58.09
	Bitumen for coating chips		Kg	2.190	43.20995425	94.63
		Over head	%	20.000		7,088.78
		CP	%	10.000		4,253.27
		Total				46,785.92
		Rate per Sqm				**668.37**
17.21	Truck Lay By as per Drawing No _____					
	Truck Lay By					
	Detail of cost of		1.00	No		
	1) Construction of covered drain type B1		m	111.000	8507.726	944,357.59
	2) construction of divisional island					-
	Providing and fixing Type II Kerb		m	91.740	268.64	24,645.25
	GSB		m3	4.400	1395.00	6,138.00
	Cement concrete M15		m3	9.100	5690	51,779.00
	15mm thick plaster in CM 1:4		m2	36.690	124.00	4,549.56
	PVC pipe 150 mm dia		m	9.760	264	2,576.64
	3) Lay by parking area & approaches					-
	subgrade		m3	357.000	270.00	96,390.00
	GSB		m3	238.000	1395.00	332,010.00
	WMM		m3	183.160	1729.00	316,683.64
	Polythene sheet		m2	1,130.000	150	169,500.00
	CC-M30		m3	282.500	6824.00	1,927,780.00
	filler pad		m2	31.200	508	15,849.60
	Reinforcement		MT	9.700	71284.00	691,454.80
	4) Joint filling with Sealing compound					-
	Elastic/ Dummy joints	6mm x 50m	m	267.750	97	25,971.75
	Longitudenall Joints	6mm x 50m	m	239.400	97	23,221.80
	Kerb Joint	25mm x 50n	m	163.400	120	19,608.00
	5) Painting					-
	Thermoplastic Painting	as per NH S	m2	32.150	320.00	10,288.00
	Painting to kerbs as per drawing	as per NH S	m2	41.630	64.00	2,664.32
		G Total				4,665,467.95
		Rate per No.				4,665,467.95
17.22	Laying Reinforced cement concrete pipe NP4 900mm dia/prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .					
	Unit = metre					
	Taking output = 12.5 metres (5 pipes of 2.5 m length each)					
	900 mm dia					
	a) Labour					
	Mate		day	0.180	275	49.50
	Mason		day	0.500	245	122.50
	Mazdoor		day	4.000	245	980.00
	b) Material					-
	Sand at site		cum	0.070	1184.68	82.93
	Cement at site		tonne	0.050	7598	379.90
	RCC pipe NP-4 900mm dai/prestressed concrete pipe including collar at site		metre	12.500	4090	51,125.00
	Granular material passing 5.6 mm sieve for bedding		cum	4.500	466.30	2,098.35
	c) Overhead charges @ 10%					5,483.82
	d) Contractor's profit @ 10%					6,032.20
	Cost for 12.5 metres					66,354.19
	Rate per metre					**5,308.34**

17.23	Laying Reinforced cement concrete pipe NP3 750mm dia/prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .				
	Unit = metre				
	Taking output = 12.5 metres (5 pipes of 2.5 m length each)				
	750 mm dia				
	a) Labour				
	Mate	day	0.171	275	47.03
	Mason	day	0.475	245	116.38
	Mazdoor	day	3.800	245	931.00
	b) Material				-
	Sand at site	cum	0.050	1184.68	59.23
	Cement at site	tonne	0.040	7598	303.92
	RCC pipe NP-3 750mm dia/prestressed concrete pipe including collar at site	metre	12.500	2640	33,000.00
	Granular material passing 5.6 mm sieve for bedding	cum	4.500	466.30	2,098.35
	c) Overhead charges @ 10%				7,311.18
	d) Contractor's profit @ 10%				4,386.71
	Cost for 12.5 metres				48,253.79
	Rate per metre				**3,860.30**
17.24	Laying Reinforced cement concrete pipe NP3 600mm dia/prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .				
	Unit = metre				
	Taking output = 12.5 metres (5 pipes of 2.5 m length each)				
	600 mm dia				
	a) Labour				
	Mate	day	0.171	275	47.03
	Mason	day	0.475	245	116.38
	Mazdoor	day	3.800	245	931.00
	b) Material				-
	Sand at site	cum	0.050	1184.68	59.23
	Cement at site	tonne	0.040	7598	303.92
	RCC pipe NP-3 600mmdia /prestressed concrete pipe including collar at site	metre	12.500	2440	30,500.00
	Granular material passing 5.6 mm sieve for bedding	cum	4.500	466.30	2,098.35
	c) Overhead charges @ 10%				3,405.59
	d) Contractor's profit @ 10%				3,746.15
	Cost for 12.5 metres				41,207.64
	Rate per metre				**3,296.61**
17.25	Laying Reinforced cement concrete pipe NP3 450mm dia/prestressed concrete pipe for culverts on first class bedding of granular material in single row including fixing collar with cement mortar 1:2 but excluding excavation, protection works, backfilling, concrete and masonry works in head walls and parapets .				
	Unit = metre				
	Taking output = 12.5 metres (5 pipes of 2.5 m length each)				
	450 mm dia NP3				
	a) Labour				
	Mate	day	0.171	275	47.03
	Mason	day	0.475	245	116.38
	Mazdoor	day	3.800	245	931.00
	b) Material				-
	Sand at site	cum	0.050	1184.68	59.23
	Cement at site	tonne	0.040	7598	303.92
	RCC pipe NP-3 450mmdia/prestressed concrete pipe including collar at site	metre	12.500	2040	25,500.00
	Granular material passing 5.6 mm sieve for bedding	cum	4.500	466.30	2,098.35
	c) Overhead charges @ 10%				2,905.59
	d) Contractor's profit @ 10%				3,196.15
	Cost for 12.5 metres				35,157.64
	Rate per metre				2,812.61
17.26	Filling foundations with boulders and sand and compacting.				
	Unit = cum				
	Taking output = 10 cum				
	Granular material				
	a) Labour				
	Mate	day	0.280	275	77.00
	Mazdoor	day	7.000	245	1,715.00
	b) Material				-
	Granular material	cum	10.000	849.52	8,495.20
	Sand	cum	2.000	1184.68	2,369.36
	c) Machinery				-
	Plate compactor/power rammer	hour	2.500	250	625.00
	Water Tanker	hour	0.050	374	18.70
	d) Overhead charges @ 10%				1,330.03
	e) Contractor's profit @ 10%				1,463.03
	Cost for 10 cum				16,093.31
	Rate per cum				**1,609.33**
17.27	Providing and fixing grating in cover slabs with 25 x 8 mm Galvanised iron flats.				
	Taking output = 1 No.				
	a) Labour				
	Fabrication	Sum			40.00
	b) Material				
	MS Flats	KG	2.470	51.198	126.46
	d) Overhead charges @ 10%				16.65
	e) Contractor's profit @ 10%				18.31
	Rate per no.				**201.42**
17.28	Gabion walls as per Tech. Spec. 2503 & 2504.				
	Detail of cost of	1.00	m3		

	Materials					
	Zinc + PVC coated Gabion boxes		m3	1.000	552.5	552.50
	Stone boulders		m2	1.000	677.02	677.02
	Labour					-
	Mazdoor		each	0.600	245	147.00
	Black Smith II		each	0.300	245	73.50
	Mason		each	0.300	245	73.50
		Over head	%	20.000		304.70
		CP	%	10.000		182.82
		G Total				2,011.05
		Rate per Cum				**2,011.05**
17.29	Gabion matresses 170 mm high as per Tech. Spec. Cl. 2503 & 2504					
	Detail of cost of		1.00	m2		
	Materials					
	Zinc + PVC coated Gabion boxes		m3	1.000	552.5	552.50
	Stone boulders		m2	0.170	677.02	115.09
	Labour					-
	Mazdoor		each	0.450	245	110.25
	Black Smith II		each	0.300	245	73.50
	Mason		each	0.150	245	36.75
		Over head	%	20.000		177.62
		CP	%	10.000		106.57
		G Total				1,172.28
		Rate per sqm				**1,172.28**
17.30	Gabion matresses 230 mm high as per Tech. Spec. Cl. 2503 & 2504					
	Detail of cost of		1.00	m2		
	Materials					
	Zinc + PVC coated Gabion boxes		m3	1.000	552.5	552.50
	Stone boulders		m2	0.230	677.02	155.71
	Labour					-
	Mazdoor		each	0.500	245	122.50
	Black Smith II		each	0.300	245	73.50
	Mason		each	0.200	245	49.00
		Over head	%	20.000		190.64
		CP	%	10.000		114.39
		Rate per sqm				**1,258.24**
17.31	Painting of details on Culverts/Bridges as per Tech. Spec. Cl.					
	Detail of cost of		1.00	m2		
	Materials					
	Painting 2 coats of Enamel paint		m2	1.000	64.00	64.00
	Writing of letters		m2	60.000	0.40	24.00
		Rate per sqm				**88.00**
17.32	Filling and Patching of Potholes as per Technical Specification Clause.	Out put	1Sqm			
a	100mm Deep and less					
	Labour					
	mazdoor		each	0.030	245	7.35
	Prime coat		m2	1.000	24.00	24.00
	MSS	1 layer of 20	m2	1.000	119.20	119.20
	WBM		Cmu	0.075	1675.00	125.63
		Over heads	%	10.000		2.40
		Contracotr F	%	10.000		2.64
		Total				**281.22**
b	>100mm Deep and less	Out put	1Sqm			
	Labour					
	mazdoor		each	0.030	245	7.35
	Prime coat		m2	1.000	24.00	24.00
	MSS	1 layer of 20	m2	1.000	119.20	119.20
	WBM		Cmu	0.150	1675.00	251.25
		Over heads	%	10.000		2.40
		Contracotr F	%	10.000		2.64
		Total				**406.84**
17.33	Rain water Harvesting structure					
	Providing and constructing Water harvesting unit alternately on either side of the carriage way as per the drawings, Additional Technical Specification A-20 and as directed by the Engineer.					
	a) 5 m length Trench		No			
	Details of cost for		1.00	No.		
	Earthwork in excavation		cum	8.438	140.00	1,181.25
	Filling pebbles (size stone)		cum	2.188	799.52	1,748.95
	Filling pebbles (5-20mm) size		cum	2.813	814.52	2,290.84
	Filling Sand		cum	3.438	1184.68	4,072.34
	Boring		m	6.000	650	3,900.00
	For miscellaneous work		%	10.000		1,319.34
		Rate perNo				**14,512.71**
17.34	Providing New Jersey Barrier with RCC M30 including reinforcement					
	Detail of cost of		10.00	Rmt		
	M30 Grade Concrete		m3	5.023	6916.00	34,739.07
	Steel reinforcement		MT	0.276	71423.00	19,712.75
		Rate for 10Rmt				**54,451.82**
		Rate per Rmt				**5,445.18**
17.35	Construction of reinforced earth retaining structures together with construction of earthwork in layers, assembling and erection of reinforcing elements and placing of facia panels and all associated components as per Additional Technical Specification A-16, approved design and drawing of specialised firm					
A	Providing and laying M-35 grade RCC facia panels including reinforcement and reinforcing elements with all fixtures and accesories complete					
	Details of cost for		1.00	sqm		
		as per mark	sqm	1.000	4050	4,050.00
		Over head	%	10.000		405.00
		CP	%	10.000		445.50
	Add for patent cost		%	20.000		1,012.50
		Rate per sqm				**5,913.00**

B Providing levelling pad in cement concrete M-20 grade below facia panels, including earthwork in excavation, backfilling and profiling of fore slope complete as per approved design, drawing and Technical Specifications Sections 300, 1500, 1700 and 2100.

a) M-20 grade

Detail of cost of MATERIALS		15.00	m3		
Cement		mt	5.210	7598	39,585.58
Sand		cum	6.750	1184.68	7,996.59
Aggregate 20mm		cum	8.100	974.52	7,893.61
Aggregate 10mm		cum	5.400	774.52	4,182.41
LABOUR					-
					-
Mate		each	0.860	275	236.50
Mason		each	1.500	245	367.50
Mazdoor		each	20.000	245	4,900.00
Machinary					-
Mixer		hrs	6.000	180	1,080.00
Generator		hrs	6.000	264	1,584.00
Formwork		%	4.000		2,713.05
	Over head	%	20.000		14,107.85
	CP	%	10.000		8,464.71
	G Total				93,111.79
	Rate per cum (a)				**6,207.45**

17.36 Providing and laying heavy duty cobble stones 75mm thick interlock pavers, using cement and course sand for manufacture of blocks of approved size, shape and colour with a minimum compressive strength of 281 kg per sqm over 50mm thick sand bed (average thickness) and compacting with plate vibrator having 3 tons compaction force thereby forcing part of sand underneath to come up in between joints, final compaction of paver surface joints into its final level, including cost of materials, labour and HOM of machineries complete as per specifications.

Out Put **10Sqm**

A) Material					
Cobble stones of 75mm thick with 5% wastage		sqm	10.5	316	3,318.00
Sand		cum	0.50	1184.68	592.34
B) Labour					
Mason class-I		each	2	250	500.00
Mazdoor		each	6	245	1,470.00
c) Machinary					
HOM of plate vibrator having 3 tons compaction force		Hrs	3.000	250	750.00
O.C. 10%					663.03
C.P. 10%					729.34
				Total	**8,022.71**
				For Per Sqm	**802.27**

17.37 Reinforced Cement Concrete Crash Barrier

Provision of an Reinforced cement concrete crash barrier at the edges of the road, approaches to bridge structures and medians, constructed with M-40 grade concrete EXCLUDING HYSD reinforcement conforming to IRC:21 and dowel bars 25 mm dia, 450 mm long at expansion joints filled with pre-moulded asphalt filler board, keyed to the structure on which it is built and installed as per design given in the enclosure to MOST circular No. RW/NH - 33022/1/94-DO III dated 24 June 1994 as per dimensions in the approved drawing and at locations directed by the Engineer, all as specified

Unit = Linear metre					
Taking output = 10 m					
a) M 40 grade concrete					
M 40 grade concrete	cum	2.850	6353.52	18107.53	Item 14.1(A)
b) Labour					
Mate	day	0.040	275.00	11.00	L-12
Mazdoor	day	1.000	245.00	245.00	L-13
c) Material					
HYSD steel reinforcement including dowel bars	tonne	0.000	49198.00	0.00	M-082
Pre-moulded asphalt filler board	sqm	0.320	215.00	68.80	M-144
d) Overhead charges @ 10%				32.48	
e) Contractor's profit @ 10%				35.73	
Cost for 10 metre				18500.54	
Rate per metre				1850.05	
			say	*1850.00*	

17.38 Ston Matrix Asphalt (19mm SMA)

Providing and laying Ston Matrix Asphalt with 100-120 TPH batch type hot mix plant producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 5.24 to 5.43 and 0.3 by weight by total mix using celluloid fibres and filler, transporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MORTH specification clause No. 509 and IRC SP-79-2008 complete in all respects

Unit = cum					
Taking output = 191 cum (450 tonnes)					
a) Labour					
Mate	day	0.840	275.00	231.00	L-12
Mazdoor working with HMP, mechanical broom, paver, roller, asphalt cutter and assistance for setting out lines, levels and layout of construction	day	16.000	245.00	3920.00	L-13
Skilled mazdoor for checking line & levels	day	5.000	245.00	1225.00	L-15
b) Machinery					
Batch mix HMP @ 75 tonne per hour	hour	6.000	12280.00	73680.00	P&M-022
Paver finisher hydrostatic with sensor control @ 75 cum per hour	hour	6.000	2070.00	12420.00	P&M-034
Generator 250 KVA	hour	6.000	1348.80	8092.80	P&M-081
Front end loader 1 cum bucket capacity	hour	6.000	624.00	3744.00	P&M-017
Tipper 10 tonne capacity	tonne.km	6300.000	1.90	11970.00	Lead 14km
Add 10 per cent of cost of carriage to cover cost of loading and unloading				1197.00	
Smooth wheeled roller 8-10 tonnes for initial break down rolling.	hour	6.00x0.65*	386.00	1505.40	P&M-044
Vibratory roller 8 tonnes for intermediate rolling.	hour	6.00x0.65*	1292.00	5038.80	P&M-059
Finish rolling with 6-8 tonnes smooth wheeled tandem roller.	hour	6.00x0.65*	922.00	3595.80	P&M-045
c) Material					
Total Bitumen Requirement is 450x5.25%	tonne	23.625			
i) Bitumen@ 5.09% per cent of weight of mix	tonne	23.554	43209.95	1017772.66	M-074
ii) Celluloid Fibres	tonne	0.071	45000.00	3189.38	

	ii) Aggregate					
	Total weight of mix = 450 tonnes					
	Weight of bitumen = 22.5 tonnes	5.09				
	Weight of aggregate = 450 -22.50 = 427.50 tonnes					
	Taking density of aggregate = 1.5 ton/cum					
	Volume of aggregate = 285 cum					
	* Grading - I-19 mm (Nominal Size)					
	20 - 10 mm 35 per cent	cum	99.750	824.52	82245.87	M-045
	10 - 5 mm 23 per cent	cum	65.550	774.52	50769.79	M-040
	5 mm and below 40 per cent	cum	114.000	774.52	88295.28	M-030
	Filler @ 2 per cent of weight of aggregates.	tonne	8.620	7598.00	65494.76	M-188
	or					
	Grading - II-13 mm (Nominal Size)					
	13.2 - 10 mm30 per cent	cum	85.500	774.52	66221.46	M-044
	10 - 5 mm 25 per cent	cum	71.250	774.52	55184.55	M-040
	5 mm and below43 per cent	cum	122.550	774.52	94917.43	M-030
	Filler @ 2 per cent of weight of aggregates.	tonne	8.620	7598.00	65494.76	M-188
	*Any one of the alternative may be adopted as per approved design					
	for Grading-I (13 mm nominal size)					
	d) Overhead charges @ 10%				143438.75	
	e) Contractor's profit @ 10%				157782.63	
	Cost for 191 cum				1735608.92	
	Rate per cum				9086.96	
				say	*9087.00*	
	for Grading-II(10 mm nominal size)					
	d) Overhead charges @ 10%				142940.00	
	e) Contractor's profit @ 10%				157234.00	
	Cost for 191 cum				1729574.04	
	Rate per cum				9055.36	
				say	*9055.00*	

17.39	Chute Drain					
	Out Put per rmtr					
	a) Excavation	Cum	0.21	86.000	18.06	
	b) PCC M-15	Cum	0.07	4,692.000	328.44	
	c) PCC m-20	Cum	0.08	5,486.000	438.88	
				Say	*785.00*	
17.4	Energy Dissipation Basin					
	Each					
	a) Excavation	Cum	0.8	86.000	68.8	
	b) PCC M-20	Cum	0.728	5,486.000	3993.808	
				Say	***4,063***	
17.41	Cement Concrete M-20 Kerb with Channel	Mtr	476.00	wide Item no. 8.02	***476.00***	

CHAPTER-18								
Toll Plaza Lighting								
Sr No	Ref. to MoRTH Spec.		Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks/ Input ref.
3.18	305		Construction of Subgrade and Earthen Shoulders with borrow earth (Lime 3%)					
			Construction of sub-grade and earthen shoulders with approved material obtained from borrow pits with all lifts & leads, transporting to site, spreading, grading to required slope and compacted to meet requirement of table No. 300-2					
			Unit = cum					
			Taking output = 100 cum					
			a) Labour					
			Mate	day	0.040	275.00	11.00	L-12
			Mazdoor	day	1.000	245.00	245.00	L-13
			b) Machinery					
			Hydraulic excavator1 cum bucket capacity @ 60 cum per hour	hour	1.670	966.00	1613.22	P&M-026
			Tipper 10 tonne capacity	tonne.km	175.000	1.90	332.50	
			Add 10 per cent of cost of carriage to cover cost of loading and unloading				33.25	
			Dozer 80 HP for spreading @ 200 cum per hour	hour	0.500	2640.00	1320.00	P&M-014
			Motor grader for grading @ 50 cum per hour	hour	2.000	1854.00	3708.00	P&M-032
			Water tanker with 6 kl capacity	hour	4.000	374.00	1496.00	P&M-060
			Vibratory roller 8-10 tonnes @ 80 cum per hour	hour	1.250	1292.00	1615.00	P&M-059
			c) Material					
			Cost of water	KL	24.000	30.00	720.00	M-189
			Lime	Tonne	5.250	4055.00	21288.75	
			Compensation for earth with Royalty, Extra Lead	cum	97.000	112.00	10864.00	M-092
			d) Overhead charges @ 10%				4324.67	
			e) Contractor's profit @ 10%				4757.14	
			Cost for 100 cum				52328.53	
			Rate per cum				523.29	
						say	*523.00*	

Prepared for:

सड़क परिवहन और राजमार्ग मंत्रालय
MINISTRY OF ROAD TRANSPORT & HIGHWAYS

Karnataka
Public Works, Ports & Inland Water Transport Department

Project:

Consultancy Services for "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.000 to 261.450 on NH-48 in the State of Karnataka"

Subject:

KD-6 - Draft Detailed Project Report for Final Approved Alignment for Bypass

Volume - VII: Cost Estimates

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Revision History

Rev.	Date	Long Description

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INTRODUCTION

This report is prepared under Contract Agreement clause 2.8; "Key Date No: KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)" after incorporation of Client's observations on earlier submitted "KD5: Kucha Draft Detailed Project Report (KDDPR)" vide letter no. NH/PIU-Tunnel/NH-48/KD-3/2015-16/383-386 dated 14.12.2015.

The present submission (10 Hard Bound Sets and 5 Soft Copies of each) is as de tailed below:

(i) Volume-I, Main Report:

- *Executive summary*
- *Project Description*
- *Socio Economic Profile*
- *Materials Surveys and Investigation*
- *Traffic Surveys and Analysis*
- *Design Standards and Specifications*
- *Alignment Proposals*
- *Summary of EIA/IEE and Action Plan*
- *Summary of Resettlement Plan*
- *Preliminary Cost Estimates*
- *Preliminary Economic Analysis*
- *Preliminary Financial Analysis*
- *Suggested Methods of procurement and packaging*
- *Conclusions and Recommendations*
- *Acknowledgement*
- *Compliance of the Observations*

The basic data obtained from the field studies and investigations and input data used for the detailed engineering design (if any) shall be submitted in a separate volume as an Appendix to Main Report.

(ii) Volume – II : Design Report

Part- I Traffic Study, Analysis and Forecast :

- *Description of Existing Road in Ghat Section*
- *Road and Bridge Inventory*
- *Traffic Surveys, analysis and forecast*
- *Proposed Pavement Design*

Part-II Design of Tunnels :

- *Proposed Tunnel Design, Standards*
- *Structural Analysis- Primary Lining*

Part-III Design of Bridges and Cross-Drainage Structures :

- *Proposed Bridges and Structures Design Basis and*
- *Bridges Dimensioning*

Part-IV Geological Design and Geotechnical Report :

- *Geological Survey and Analysis*
- *Geotechnical Investigations Report*

(iii) Volume-III Materials Report :

(iv) Volume - IV(a) Environmental Assessment Report including Environmental Management Plan (EMP) &

(v) Volume - IV(b) Resettlement Action Plan (RAP) :

(vi) Volume - V Technical Specifications :

(vii) Volume - VI Rate Analysis :

(viii) Volume - VII Cost Estimates :

(ix) Volume - VIII Bill of Quantities :

(x) Volume - IX Drawings (A3 Size) :

a. *Location map*
b. *Layout plans*
c. *General Drawings*
d. *Plan and Profile of Refined Alignment "A"*
e. *Typical Cross Sections showing Pavement details of Cut & Fill Section*
f. *Typical Cross Sections of Tunnel*
g. *Typical Cross Sections of Bridges*
h. *Tunnels- General Arrangement Plan and L-Sections (L&R)*
i. *Viaducts – General Arrangement Plan and L-Section*
j. *Cut & Fill and Viaducts – General Arrangement Plan and L-Section*
k. *GAD for proposed RoB at Railway km 54+650*
l. *Standard Drawings*
m. *Miscellaneous Drawings*
n. *Indicative Land Acquisition Plans*
o. *Detailed Cross Sections @ 100m interval*

(xi) Volume - X Civil Work Contract Agreement :
(xii) Volume - XI Project Clearances :

Volume – VII : Cost Estimates

1 GENERAL

This Volume - VII: Cost Estimates, a part of “KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)” is submitted in accordance with the Contract Agreement and as per requirement specified in Terms of Reference (ToR) for preparation of Cost Estimates of “Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH-48 in the State of Karnataka”.

2 METHODOLOGY

The quantities of earth work in cut and fill were computed after designing horizontal and vertical alignment using Civil3D/MX software. Digital Terrain Modeling (DTM) has been developed using high resolution satellite imaginaries, cartosat1 and preliminary topographic survey data. A number of typical cross sections have been developed for tunnel, bridges, viaducts and road approaches as per site requirements and optimum alignment. Quantities of all other items like subgrade (SG), granular sub-base (GSB), dry lean concrete (DLC), pavement quality concrete (PQC) for project road and wet mix macadam, dense bituminous macadam & bituminous concrete for junctions development, bus bays, rest areas and other minor items, (if required) have been worked out using the typical cross sections adopted in the respective locations. The quantities for cross drainage structures, culverts, bridges, viaducts and tunnels have been calculated from typical GAD's on sqm basis for required construction. Road signage, toll plaza, lighting, avenue plantation etc all items are calculated as per Design Plan and IRC standard

The estimates for utility relocations are based on data collected from site and other utility departments. Tentative cost of land acquisition, Resettlement and Rehabilitation is calculated based on approximate land rate and preliminary screening data on local enquiry. Provisions for physical contingencies, engineering supervision and landscaping etc. have been made as per normal practices.

The rates of various items of works are analyzed keeping in view the basic rates for various inputs and the leads involved. Tentative cost estimates have been prepared for different contracts packages. Detailed methodology is given in the subsequent paragraphs.

3 UNIT RATES

The rates of various items of construction work have been analysed as per procedure laid down in the “MORT&H Standard Data Book”-2003 (Fourth Revision, Reprint 2006) and guidelines set there in. Market studies were made to ascertain the rates of various items of construction materials. The market rates of major BoQ items like earthworks and pavement layers collected from similar adjacent packages and the rates worked out from the standard data book are compared with these market rates.

The rates of natural materials like river sand, moorum, gravel and stone aggregate etc. have been collected from the available quarry sources, in the vicinity of the road, by local enquiry and from government departments. Aggregate quarries are used from the excavated muck disposal, nearest quarries available are within one to two km from the construction place. In case if number of local aggregate crushers are not sufficient to meet the requirement, the rates of crushed aggregate, and crusher dust are adopted in the rate analysis by considering own cone crusher by the contractors. Sand is available at the Kempuhole river and nalla beds all along Hassan, Sakleshpur, Heggade, Maranhally, and Gundya., Rates of manufactured / proprietary items have been ascertained from the trade. Unit cost of transportation to site, based on the average lead, has been added to the basic cost.

Cartage rates have been considered as per MORT&H Data Book and guide lines laid there in. Hourly cost of owning and operating various machineries and equipment has been considered as per the Standard Data Book and local market enquiry. Local prevailing hire charges and diesel charges were also considered in arriving at Machinery & Equipment hiring charges. For machinery and equipment not covered by the Data Book, prevailing market rates were considered. Rates of different categories of skilled and unskilled manpower, labor have been taken from the rates as provided in the latest NH-SSR of Karnataka 2014-15.

An escalation as per RBI indices has been taken into account wherever applicable for determining current year 2015-2016 rates. Machinery hire charges have been taken from Standard data book with 60% enhancement (5% per year from year 2003 onwards) MoRTH and Karnataka SOR. A conscious effort has been made to arrive at reasonable and logical rates for various items of work. Unit rates have been checked against rates of similar ongoing project under MoRTH near the project road vicinity and were found reasonable.

4 DETAILED RATES ANALYSIS

This software of Rate Analysis is based on “Standard Data book for analysis of Rates for Road and Bridge Works” prepared and published by MoRT&H. This Software runs on Microsoft Excel with Automatic updation & calculation of Item Rate. The Overhead charges (8% for road works and 10% for bridges/ tunnel works) and Contractor profits (10%) are fixed by MoRT&H; and the same is adopted. Items which are not covered in standard data book but used & required for tunneling (including E&M) have been analyzed and/or adopted from similar international projects and practice.

5 MoRTH Guidelines for Rate Analysis and Cost Methodology

The "Guidelines for Costing Methodology" to be adopted for framing up Cost Estimates of BOT Projects was issued by NHAI on 8th December 2010. These are adopted for preparation of Rate Analysis, Estimation of Quantities and Cost Estimates, and the same has been adopted for this project.

5.1 Steps for Rate Analysis

The Rate Analysis is worked out on the basis of guidelines given in the Cost Methodology issued by NHAI on 8th December 2010. These are as listed as below :

The analysis is to be worked out on the basis of following:

Step-1 - The basic rates for labour, material and cartage are to be taken from the available SOR for NH works (latest Schedule), if the Schedule is of previ ous years, an escalation of 5% is adopted for labour / material / cartage per year or for the labour minimum wages for particular State / District is con sidered, if available.

Compliance- *The estimate is reported to be prepared based on MORTH Standard data book. Basic rates of Labour, material as per Karnataka State SOR 2014-15, Govt. Of Karnataka PWD-NH. The machinery rates arrived are based on MORTH standard Data book 2003 and escalation applied as per RBI in dices related to machinery and the market rates are adopted wherever schedule rates are not available. The rates for bitumen, cement & steel has been considered as per current market rate & petroleum company cir culars.*

Step-2 - The leads of different construction material are to be worked out based on material investigation for location of borrow area in case of borrowed earth, quarry of Stone Aggregates, Sand etc.

Compliance- *The leads of construction materials are taken from excavated materials of proposed tunnels and identified borrow areas.*

Step-3 - The lead of bitumen, cement and steel is to be fixed based on location of re-finery in case of bitumen, location of main city for cement, steel and hume pipe.

Compliance- *The leads of Bitumen, Cement and Steel is taken from Mangalore, Hassan, Bangalore, and Vishakhapatnam.*

Step-4 - The current rates of bitumen, cement, steel & NP pipes are to be adopted from the market / website. On the basic rate of bitumen taken from the near-est Refinery an excise duty @ 14.42% is to be undertaken on which the CST/VAT and Cartage cost is further added to arrive at the current rate of Bitumen.

Compliance- *The rates for bitumen, cement & steel has been considered as per current market rate & nearest Refinery petroleum company circulars. Excise Duty @14.42% is taken. VAT/ CST and Cartage Cost is further added.*

Step-5 - The format for working out rates for different items of bill of quantities is to be used from The Standard Data Book of MORT&H. If the Machinery rates are available in Schedule of Rate (SOR), the rates are taken from SOR only;

however, if not available, the machinery rentals of 2001-2002 are considered from Standard Data Book and increased @ 5% per year to bring it to the current date. The same may also be compared with the market rate of hiring charges plus POL, applicable to the project location.

Compliance- *Yes same is considered. The estimate is reported to be prepared based on MORTH Standard data book.*

Step-6- In Granular Sub Base, Mix in place Method is used while analyzing and putting the rate for Cost Estimation.

Compliance-*Yes, Granular Sub-base "Mix in Place Method" is used.*

Step-7- The contingency rates for different type of structures as proposed in Standard Data Book of the Ministry are to be continued presently as they are based on different site conditions and sound practical investigation done by the Ministry at the time of preparing the SDB, until they are revised.

Compliance-*Yes; 3% Contingencies is adopted.*

5.2 Steps for Cost Methodology

The Cost Estimate is worked out on the basis of guidelines given in the Cost Methodology issued by MoRTH for a Highway Project. These are as listed as below:

Step-1- Bill No. - 1 Site clearance and Dismantling

This bill includes removing the roots of trees of girth more than 300mm, Clearing & Grubbing which is taken for full width of ROW. Also the disman tling of existing pavement and structures (if any) is considered. The thick ness of the existing pavement is taken from the details of site inventory for the existing crust (if any).

Rebate towards the salvage value of dismantled materials is to be consid ered.

Step 2- **Bill No. - 2 Earth Work**

Bill No. -3 Granular Sub Base and Base Courses

Bill No.-4 (A) Bituminous Courses (Flexible Pavement), 4 (B) Rigid Pavement

Quantities are to be estimated based on typical cross sections and the layer thickness based on pavement design as per IRC-37 for flexible pavement and IRC 58 for rigid pavement. The quantity of cut/ fill is worked out using Civil 3d/Mx Road and the pavement quantity is worked out from detailed drawings. The length of structure is deducted while calculating the quanti ties of earthwork and pavement.

a) It is assumed that approximately 50-70% of the excavated earth can be reused for embankment and 30%-50% is unsuitable for use in em bankment.

b) If hard rock is available, then 10% of the quantity out of Excavation is assumed for hard rock and the salvage value of rock is considered in bill no.1. Rest 90% of excavated stuff is considered as ordinary soil; however, this classification may vary with specific location.

c) It is mandatory to use fly ash for Embankment construction, if fly ash is available at the nearest Thermal power plant within a radius of 100 kms. In this case an item rate needs to be analysed for embankment with use of Fly ash with appropriate lead and this, in general, works out to be more expensive than Embankment fill rate from borrow area.

d) The quantity of fly ash (if used) and the Backfill quantity used in con struction of RE Wall is finally deducted from the total quantity of em bankment.

e) The quantity for Junctions, median opening, Bus bays, Truck Parking and Rigid Pavement for Toll Plaza is considered in Bill No. 2,3 and 4.

f) The median opening is to be considered every 5 km as per codal pro vision and the quantities worked out accordingly in Bill No. 2, 3 and 4.

Step-3- **Bill No. – 5 Culverts**

Provision of additional new Culverts is based on hydrological investigation. The schedule of widening and providing new culverts are fixed up and accordingly the different types of culverts (viz pipe, slab, box) quantities are worked out from the standard drawings or from the available drawings of the particular project. A new pipe culvert of size 1200 mm dia – 1 no. each for T & Y junction and 2 No. for each X junction is considered. Further the abstract of Quantities is prepared for all the culverts and the Abstract of cost is prepared by multiplying the rates.

Step-4**-** **Bill no.- 6 Bridges, Viaducts, Tunnels**

Provision of additional new bridges, viaducts and tunnels are based on Hy drological Investigation and the quantities & cost estimate of Bridge is based on GADs. Few bridges of different foundation are worked out to as sess the per sqm cost of deck area. This constant of cost is used to esti mate the total estimated cost of the bridges based on the span configure tion in a tabular form. This step is generally followed in the Feasibility stage. But in the DPR stage, once the design is finalized and all the detailed draw ings are ready, the estimate is worked out based on them.

Step -5- **Bill No. - 6A Repair and Repair and Rehabilitation of Existing Bridges**

The quantities are based on Site assessment & preparation of inventory of the structure for Repair & Rehabilitation of existing bridges:This head is Not Applicable for this project

Step-6- **Bill No. -7 Drainage and Protection works**

This Bill include types of drains, protection work such as stone pitching, crash barrier, RE wall, RCC Retaining wall, Breast wall , Drainage chutes, River Training Works etc. The Metallic crash Barrier is provided where height of Embankment is more than 3m and the drainage chutes provided where height of embankment is more than 6m. Median drain is provided in the superelevated portion.

Step-7- **Bill No. - 8 Junctions**

In this bill quantities includes only the chequered Tiles and kerb for junction and Island. Remaining items like earthwork, pavement items are already covered in Bill nos. 2,3 and 4 for Major and Minor Junctions.

Step-8- **Bill No. - 9 Traffic Signs, markings and Appurtenances**

Traffic signages are provided as given in the drawing. Gantry mounted Can tilever/ Overhead signs are provided and the numbers are based on the Start and End chainage and the location of Major Junction/ Interchanges, Toll Plaza as per provisions in the drawings. The weight of steel truss is taken as 2.5 tonne /No. for 4- Lane and 1.5 tonne / No. for cantilever truss. The lane marking, delineators, road studs, cluster of Red Reflector is con sidered according to the drawings and the details marked on the drawing by Traffic/Highway Engineer.

Step-9- **Bill No.- 10 Maintenance**

This bill covers Maintenance of existing road items such as pot hole and MSS for road maintenance are considered under this bill. It is also assumed that out of the whole existing road approximately 3-5% length of the road has potholes depending on the road condition. For assessing the perfor mance of the pavement and requirement of re-laying of bituminous layers, the existing pavements are to be subjected to investigations under the Ben kelman Beam Method under guidelines of IRC 81. This head is Not Applica ble for this project

Step-10- **Bill No. -11 Various Miscellaneous Items**

Various miscellaneous items such as vehicles, mobile phones, Trauma center, Way side amenities, Traffic aid post, Administrative, Operational and Maintenance Base Camp, Vehicle rescue Post, Passenger shelter , ATMS, Toll plaza automatic Barrier including ETC , Landscaping are covered under this bill. The provision for street lighting is taken in urban sections as well as for Flyovers and structures. It is assumed that the poles are placed at 30m c/c. High mast is provided in Toll plaza and Junctions. A temporary Traffic diversion (access roads) , if necessary, is considered as per requirement. Also traffic safety measures items are considered under this sub head.

Some of items under this head are Not Applicable for this project

The number of photographs for the project is assumed as below

@ 30 Nos per Tunnel

@ 10 Nos per bridge and Major Structures

@ 2 Nos per culvert and underpass

@ 4 Nos per km for laying crust

The civil cost is the addition of Bill No. 1 to Bill No. 11.

5.3 Steps for formulating TPC

There is guideline in MCA to calculate TPC by adding 25% of Civil Construction Cost to it to account for the financing charges required by the Concessionaire to implement the BOT project. The rational method of formulating the TPC of a BOT project is to get the financial modelling done by a Financial Analyst based on uniform parameters to be applicable for all MORTH projects. The rational method of financial modelling involves the following parameters/components:

(i) Interest on Debt Component (IDC)
(ii) Contingencies

(iii) Escalation during construction
(iv) Financing charges
(v) IC/IE cost borne by the Concessionaire

The rates of these components usually vary from project to project and for different financial consultants. A uniform parameter for deciding the rates of the above mentioned components may be taken as below:

i) Interest on Debt Component (IDC) –

Depending on period and phasing of expenditure during construction, and taking a uniform rate of Rs.11.75% per annum, the impact of IDC varies from 12 to 14% of TPC.

The phasing of expenditure during the construction period may be taken as :

Upto 365 days – 10%

365 to 730 days- 20%

730 to 1095 days – 25%

1095 to 1460 days – 25%

1460 to 1825 days – 20%;

Total 100%

ii) Escalation of Cost during construction :

It depends on phasing of construction period. Usually we take a figure of 5% per annum for this component. On comparing cost analysis of many projects, this component consists of 5% of TPC.

iii) Financing Cost

We may take a figure of 2% of TPC as the financing cost of the project

iv) Contingency

This may be taken as 3% of TPC

v) IC/IE cost borne by the Concessionaire – 1% of TPC

The TPC of a BOT project should be decided by the financial modelling done by the financial consultant on the basis of the uniform parameters as proposed above. It may or may not be within the guideline of the MCA of calculating TPC by adding 25% financing cost to them.

6 COST OF VARIOUS COMPONENTS

The cost of work has been worked out component wise as under:

(i) Site Clearance
(ii) Earthworks
(iii) Sub-Base Course & Base Course
(iv) Concrete Works
(v) Bituminous Works
(vi) Cross Drainage works - Culverts
(vii) Major & Minor Bridges, Viaducts, RoBs. Flyover.
(viii) Drainage and Protection Works
(ix) Traffic Signs, Markings & Other Road Appurtenances
(x) Maintenance, construction of access roads during construction
(xi) Truck Laybys & Bus bays
(xii) Tunnels (twin tubes)
(xiii) E & M works for Tunnels
(xiv) Geological Stability, Rock Bolting,
(xv) Slope Protection
(xvi) Lightings,
(xvii) Entry and Exit Intersections,
(xviii) Toll Plaza (if any planned by the Authority)
(xix) Planting and Landscaping and Environmental Mitigation Measures
(xx) Administrative Block and Maintenance Base Camp ,HTMS (if Toll plaza is provided)
(xxi) Rest areas (way side amenities)
(xxii) Miscellaneous works

Under sub head 'site clearance' provision has been made for removal of roots of trees, stumps, shrubs, grass and top organic soil not exceeding 150 mm in depth. Provision has also been made for dismantling of existing structures (if any) and pavement (at takeoff & merging points), salvaging of dismantled materials and removal of unserviceable items, as required. Under sub head 'earth work', the earth work in embankment and in cutting, sub-grade and shoulders for road approaches, tunnels & bridges, and as well as for access roads, has been catered for. Provision has been made for granular subbase for project road under the sub head 'sub base courses'. Under sub head 'bituminous/cement concrete courses', provision has been made for DBM & Bituminous Concrete for access roads and dry lean concrete and cement concrete pavement (PQC) for project road, Truck Terminals and Toll plaza lanes (if any). It is proposed to provide box culverts with adequate water way and structural safety. Besides, some of the temporary bridges need to be constructed for access roads as per site conditions and applicability. New bridges, viaducts and other structures will be constructed for 12m road way as per IRC: SP-84: 2014. Provision for these works has been made under the sub heads 'culverts, bridges and flyovers have been provided SH-114 Gundya – Subramanya road crossings, ROB's have been provided for railway crossings. Works for improvement of road junctions and drainage and protective works have been considered under the respective sub heads. Under sub head 'miscellaneous items', besides road appurtenances and other miscellaneous items of works, provision has also been made for the following:

(i) Safety items have been introduced to ensure the project safety during the construction.

(ii) Supply of digital color photographs of road works mounted in Albums and also as a computer soft copy.

Supply of digital (VCD/DVD) video graphic record of road before commencement of work, various stages of construction and condition of road after completion of works.

7 CONSTRUCTION QUANTITIES

The quantities of earth work in cut and fill were computed after designing horizontal and vertical alignment using Civil3/MX software. Digital Terrain Modeling (DTM) has been developed using high resolution satellite imaginaries, cartosat1 and preliminary topographic survey data. A number of typical cross sections have been developed for tunnel, bridges, viaducts and road approaches as per site requirements and optimum alignment. Detailed Cross Sections @ 50m interval are generated using MX and TCS adopted in the respective chainages. Provisions are made for the soft and hard rock excavation based on the road inventory and the site investigation. Quantities of all other items like subgrade (SG), granular sub-base (GSB), dry lean concrete (DLC), pavement quality concrete (PQC) for project road and wet mix macadam, dense bituminous macadam & bituminous concrete for junctions development, bus bays, rest areas and other minor items, (if required) have been worked out using the typical cross sections adopted in the respective locations. The quantities for cross drainage structures, culverts, bridges, viaducts and tunnels have been calculated from typical GAD's on sqm basis for required construction. Road signage, toll plaza, lighting, avenue plantation etc all items are calculated as per Design Plan and IRC standard

8 SHIFTING OF UTILITIES & TREE CUTTING

Shifting of Utilities like Electrical installations, transformers, H.T/L.T line shifting, High tension towers, Telephone poles, OFC lines, Water pipe lines etc., the required estimates for shifting of these utilities from the concerned Departments will be obtained in detail during Draft DPR stage. Presently, tentative quantities from the road inventory and topography survey data are taken into consideration against shifting of utilities & tree cutting in the costing.

Age old trees with different girths exist on both sides of the existing highway. On an average for all types of Girths, nearly 150 to 200 trees per km are available. Average Tree cutting Cost per tree shall be taken as @ Rs. 700. Average cost of Cutting of trees per Km comes to be Rs. 1.20 Lakhs for the widening portions of existing NH road. In the bypass/new alignment areas this cost shall be less. Salvage value as per the Forest Department norms shall be deducted from the tree cutting cost.

9 MAINTENANCE, LAND ACQUISITION, REHABILITATION & RESETTLEMENT COST

Provision has been included for maintenance of the existing 2-lane road during construction at Rs. 5,00,000 /= per Km per month for 60 months. This covers repair of pot holes and renewal coat by 25mm Mastic Asphalt/ Wearing Coat. Cost of Rehabilitation & Resettlement has been provided for as per initial social impact assessment. Provision for cost of land acquisition and compensation for permanent/temporary buildings and other structures has been made there in. The cost of environmental mitigation has been provided for, as per initial assessment. For specific items that have been used for mitigation of impacts in construction or operation stages including environmental monitoring, training of personnel for implementation of the Environmental Management Plan, logistical support for the implementing agency. General components like RCC, PCC, steel ISMB sections or angle sections etc., required for various mitigation measures have been included in the overall rate for the item. The costs of Resettlement and Rehabilitation were worked out based on the prevailing market rates in Heggade, Maranhally, Shiradi and Gundya, Adda hole villages of Hassan and Mangalore Districts respectively. The land acquisition costs for the properties to be acquired for this project has been worked out based on a market value assessment survey conducted at various locations along the proposed bypass alignments. The property dealers, locals and the government agencies as the revenue department etc. were contacted for this purpose.

It has already been stated that the list of affected properties is yet to be firmed up. However, a tentative estimate of cost for Rehabilitation & Resettlement has been worked out to Rs. 15 Crores, which covers all components of compensation, assistance and entitlements. The detailed cost estimate for resettlement will be provided in the Preliminary Project Report. The broad break up of tentative R & R budget is given below:

Table 1.1: Tentative budget for R&R Activities

Sl. No	Particulars	Amount (Rs.)
1	Compensation for structure	1,00,00,000
2	Construction cost	5,00,00,000
3	Compensation for land (including 30% as solatium)	5,00,00,000
4	Assistance @ Rs.20000 per PAF as per National Policy on Resettlement & Rehabilitation	4,00,00,000
5	Support for implementation of RAP (lump sum)	50,00,000
6	M & E consultant (lump sum)	50,00,000
Total		15,00,00,000

10 ENVIRONMENTAL BUDGET

Environmental Management Plan will be prepared as part of detailed EIA study and is intended to become a part of the contract documents so that implementation of all the environmental measures can be ensured. The implementation actions, responsibilities and timeframes will be specified for each component and adverse impact anticipated. The cost of implementing above mitigation measures during the construction stage works out to Rs. 1.0225 Crores. The operational cost of the same is estimated at Rs. 4.85 lakhs during the first two years. The cost estimates are presented in **Table 1.2**.

Table 1.1: Estimation of Environmental Management Plan Cost

Description	Unit	Quantity	Rate(Rs.)	Amount(Rs.)
A. Annual Cost During Construction Phase during Five Years				
1.Compensatory avenue plantation of twice the number of trees to be cut and their fencing and maintenance for five years	No.	15,000	400	60,00,000
2.Shrub plantation@500 saplings (single row) per Km for the cut and fill section and their fencing and maintenance for five years	No.	100	15000	15,00,000
3. Environmental Monitoring				
3.1. Air Quality Monitoring at 15 sensitive locations for three seasons for 5 consecutive years	No.	70	12,000	8,40,000
3.2. Water Quality Monitoring at 5 locations for two seasons for 5 consecutive years	No.	50	3,000	1,50,000
3.3. Noise Monitoring at 15 sensitive locations for three seasons for 5 consecutive years	No.	75	1000	75,000
3.4. Soil Quality Monitoring at 9 sensitive locations for two seasons for 5 consecutive years	No.	45	3,000	1,35,000
3.5. Mobilisation Charges for 3 seasons for 5 years	No.	15	75,000	11,25,000
4. Dust Suppression at Site(6 trips/day for 365 days for 5 years)	No.	150	1000	1,50,000
5. Severances & Others (including training, workshops, awareness campaigning etc.)		Lump sum		50,000
6. Two Rainwater Harvesting Structures per 5 Kilometer for 24km	No.	5	40,000	2,00,000
Total cost during construction phase				1,02,25,000
B. Annual Cost During Operational Phase during First Two Years				

Description	Unit	Quantity	Rate(Rs.)	Amount(Rs.)
1. Environmental Monitoring				
1.1. Air Pollution Monitoring at 15 sensitive locations for 3 seasons for first two years	No.	37.25	12,000	4,47,000
1.2. Noise Monitoring at 15 sensitive locations for 3 seasons for first two years	No.	37.5	1000	37,500
Total cost during Operation phase				4,84,500
Total Cost (A+B)				**1,07,09,500**
Contingency (10%)				**10,70,950**
Total				**1,17,80,450**

11 TOTAL PROJECT COSTS

Details of various costs for this project road are given separately as below:

a) Civil Construction Cost

Cost estimate have been prepared by estimation of quantities for various item of works and rates adopted from the similar nature projects considering difficult site constraints.

b) Total Project Cost

(i) Interest on Debt Component (IDC)
(ii) Contingencies
(iii) Escalation during construction
(iv) Financing charges
(v) IC/IE cost borne by the Concessionaire

c) Project Capita Cost

Project Capital Cost including Total Project Cost and the costs of Land Acquisition, Environmental mitigation measures and Utilities relocation are given in **Table 1.3**.

Table 1.3: Project Capital Cost

Part A) Civil Construction Cost

S No.	Description	Amount (Rs)
1	Site Clearance and Dismantling	142,56,246
2	Earthwork	9142,84,714
3	Granular Base Course and Sub - Base	1239,52,451
4(A)	Cement Concrete Pavement	19178,61,987
4(B)	Bituminous Course	90,61,329
5	Culverts and Cross Drainage Works	1672,13,336
6	Bridges	401288,62,916
7	Drainage Works and Protection Works	21681,39,209
8	Traffic Signs, Markings and Other Appurtenances.	743,78,824
9	Miscellaneous	3980,27,321
10	Horticulture	81,49,534
11	Access / Approach Roads	41500,00,000
12	Tunnels (6 Nos, Total Length 12.631 km)	440938,27,424
	Total Civil Cost	**941680,15,290**
	Civil Cost in Crores	**9,416.80**
	Civil Cost per Km (Length = 23.579 Km.) in Crores	**399.37**

Part B) Other Costs:

S No.	Description	Amount (Rs)
	Interest on Debt Component (IDC)	Considered 1.75% of Civil Construction Cost
	Contingencies	
	Escalation during construction – 60 months (on 90% debt)	
	Financing charges	
	IC/IE cost borne by the Concessionaire	
B	**Total Project Cost (101.75% of Civil Cost)**	958159,55,558
	Land Acquisition and R&R cost	1500,00,000
	Environmental mitigation measures cost	117,80,450
	Shifting of utilities cost (LS)	5000000
	Project Capital Cost	959827,36,008
	Amount (Rs in Crores)	9,598.3
	Per km cost (Rs Crore/km)	**407.07**

12 COST ESTIMATES

Detailed cost estimates have been worked out for various items of works. The details are given as **Annexure - I:**

--------End of Main Document----------

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ANNEXURE – 1

Abstract of Cost Estimate – Tunnels

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

S. No	Tunnel No.	Section	Design Chainage		Length	CPs	Tunnel Cost
			Start	End			[INR]
1	T1	Main Road NH 48 (Left)	2686.59	5581.47	**2894.88**	9	10340930162.84
		Main Road NH 48 (Right)	2715.56	5553.19	**2837.63**		
2	T2	Main Road NH 48 (Left)	5863.07	7920.00	**2056.93**	7	6988523390.34
		Main Road NH 48 (Right)	5901.33	7903.44	**2002.11**		
3	T3	Main Road NH 48 (Left)	9216.58	11299.6	**2083.02**	7	7575412663.02
		Main Road NH 48 (Right)	9204.84	11231.06	**2026.22**		
4	T4	Main Road NH 48 (Left)	11603.15	13505.3	**1902.15**	6	7153250104.54
		Main Road NH 48 (Right)	11539.99	13467.65	**1927.66**		
5	T5	Main Road NH 48 (Left)	14804.99	16500.96	**1695.97**	5	6222549285.90
		Main Road NH 48 (Right)	14770.00	16419.91	**1649.91**		
6	T6	Main Road NH 48 (Left)	17805.62	19797.17	**1991.55**	5	5813161817.40
		Main Road NH 48 (Right)	18030.76	19636.07	**1605.31**		
						Total	**44093827424**

I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

TUNNEL 1

S No	Item Description	Left	Right	CP	Portal	Unit (quantity)	Total Quantity	Unit (rates Rs per)	Rate	Amount
A102	**Theoretical Excavation Volume**									
A1021	Underground Excavation - Blasting (Rock)	432173	423626	18141		m^3	873940	m^3	3388	**2960907790**
A1022	Underground Excavation - Excavator (Soil/Soil like)	17014	16475	0		m^3	33489	m^3	2000	**66978148**
A106	**M25 - Shotcrete**									
A1061	50mm thickness	2227	2183	680		m^3	5090	m^3	16464	**83799236**
A1062	100mm thickness	4922	4824	0		m^3	9746	m^3	16464	**160461177**
A1063	150mm thickness	6552	6422	0	4934.40	m^3	17908	m^3	16464	**294840879**
A1064	200mm thickness	1605	1573	0		m^3	3178	m^3	16464	**52324297**
A1065	250mm thickness	1261	1236	2181		m^3	4678	m^3	16464	**77025365**
A1066	300mm thickness	1490	1461	0		m^3	2951	m^3	16464	**48586847**
A108	**Wire Mesh, Fy = 500 N/mm2**									
A1081	150/150/6mm	111912	108661	16011	15666.20	m^2	252251	m^2	600	**151350331**
A1082	150/150/8mm	0	0	0		m^2	0			
A110	**Rock bolts, SW type**									
A1101	3m length	1465	1436	0		pcs	2901	No.	11200	**32487281**
A1102	4m length	0	0	0		pcs	0			
A1103	6m length	0	0	0		pcs	0			
A111	**Rock bolts, SN type**									
A1111	3m length	0	0	0		pcs	0			
A1112	4m length	7787	7633	0		pcs	15420	m	1232	**75991987**
A1113	6m length	1106	1084	0		pcs	2190	m	1232	**16187141**
A112	**Rock bolts, SD type**									
A1122	4m length	0	0	0		pcs	0			
A1123	6m length	1485	1456	1512	40.00	pcs	4493	No.	13028.4	**58533704**
A1124	9m length	608	596	224	586.00	pcs	2014	No.	18411.4	**37079217**
A1125	12m length	0	0	0		pcs	0			
A115	**Lattice Girder, Fe 500**									
A1153	95/20/25	4774	4679	4123		m	13576	t	132456	**20679270**
A1154	130/32/25	3022	2962	0		m	5985	t	132456	**13951780**
A116	**Forepoling**									
A1161	25mm dia, 4m length, SN type	1560	1529	0		pcs	3090	m	1332	**16462576**

A1162	25mm dia, 4m length, rammed	0	0	0		pcs	0			
A117	**Forepoling, SD type**									
A1172	25mm dia, 4m length	0	0	0		pcs	0	No.	9363	**0**
A1173	32mm dia, 4m length	6791	6657	6823		pcs	20271	No.	9503	**770571475**
A1174	32mm dia, 5m length	0	0	0		pcs	0			
A195	**Bolts, SD type R38N**									
A1951	6m length			0	60.00	pcs	60	No.	9643	**3471552**
A1952	9m length			0	282.00	pcs	282	No.	9643	**16316294**
A1953	12m length			0	42.00	pcs	42	No.	9643	**2430086**
A1954	15m length			0	1146.00	pcs	1146	No.	9643	**66306643**
A200	**Rebars in Poratl Area**			0	8.40	t	8	t	60000	**504000**
B155	**Drainage Pipes 50 mm dia PVC pipe**	1505	1476	0		pcs	2981	m	300	**5365629**
B156	**Base Drainage pipe, 300mm dia PVC pipe**	2895	2838	0		m	5733	m	2195	**12582859**
B157	**Plugging concrete for base drainage pipe**	434	426	0		m^3	860	m^3	5000	**4299383**
B158	**Weep Holes**	6253	6129	0		pcs	12382	No.	204	**2525973**
B169	**Collector Drainage Pipe, 200m dia**	2895	2838	0		m	5733	m	1094	**6271366**
B170	**Waterproofing Membrane**	89544	87773	8352		m^2	185668	m^2	2200	**408469245**
C100	**Concrete - Inner Lining**	51902	50875	8352		m^3	111129	m^3	11200	**1244640144**
C101	**Steel - Inner Lining Reinforcement**	1726298	1692158	8352		kg	3426808	t	60000	**205608467**
										6917010142

Misc Cost for Precast Manholes, No Fine Porous Concrete, Footpath, Polyproplene Fibre, portal excavation etc	15.00%	**1037551521**
		7954561664
Towards Design, Supply & Installation of E&M equipments	30.00%	**2386368499**
		10340930163

Assumptions

1. Transportation lead for Muck is 54 km
2. Losses have been considered for the following items
   - Wire mesh
   - Shotcrete
   - Excavation
3. Market Rates have been taken from PPRt, NFR Railways & Z-Mohr Projects with 5% annual escalation.
4. Croos Passage Support Quantities have been taken from Z-Morh Project because Z-Morh Cross Passages is similar to Shiradi Ghat Tunnel Cross Passages.
5. Portal & Portal Slope Quantites have been taken from PPRT Project.
6. Pavement Quantity will be taken by Highway Engineer in their estimate.

I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

TUNNEL 2

S No	Item Description	Left	Right	CP	Portal	Unit (quantity)	Total Quantity	Unit (rates Rs per)	Rate	Amount
A102	**Theoretical Excavation Volume**									
A1021	Underground Excavation - Blasting (Rock)	303497	295410	8919		m^3	607826	m^3	3388	**2059313299**
A1022	Underground Excavation - Excavator (Soil/Soil like)	16119	15499	0		m^3	31618	m^3	2000	**63235475**
A106	**M25 - Shotcrete**	0	0	0						
A1061	50mm thickness	1812	1763	278		m^3	3853	m^3	16464	**63438545**
A1062	100mm thickness	4105	3996	0	795	m^3	8896	m^3	16464	**146461346**
A1063	150mm thickness	3974	3868	604		m^3	8447	m^3	16464	**139063285**
A1064	200mm thickness	652	634	0	34	m^3	1320	m^3	16464	**21724364**
A1065	250mm thickness	896	872	0		m^3	1768	m^3	16464	**29110364**
A1066	300mm thickness	1412	1374	0		m^3	2786	m^3	16464	**45870876**
A108	**Wire Mesh, Fy = 500 N/mm2**									
A1081	150/150/6mm	80733	77606	3710	7517	m^2	169566	m^2	600	**101739695**
A1082	150/150/8mm	0	0	0		m^2	0			
A110	**Rock bolts, SW type**									
A1101	3m length	1222	1189	0		pcs	2411	No.	11200	**27004048**
A1102	4m length	0	0	0		pcs	0			
A1103	6m length	0	0	0		pcs	0			
A111	**Rock bolts, SN type**									
A1111	3m length	0	0	0		pcs	0			
A1112	4m length	4577	4455	901	1251	pcs	11183	m	1232	**55111235**
A1113	6m length	576	561	0	88	pcs	1225	m	1232	**9051755**
A112	**Rock bolts, SD type**									
A1122	4m length	0	0	0		pcs	0			
A1123	6m length	1407	1369	0		pcs	2776	No.	13028.4	**36171922**
A1124	9m length	566	551	0		pcs	1116	No.	18411.4	**20551518**
A1125	12m length	0	0	0		pcs	0			
A115	**Lattice Girder, Fe 500**									
A1153	95/20/25	2602	2533	1919		m	7054	t	132456	**10745113**
A1154	130/32/25	2863	2787	0		m	5650	t	132456	**13171885**
A116	**Forepoling**									

A1161	25mm dia, 4m length, SN type	634	617	0		pcs	1250	m	1332	**6660998**
A1162	25mm dia, 4m length, rammed	0	0	0		pcs	0			
A117	**Forepoling, SD type**	0	0	0						
A1172	25mm dia, 4m length	0	0	2520		pcs	2520	No.	9363	**94381056**
A1173	32mm dia, 4m length	5990	5830	0		pcs	11820	No.	9503	**449309532**
A1174	32mm dia, 5m length	0	0	0		pcs	0			
A195	**Bolts, SD type R38N**									
A1951	6m length	0	0	0		pcs	0	No.	9643	**0**
A1952	9m length	0	0	0		pcs	0	No.	9643	**0**
A1953	12m length	0	0	0		pcs	0	No.	9643	**0**
A1954	15m length	0	0	0		pcs	0	No.	9643	**0**
A200	**Rebars in Poratl Area**	0	0	0		t	0	t	60000	**0**
B155	**Drainage Pipes 50 mm dia PVC pipe**	905	881	0		pcs	1786	m	300	**3214768**
B156	**Base Drainage pipe, 300mm dia PVC pipe**	2057	2002	0		m	4059	m	2195	**8909615**
B157	**Plugging concrete for base drainage pipe**	309	300	0		m^3	609	m^3	5000	**3044288**
B158	**Weep Holes**	3785	3684	0		pcs	7469	No.	204	**1523605**
B169	**Collector Drainage Pipe, 200m dia**	2057	2002	0		m	4059	m	1094	**4440601**
B170	**Waterproofing Membrane**	63624	61929	6496		m^2	132049	m^2	2200	**290507743**
C100	**Concrete - Inner Lining**	37197	36206	0		m^3	73402	m^3	11200	**822105050**
C101	**Steel - Inner Lining Reinforcement**	1256200	1222727	0		kg	2478927	t	60000	**148735607**
										4674597586
	Misc Cost for Precast Manholes, No Fine Porous Concrete, Footpath, Polyproplene Fibre, portal excavation etc								15.00%	**701189638**
										5375787223
	Towards Design, Supply & Installation of E&M equipments								30.00%	**1612736167**
										6988523390

Assumptions

1 Transportation lead for Muck is 54 km

2 Losses have been considered for the following items
Wire mesh
Shotcrete
Excavation

3 Market Rates have been taken from PPRt, NFR Railways & Z-Mohr Projects with 5% annual escalation.

4 Croos Passage Support Quantities have been taken from Z-Morh Project because Z-Morh Cross Passages is similar to Shiradi Ghat Tunnel Cross Passages.

5 Portal & Portal Slope Quantites have been taken from PPRT Project.

6 Pavement Quantity will be taken by Highway Engineer in their estimate.

I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

TUNNEL 3

S No	Item Description	Left	Right	CP	Portal	Unit (quantity)	Total Quantity	Unit (rates Rs per)	Rate	Amount
A102	**Theoretical Excavation Volume**									
A1021	Underground Excavation - Blasting (Rock)	292226	284117	8919		m^3	585262	m^3	3388	**1982868524**
A1022	Underground Excavation - Excavator (Soil/Soil like)	32647	31355	0		m^3	64002	m^3	2000	**128004044**
A106	**M25 - Shotcrete**									
A1061	50mm thickness	2685	2610	278		m^3	5573	m^3	16464	**91748204**
A1062	100mm thickness	4003	3892	0	795	m^3	8690	m^3	16464	**143077900**
A1063	150mm thickness	3909	3801	604		m^3	8315	m^3	16464	**136894321**
A1064	200mm thickness	990	962	0	34	m^3	1986	m^3	16464	**32694798**
A1065	250mm thickness	0	0	0		m^3	0	m^3	16464	**0**
A1066	300mm thickness	2860	2780	0		m^3	5640	m^3	16464	**92853533**
A108	**Wire Mesh, Fy = 500 N/mm2**									
A1081	150/150/6mm	84614	80293	3710	7517	m^2	176134	m^2	600	**105680659**
A1082	150/150/8mm	0	0	0		m^2	0			
A110	**Rock bolts, SW type**	0	0	0						
A1101	3m length	1191	1158	0		pcs	2350	No.	11200	**26319029**
A1102	4m length	0	0	0		pcs	0			
A1103	6m length	0	0	0		pcs	0			
A111	**Rock bolts, SN type**									
A1111	3m length	0	0	0		pcs	0			
A1112	4m length	4274	4156	901	1251	pcs	10582	m	1232	**52148138**
A1113	6m length	425	413	0	88	pcs	926	m	1232	**6845590**
A112	**Rock bolts, SD type**									
A1122	4m length	0	0	0		pcs	0			
A1123	6m length	2850	2771	0		pcs	5620	No.	13028.4	**73220550**
A1124	9m length	1083	1053	0		pcs	2136	No.	18411.4	**39331994**
A1125	12m length	0	0	0		pcs	0			
A115	**Lattice Girder, Fe 500**									
A1153	95/20/25	1600	1555	1919		m	5075	t	132456	**7729745**
A1154	130/32/25	5799	5638	0		m	11437	t	132456	**26663020**
A116	**Forepoling**									

A1161	25mm dia, 4m length, SN type	962	936	0		pcs	1898	m	1332	**10112581**
A1162	25mm dia, 4m length, rammed	0	0	0		pcs	0			
A117	**Forepoling, SD type**									
A1172	25mm dia, 4m length	0	0	2520		pcs	2520	No.	9363	**94381056**
A1173	32mm dia, 4m length	9432	9170	0		pcs	18602	No.	9503	**707118314**
A1174	32mm dia, 5m length	0	0	0		pcs	0			
A195	**Bolts, SD type R38N**									
A1951	6m length	0	0	0		pcs	0	No.	9643	**0**
A1952	9m length	0	0	0		pcs	0	No.	9643	**0**
A1953	12m length	0	0	0		pcs	0	No.	9643	**0**
A1954	15m length	0	0	0		pcs	0	No.	9643	**0**
A200	**Rebars in Poratl Area**					t	0	t	60000	**0**
B155	**Drainage Pipes 50 mm dia PVC pipe**	1166	1134	0		pcs	2301	m	300	**4141106**
B156	**Base Drainage pipe, 300mm dia PVC pipe**	2083	2025	0		m	4108	m	2195	**9017587**
B157	**Plugging concrete for base drainage pipe**	312	304	0		m^3	616	m^3	5000	**3081180**
B158	**Weep Holes**	3999	3888	0		pcs	7888	No.	204	**1609115**
B169	**Collector Drainage Pipe, 200m dia**	2083	2025	0		m	4108	m	1094	**4494415**
B170	**Waterproofing Membrane**	64431	62643	6496		m^2	133571	m^2	2200	**293855109**
C100	**Concrete - Inner Lining**	37991	36937	0		m^3	74928	m^3	11200	**839190513**
C101	**Steel - Inner Lining Reinforcement**	1302104	1265973	0		kg	2568077	t	60000	**154084635**
										5067165661
	Misc Cost for Precast Manholes, No Fine Porous Concrete, Footpath, Polyproplene Fibre, portal excavation etc								15.00%	**760074849**
										5827240510
	Towards Design, Supply & Installation of E&M equipments								30.00%	**1748172153**
										7575412663

Assumptions

1. Transportation lead for Muck is 54 km
2. Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation
3. Market Rates have been taken from PPRt, NFR Railways & Z-Mohr Projects with 5% annual escalation.
4. Croos Passage Support Quantities have been taken from Z-Morh Project because Z-Morh Cross Passages is similar to Shiradi Ghat Tunnel Cross Passages.
5. Portal & Portal Slope Quantites have been taken from PPRT Project.
6. Pavement Quantity will be taken by Highway Engineer in their estimate.

I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

TUNNEL 4

S No	Item Description	Left	Right	CP	Portal	Unit (quantity)	Total Quantity	Unit (rates Rs per)	Rate	Amount
A102	**Theoretical Excavation Volume**									
A1021	Underground Excavation - Blasting (Rock)	267555	271143	7645		m^3	546343	m^3	3388	**1851009375**
A1022	Underground Excavation - Excavator (Soil/Soil like)	29812	29845	0		m^3	59657	m^3	2000	**119313639**
A106	**M25 - Shotcrete**									
A1061	50mm thickness	2652	2688	238		m^3	5579	m^3	16464	**91845001**
A1062	100mm thickness	2882	2921	0	795	m^3	6598	m^3	16464	**108632450**
A1063	150mm thickness	3885	3937	518		m^3	8340	m^3	16464	**137311076**
A1064	200mm thickness	2109	2137	0	34	m^3	4280	m^3	16464	**70467457**
A1065	250mm thickness	0	0	0		m^3	0	m^3	16464	**0**
A1066	300mm thickness	2611	2646	0		m^3	5258	m^3	16464	**86560520**
A108	**Wire Mesh, Fy = 500 N/mm2**									
A1081	150/150/6mm	78027	77194	3180	7517	m^2	165919	m^2	600	**99551196**
A1082	150/150/8mm	0	0	0		m^2	0			
A110	**Rock bolts, SW type**									
A1101	3m length	858	869	0		pcs	1727	No.	11200	**19345136**
A1102	4m length	0	0	0		pcs	0			
A1103	6m length	0	0	0		pcs	0			
A111	**Rock bolts, SN type**									
A1111	3m length	0	0	0		pcs	0			
A1112	4m length	5001	5068	772	1251	pcs	12092	m	1232	**59588245**
A1113	6m length	905	918	0	88	pcs	1911	m	1232	**14126035**
A112	**Rock bolts, SD type**									
A1122	4m length	0	0	0		pcs	0			
A1123	6m length	2602	2637	0		pcs	5239	No.	13028.4	**68258134**
A1124	9m length	989	1002	0		pcs	1992	No.	18411.4	**36666325**
A1125	12m length	0	0	0		pcs	0			
A115	**Lattice Girder, Fe 500**									
A1153	95/20/25	3409	3454	1645		m	8508	t	132456	**12960094**
A1154	130/32/25	5296	5367	0		m	10662	t	132456	**24855973**
A116	**Forepoling**									

A1161	25mm dia, 4m length, SN type	2051	2078	0		pcs	4129	m	1332	**21996835**
A1162	25mm dia, 4m length, rammed	0	0	0		pcs	0			
A117	**Forepoling, SD type**									
A1172	25mm dia, 4m length	0	0	2160		pcs	2160	No.	9363	**80898048**
A1173	32mm dia, 4m length	8613	8728	0		pcs	17341	No.	9503	**659194397**
A1174	32mm dia, 5m length	0	0	0		pcs	0			
A195	**Bolts, SD type R38N**									
A1951	6m length	0	0	0		pcs	0	No.	9643	**0**
A1952	9m length	0	0	0		pcs	0	No.	9643	**0**
A1953	12m length	0	0	0		pcs	0	No.	9643	**0**
A1954	15m length	0	0	0		pcs	0	No.	9643	**0**
A200	**Rebars in Poratl Area**					t	0	t	60000	**0**
B155	**Drainage Pipes 50 mm dia PVC pipe**	1674	1696	0		pcs	3370	m	300	**6066419**
B156	**Base Drainage pipe, 300mm dia PVC pipe**	1902	1928	0		m	3830	m	2195	**8406433**
B157	**Plugging concrete for base drainage pipe**	285	289	0		m^3	574	m^3	5000	**2872358**
B158	**Weep Holes**	4489	4549	0		pcs	9038	No.	204	**1843824**
B169	**Collector Drainage Pipe, 200m dia**	1902	1928	0		m	3830	m	1094	**4189812**
B170	**Waterproofing Membrane**	58837	59626	5568		m^2	124030	m^2	2200	**272866528**
C100	**Concrete - Inner Lining**	34692	35157	0		m^3	69850	m^3	11200	**782315595**
C101	**Steel - Inner Lining Reinforcement**	1189042	1204988	0		kg	2394030	t	60000	**143641773**
										4784782679
	Misc Cost for Precast Manholes, No Fine Porous Concrete, Footpath, Polyproplene Fibre, portal excavation etc								15.00%	**717717402**
										5502500080
	Towards Design, Supply & Installation of E&M equipments								30.00%	**1650750024**
										7153250105

Assumptions

1. Transportation lead for Muck is 54 km
2. Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation
3. Market Rates have been taken from PPRt, NFR Railways & Z-Mohr Projects with 5% annual escalation.
4. Croos Passage Support Quantities have been taken from Z-Morh Project because Z-Morh Cross Passages is similar to Shiradi Ghat Tunnel Cross Passages.
5. Portal & Portal Slope Quantites have been taken from PPRT Project.
6. Pavement Quantity will be taken by Highway Engineer in their estimate.

I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

TUNNEL 5

S No	Item Description	Left	Right	CP	Portal	Unit (quantity)	Total Quantity	Unit (rates Rs per)	Rate	Amount
A102	**Theoretical Excavation Volume**									
A1021	Underground Excavation - Blasting (Rock)	238339	231864	6371		m^3	476574	m^3	3388	**1614632458**
A1022	Underground Excavation - Excavator (Soil/Soil like)	26581	25545	0		m^3	52125	m^3	2000	**104250644**
A106	**M25 - Shotcrete**									
A1061	50mm thickness	2342	2279	199		m^3	4820	m^3	16464	**79354558**
A1062	100mm thickness	2946	2866	0	795	m^3	6607	m^3	16464	**108775219**
A1063	150mm thickness	2996	2914	432		m^3	6342	m^3	16464	**104413208**
A1064	200mm thickness	1746	1699	0	34	m^3	3479	m^3	16464	**57270491**
A1065	250mm thickness	0	0	0		m^3	0	m^3	16464	**0**
A1066	300mm thickness	2328	2265	0		m^3	4593	m^3	16464	**75623067**
A108	**Wire Mesh, Fy = 500 N/mm2**									
A1081	150/150/6mm	69476	65981	2650	7517	m^2	145625	m^2	600	**87374876**
A1082	150/150/8mm	0	0	0		m^2	0			
A110	**Rock bolts, SW type**									
A1101	3m length	877	853	0		pcs	1730	No.	11200	**19374041**
A1102	4m length	0	0	0		pcs	0			
A1103	6m length	0	0	0		pcs	0			
A111	**Rock bolts, SN type**									
A1111	3m length	0	0	0		pcs	0			
A1112	4m length	3936	3829	644	1251	pcs	9660	m	1232	**47606011**
A1113	6m length	750	729	0	88	pcs	1567	m	1232	**11582402**
A112	**Rock bolts, SD type**									
A1122	4m length	0	0	0		pcs	0			
A1123	6m length	2320	2257	0		pcs	4577	No.	13028.4	**59633300**
A1124	9m length	882	858	0		pcs	1740	No.	18411.4	**32033310**
A1125	12m length	0	0	0		pcs	0			
A115	**Lattice Girder, Fe 500**									
A1153	95/20/25	2822	2745	1371		m	6939	t	132456	**10569121**
A1154	130/32/25	4722	4593	0		m	9315	t	132456	**21715268**
A116	**Forepoling**									
A1161	25mm dia, 4m length, SN type	1698	1652	0		pcs	3349	m	1332	**17844729**

A1162	25mm dia, 4m length, rammed	0	0	0		pcs	0			
A117	**Forepoling, SD type**									
A1172	25mm dia, 4m length	0	0	1800		pcs	1800	No.	9363	**67415040**
A1173	32mm dia, 4m length	7679	7471	0		pcs	15150	No.	9503	**575901139**
A1174	32mm dia, 5m length	0	0	0		pcs	0			
A195	**Bolts, SD type R38N**									
A1951	6m length	0	0	0		pcs	0	No.	9643	**0**
A1952	9m length	0	0	0		pcs	0	No.	9643	**0**
A1953	12m length	0	0	0		pcs	0	No.	9643	**0**
A1954	15m length	0	0	0		pcs	0	No.	9643	**0**
A200	**Rebars in Poratl Area**					t	0	t	60000	**0**
B155	**Drainage Pipes 50 mm dia PVC pipe**	1425	1386	0		pcs	2811	m	300	**5058986**
B156	**Base Drainage pipe, 300mm dia PVC pipe**	1696	1650	0		m	3346	m	2195	**7344229**
B157	**Plugging concrete for base drainage pipe**	254	247	0		m^3	502	m^3	5000	**2509418**
B158	**Weep Holes**	3595	3498	0		pcs	7093	No.	204	**1447031**
B169	**Collector Drainage Pipe, 200m dia**	1696	1650	0		m	3346	m	1094	**3660404**
B170	**Waterproofing Membrane**	52460	51035	4640		m^2	108134	m^2	2200	**237894406**
C100	**Concrete - Inner Lining**	30932	30092	0		m^3	61024	m^3	11200	**683465218**
C101	**Steel - Inner Lining Reinforcement**	1060164	1031365	0		kg	2091529	t	60000	**125491753**
										4162240325

Misc Cost for Precast Manholes, No Fine Porous Concrete, Footpath, Polyproplene Fibre, portal excavation etc	15.00%	**624336049**
		4786576374
Towards Design, Supply & Installation of E&M equipments	30.00%	**1435972912**
		6222549286

Assumptions

1. Transportation lead for Muck is 54 km
2. Losses have been considered for the following items
   - Wire mesh
   - Shotcrete
   - Excavation
3. Market Rates have been taken from PPRt, NFR Railways & Z-Mohr Projects with 5% annual escalation.
4. Croos Passage Support Quantities have been taken from Z-Morh Project because Z-Morh Cross Passages is similar to Shiradi Ghat Tunnel Cross Passages.
5. Portal & Portal Slope Quantites have been taken from PPRT Project.
6. Pavement Quantity will be taken by Highway Engineer in their estimate.

I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

TUNNEL 6

S No	Item Description	Left	Right	CP	Portal	Unit (quantity)	Total Quantity	Unit (rates Rs per)	Rate	Amount
A102	**Theoretical Excavation Volume**									
A1021	Underground Excavation - Blasting (Rock)	299301	241256	6371		m^3	546928	m^3	3388	**1852993039**
A1022	Underground Excavation - Excavator (Soil/Soil like)	7803	6214	0		m^3	14017	m^3	2000	**28033530**
A106	**M25 - Shotcrete**									
A1061	50mm thickness	1312	1058	199		m^3	2568	m^3	16464	**42281936**
A1062	100mm thickness	2429	1958	0	795	m^3	5182	m^3	16464	**85310620**
A1063	150mm thickness	4177	3367	432		m^3	7976	m^3	16464	**131324809**
A1064	200mm thickness	4259	3433	0	34	m^3	7725	m^3	16464	**127186113**
A1065	250mm thickness	0	0	0		m^3	0	m^3	16464	**0**
A1066	300mm thickness	683	551	0		m^3	1234	m^3	16464	**20323802**
A108	**Wire Mesh, Fy = 500 N/mm2**									
A1081	150/150/6mm	74065	59310	2650	7517	m^2	143543	m^2	600	**86125722**
A1082	150/150/8mm	0	0	0		m^2	0			
A110	**Rock bolts, SW type**									
A1101	3m length	723	583	0		pcs	1306	No.	11200	**14623353**
A1102	4m length	0	0	0		pcs	0			
A1103	6m length	0	0	0		pcs	0			
A111	**Rock bolts, SN type**									
A1111	3m length	0	0	0		pcs	0			
A1112	4m length	6709	5408	644	1251	pcs	14012	m	1232	**69052554**
A1113	6m length	1828	1474	0	88	pcs	3390	m	1232	**25058202**
A112	**Rock bolts, SD type**									
A1122	4m length	0	0	0		pcs	0			
A1123	6m length	681	549	0		pcs	1230	No.	13028.4	**16026531**
A1124	9m length	259	209	0		pcs	468	No.	18411.4	**8608996**
A1125	12m length	0	0	0		pcs	0			
A115	**Lattice Girder, Fe 500**									
A1153	95/20/25	6883	5548	1371		m	13802	t	132456	**21023377**
A1154	130/32/25	1386	1117	0		m	2503	t	132456	**5836008**
A116	**Forepoling**									

A1161	25mm dia, 4m length, SN type	4140	3337	0		pcs	7478	m	1332	**39841991**
A1162	25mm dia, 4m length, rammed	0	0	0		pcs	0			
A117	**Forepoling, SD type**									
A1172	25mm dia, 4m length	0	0	1800		pcs	1800	No.	9363	**67415040**
A1173	32mm dia, 4m length	2254	1817	0		pcs	4072	No.	9503	**154774217**
A1174	32mm dia, 5m length	0	0	0		pcs	0			
A195	**Bolts, SD type R38N**									
A1951	6m length	0	0	0		pcs	0	No.	9643	**0**
A1952	9m length	0	0	0		pcs	0	No.	9643	**0**
A1953	12m length	0	0	0		pcs	0	No.	9643	**0**
A1954	15m length	0	0	0		pcs	0	No.	9643	**0**
A200	**Rebars in Poratl Area**					t	0	t	60000	**0**
B155	**Drainage Pipes 50 mm dia PVC pipe**	2310	1862	0		pcs	4172	m	300	**7510223**
B156	**Base Drainage pipe, 300mm dia PVC pipe**	1992	1605	0		m	3597	m	2195	**7895086**
B157	**Plugging concrete for base drainage pipe**	299	241	0		m^3	540	m^3	5000	**2697638**
B158	**Weep Holes**	5337	4302	0		pcs	9640	No.	204	**1966470**
B169	**Collector Drainage Pipe, 200m dia**	1992	1605	0		m	3597	m	1094	**3934954**
B170	**Waterproofing Membrane**	61602	49655	4640		m^2	115896	m^2	2200	**254972168**
C100	**Concrete - Inner Lining**	34473	27787	0		m^3	62260	m^3	11200	**697312389**
C101	**Steel - Inner Lining Reinforcement**	1072994	864903	0		kg	1937896	t	60000	**116273787**
										3888402553
	Misc Cost for Precast Manholes, No Fine Porous Concrete, Footpath, Polyproplene Fibre, portal excavation etc								15.00%	**583260383**
										4471662936
	Towards Design, Supply & Installation of E&M equipments								30.00%	**1341498881**
										5813161817

Assumptions

1. Transportation lead for Muck is 54 km
2. Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation
3. Market Rates have been taken from PPRt, NFR Railways & Z-Mohr Projects with 5% annual escalation.
4. Croos Passage Support Quantities have been taken from Z-Morh Project because Z-Morh Cross Passages is similar to Shiradi Ghat Tunnel Cross Passages.
5. Portal & Portal Slope Quantites have been taken from PPRT Project.
6. Pavement Quantity will be taken by Highway Engineer in their estimate.

ANNEXURE – 2

Abstract of Cost Estimate – Bridges

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

Abstract : Cost Estimate for Bridges, ROB and Viaduct

Items	Unit	Bridge 0	Bridge1	Bridge 2	Bridge 2 - Spl	Bridge 3	Bridge 4	Bridge 4 - Spl	Bridge 5	Bridge 6	ROB	Via Duct	Total	Rate (Rs)	Amount (Rs)
Foundation	Cum	56250.0	9375.0	204375.0	102187.5	9375.0	191250.0	95625.0	18750.0	37500.0	56250.0	603000.0	1383937.5	8500	11763468750
Cap	Cum	651.3	186.1			186.1			279.1	465.2	465.2		2233.1	8500	18981620
Shaft - Minor Bridges	Cum	645.8	125.7			91.9			492.6	2370.6	474.0		4200.6	9500	39905700
Y-Pier	Cum				32461.6			15154.9					47616.6	50000	2380828740
Cap Tall Piers	Cum			10886.8			18734.4					78113.9	107735.2	40000	4309407289
Shaft -Tall Piers	Cum			15293.1	25615.7		23278.1	7717.3				111749.1	183653.2	40000	7346126621
Footing	Cum	1270.9	363.1	4306.0	6100.0	363.1	7594.0	2800.0	750.2	1318.9	907.8	33420.0	59194.0	8500	503148632
Pedestal	Cum	9.1	1.5	10.6	1.5	1.5	19.8	0.0	3.0	6.1	6.1	89.7	149.0	9200	1370432
Bearing															
Fixed(capacity 650t)	Nos.	12.0	2.0	12.0	0.0	2.0	24.0	0.0	4.0	8.0	8.0	116.0	188.0	139050	26141400
Guided (capacity 650t)	Nos.	24.0	4.0	28.0	4.0	4.0	52.0	0.0	8.0	16.0	16.0	236.0	392.0	125120	49047040
Free (capacity 650t)	Nos.	12.0	2.0	16.0	4.0	2.0	28.0	0.0	4.0	8.0	8.0	120.0	204.0	115000	23460000
Dirt wall	Cum	84.6	84.6	90.6	0.0	84.6	90.6	0.0	84.6	84.6	84.6	90.6	779.3	9500	7403184
Approach slab	Cum	88.9	88.9	150.6	0.0	88.9	150.6	0.0	68.4	123.1	109.4	150.6	1019.5	9500	9685440
RE Wall	Sqm	697.0	569.7	6378.6	0.0	321.3	5247.9	0.0	270.2	657.1	362.5	1431.0	15935.4	8000	127483320
Back Fill	Cum	2891.1	2340.7	61987.5	0.0	1069.2	49616.1	0.0	799.5	2245.4	1291.5	12952.1	135193.1	2200	297424760
Friction slab(capping wall)	Cum	189.9	147.7	611.9		84.4	540.2		84.4	76.0	126.6	409.3	2270.4	8500	19298060
Deck/Box - M60	Cum				15147.8			7573.9					22721.7	15000	340825500
Deck/Box - M45	Cum	6141.0	1023.5	6141.0		1023.5	12282.0		2047.0	4094.0	4094.0	50616.1	87462.1	12500	1093276250
Drainage spout	Nos.	200.0	34.0	200.0	494.0	34.0	400.0	248.0	68.0	134.0	134.0	1968.0	3914.0	1600	6262400
Parapet	LM	1200.0	200.0	1200.0	2960.0	200.0	2400.0	1480.0	400.0	800.0	800.0	11800.0	23440.0	6000	140640000
Hand rail	LM	1200.0	200.0	1200.0	2960.0	200.0	2400.0	1480.0	400.0	800.0	800.0	11800.0	23440.0	2500	58600000
Pedestrian railing	LM	600.0	100.0	600.0	1480.0	100.0	1200.0	740.0	200.0	400.0	400.0	5900.0	11720.0	3500	41020000
Painting on railing	Sqm	1560.0	260.0	1560.0	3848.0	260.0	3120.0	1924.0	520.0	1040.0	1040.0	15340.0	30472.0	200	6094400
Wearing Surface (inculding water proofing)	Cum	396.9	66.2	396.9	979.0	66.2	793.8	489.5	132.3	264.6	264.6	3902.9	7752.8	15000	116291700
Expansion Joint (strip seal)	LM	98.4	24.6	123.0	24.6	24.6	196.8	0.0	49.2	73.8	73.8	713.4	1402.2	20000	28044000
Prestressing	MT	337.8	56.3	337.8	984.6	56.3	798.3	492.3	112.6	225.2	225.2	2783.9	6410.1	325000	2083297450
Reinforcement Fe500	MT	1423.9	297.6	6666.9	14639.9	285.5	11141.9	6061.6	588.1	1395.7	978.4	49502.9	92982.2	85000	7903491160
Structural Steel	MT				1477.5			738.7					2216.2	175000	387839068
Miscellaneous Items	LS												100	10000000	1000000000
														Total	**40128862916**
														Rs in (Cr.)	**4012.886**

ANNEXURE – 3

General Abstract of Cost – Road

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

GENERAL ABSTRACT OF COST

S No.	Description	Amount (Rs)
1	Site Clearance and Dismantling	14,256,246
2	Earthwork	914,284,714
3	Granular Base Course and Sub - Base	123,952,451
4(A)	Cement Concrete Pavement	1,917,861,987
4(B)	Bituminous Course	9,061,329
5	Culverts and Cross Drainage Works	167,213,336
6	Bridges	40,128,862,916
7	Drainage Works and Protection Works	2,168,139,209
8	Traffic Signs, Markings and Other Appurtenances.	74,378,824
9	Miscellaneous	398,027,321
10	Horticulture	8,149,534
11	Access / Approach Roads	4,150,000,000
12	Tunnels (6 Nos, Total Length 12.631 km)	44,093,827,424
	Total Civil Cost	**94,168,015,290**
	Civil Cost in Crores	**9,416.80**
	Cost per Km (Length = 23.579 Km.) in Crores	**399.37**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

ABSTRACT OF COST

Bill No. 1 : SITE CLEARANCE AND DISMANTLING

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
# # #	Removal of stumps and roots of girth above 300mm and back filling to required compaction complete as per Technical Specification clause 201 and 305.				
(	300 mm to 600mm	Nr.	1,061	218.00	231,298.00
(	600 mm to 900 mm.	Nr.	884	382.00	337,688.00
(	900 mm to 1800 mm.	Nr.	955	755.00	721,025.00
(	1800 mm and above	Nr.	637	1,442.00	918,554.00
1.02	Clearing and grubbing road land complete as per Technical Specifications Clause 201.	Hct.	190.00	62,630.00	11,899,700.00
1.03	Dismantling including disposal of unserviceable material and stacking the serviceable material complete as per Technical Specifications Clauses 202 .				
(i)	**Brick/Stone Masonry**	Cum	100.00	259.00	25,900.00
ii)	Plain Concrete/Reinforced cement concrete structures including cleaning, straightening & cutting of bars and separating them out from RCC/PCC.				
a)	PCC	Cum	100.00	383.00	38,300.00
b)	RCC	Cum	100.00	1,002.00	100,200.00
iii)	Stone Masonry	Cum	200.00	259.00	51,800.00
iv)	Hand Rail	Lm			-
v)	Kilometre Stone	Nr.			-
vi)	Hectometre Stone	Nr.			-
vii)	Kerb stone	Lm			-
viii)	Bituminous course	Cum	175.00	593.00	103,775.00
ix)	Granular course	Cum	750.00	422.00	316,500.00
1.04	Rebate towards salvage value of dismantled materials from pavement and structures as per Technical Specification Clause 202				
(i)	Brick Masonry	Cum	100.00	25.90	2,590.00
(ii)	Concrete PCC/RCC				
	a) PCC	Cum	100.00	38.30	3,830.00
	b) RCC	Cum	100.00	100.20	10,020.00
iii)	Stone Masonry	Cum	200.00	25.90	5,180.00
iv)	Hand Rail	Lm			-
v)	Kilometre Stone	Nr.			-
vi)	Hectometre Stone	Nr.			-
vii)	Kerb stone	Lm			-
viii	Bituminous Course	Cum	175.00	59.30	10,377.50
ix)	Granular course	Cum	750.00	42.20	31,650.00
1.05	**Rebate towards salvage value of Stumps.**				
(	300 mm to 600mm	Nr.	1,061	54.50	(57,825.00)
(	600 mm to 900 mm.	Nr.	884	95.50	(84,422.00)
(	900 mm to 1800 mm.	Nr.	955	188.75	(180,256.00)
(	1800 mm and above	Nr.	637	360.50	(229,639.00)
				Total Cost =	**14,256,245.50**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
ABSTRACT OF COST
Bill No. 2 : EARTH WORK

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
2.01	Earthwork in **excavation** necessary for construction of roadway and drainage in all types of soil all complete as per Technical Specifications Clause 301.				
(i)	Ordinary / Hard soil	Cum	691,712.00	140.00	96,839,680.00
(ii)	Soft/Ordinary Rock	Cum	288,213.00	310.00	89,346,030.00
(iii)	Hard Rock	Cum	691,712.00	894.50	618,736,384.00
2.02	Construction of **embankment with approved material** with all leads and lifts all complete as per drawings and Technical Specifications Clause 305.	Cum.	222,548.00	244.00	54,301,712.00
2.03	Construction of **embankment with suitable material obtained from roadway**, drainage excavation etc. with all leads and lifts all complete as per drawings and Technical Specifications Clause 305.	Cum.	325,644.00	82.00	26,702,808.00
2.04	Construction of **Subgrade** with approved material satisfying the requirements of minimum soaked CBR value as indicated in the drawings including all leads and lifts complete as per Technical Specifications Clause 305.	Cum.	105,030.00	270.00	28,358,100.00
				Total Cost =	**914,284,714.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
ABSTRACT OF COST
Bill No. 3 : GRANULAR BASE COURSE AND SUB-BASE

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
3.01	Constructing **Granular Sub-base** complete as per Technical Specifications Clause 401. Grading –I (Table–400-1).	Cum.	59,360.00	1,540.00	91,414,400.00
3.02	Constructing **Wet mix macadam** base complete as per Technical Specifications Clause 406.	Cum.	18,819.00	1,729.00	32,538,051.00
				Total Cost =	**123,952,451.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
ABSTRACT OF COST
Bill No. 4 A : CEMENT CONCRETE PAVEMENT

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
4A.01	Providing & construction of **Dry Lean Cement Concrete** Base of Grade M15 for cement concrete pavement as per drawing, as directed by the Engineer and as per Technical Specifications Clause 601.	Cum	55,201.00	6,592.00	363,884,992.00
4A.02	Construction of M40 grade cement **concrete pavement** including and providing 2 coats of wax based white pigment complete as per drawing and Technical Specification Clause 602	Cum	117,763.00	13,195.80	1,553,976,995.40
				Total Cost =	**1,917,861,987.40**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
ABSTRACT OF COST
Bill No. 4 B: BITUMINOUS COURSE

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
4B.01	Providing and laying Bituminous Emulsion **Prime coat** over granular surface with medium curing cutback complete as per Technical Specifications Clause 502.	Sqm	75,280.00	24.00	1,806,720.00
4B.02	Providing and laying **Tack Coat** with Bituminous Emulsion all complete as per Technical Specifications Clause 503.				
	(a) On granular surface.	Sqm	75,280.00	11.00	828,080.00
	(b) On Bituminous surface.	Sqm	3,650.00	9.00	32,850.00
4B.03	Providing and laying **Dense Graded Bituminous Macadam** Course with 60/70 Bitumen complete as per Technical Specification Clause 521 and confirming to IRC-SP-53.	Cum	219.00	7,946.00	1,740,174.00
4B.04	Providing & laying **Bituminous Concrete** wearing course PMB complete as per drawing and Technical Specifications Clause 521 and confirming to IRC-SP-53.	Cum.	503.00	9,251.50	4,653,504.50
				Total Cost =	**9,061,328.50**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

ABSTRACT OF COST

Bill No. 7 : DRAINAGE WORKS AND PROTECTION WORKS

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
7.01	Earthwork in **excavation** for construction of drains including disposal of surplus excavated earth with all leads Technical Specifications section 300	Cum	234,127.00	42.00	9,833,334.00
7.02	Providing cement concrete for Levelling Course grade below masonry drains, RCC Drains, vertical falls, outfalls, Toe Wall , cut off wall, escape for drainage arrangement as per drawings and Technical Specifications sections 1500, 1700 and 2500.	Cum			
	a) PCC M-10 grade		3,957.00	4,872.00	19,278,504.00
	b) PCC M-15 grade		23,191.00	5,690.00	131,956,790.00
7.03	Providing **PCC M-20 Grade** for Drain, Utility duct, toe wall, drainage chute etc. as per drawing and Technical Specification.	Cum	16,842.00	6,218.00	104,723,556.00
7.04	Providing **Reinforced Cement Concrete M-20 Grade** for drains and toe wall etc. as per drawing and Technical Specification.	Cum	36,688.00	5,919.00	217,156,272.00
7.05	Providing & fixing **HYSD Reinforcement** for Drain, Utility duct, toe wall etc. as per drawings & Technical Specifications Section 1600.	MT	2,018.00	71,284.00	143,851,112.00
7.06	Providing & Fixing of Heavy duty pipe of 200 mm Dia for Utility Duct as per drawings & Technical Specifications.	Lm	34,504.00	3,327.00	114,794,808.00
7.07	Providing PCC / RCC Median Drain at Super elevated portion as per drawing and Technical Specification.				
	a) PCC M-15	Cum	503.00	5,690.00	2,862,070.00
	b) PCC M-20	Cum	1,799.00	6,218.00	11,186,182.00
	c) RCC M-20	Cum	39.00	5,919.00	230,841.00
	d) RCC M-25	Cum	6.00	6,488.00	38,928.00
	e) HYSD Reinforcement	MT	4.00	71,284.00	285,136.00
	f) 1000 Dia Hume Pipe	Lm	210.00	5,699.00	1,196,790.00
7.08	Providing Metallic Crash Barrier (W-Type) complete as per Drawings And Technical Specifications Clause 810	Lm			
	a) Double " W " beam		43,336.00	5,053.00	218,976,808.00
	b) Single " W " beam		14,000.00	3,686.00	51,604,000.00
7.09	Filter material underneath stone pitching on slopes complete as per drawing and Technical specifications section 2500	Cum	24,514.00	1,802.00	44,174,228.00
7.10	Providing and laying stone pitching on Road slopes, Canal Diversion work and river bed for protection against scour with stone boulders complete as per drawing and Technical specification.	Cum	36,134.00	1,500.00	54,201,000.00
7.11	Providing and laying boulders apron on river bed for protection against scour with stone boulders weighing not less than 40 kg each complete as per drawing and Technical specification.	Cum	1,200.00	1,500.00	1,800,000.00

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

ABSTRACT OF COST

Bill No. 7 : DRAINAGE WORKS AND PROTECTION WORKS

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
7.12	Providing and fixing 1.2 metres high GI barbed wire fencing with 1.8 m angle iron posts every 3 metres center to center founded in M15 grade cement concrete, wires, fixed with GI staples, turn buckles etc complete as per clause 807	Lm	9,242.00	415.00	3,835,430.00
7.13	**RCC Retaining Wall**				
i)	Excavation	Cum	58,527.00	42.00	2,458,134.00
ii)	Levelling course. M-15	Cum	2,787.00	5,690.00	15,858,030.00
iii)	RCC - M30	Cum	35,163.00	6,318.00	222,159,834.00
iv)	Filter Media Behind Wall	Cum	16,032.00	1,802.00	28,889,664.00
v)	Weep Hole	Nos	21,900.00	256.00	5,606,400.00
vi)	HYSD Reinforcement	MT	2,813.00	71,284.00	200,521,892.00
7.14	**REINFORCED EARTH WALLS** Construction of reinforced earth retaining structures together with construction of earthwork in layers , assembly and erection of reinforcing elements and placing of facing panels and all associated components as per Technical Specifications Section 3100				
(i)	Providing and laying RCC facia panels as per Technical Specifications Clause 3104 and approved design and drawing	Sqm	36,300.00	5,913.00	214,641,900.00
(ii)	Providing reinforced cement concrete M-40 grade crash barrier excluding reinforcement as per drawing and Technical Specifications Clauses 1500, 1600, 1700.	Cum	2,494.00	1,250.00	3,117,500.00
(iii)	Providing and Backfilling behind reinforced earth facia panels with approved selected imported fill material including all leads complete as per drawing and Technical Specifications Clauses 305 and 3103	Cum	140,000.00	1,250.00	175,000,000.00
(iv)	Providing HYSD Reinforcement	MT	276.22	71,284.00	19,690,066.00
7.15	Providing and installing sand column for ground improvement at high embankment location by using Prefabricated Vertical Drain of size 500mm diameter and 10m long completed as per Technical specification , drawing and as directed by the engineer-in -charge.	m	140,210.00	1,000.00	140,210,000.00
7.16	Providing drainage blanket on top of Vertical drain and then pre-loading with embankment fill completed as per Technical specification , drawing and as directed by the engineer-in -charge.	cum	4,000.00	2,000.00	8,000,000.00
				Total Cost =	**2,168,139,209.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

ABSTRACT OF COST

Bill No. 8 : TRAFFIC SIGNS MARKING AND OTHER APPURTENANCES

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
8.01	Pavement marking with hot applied thermoplastic paints conforming to ASTM D36/BS-3262 (Part - I) as per drawing & Technical Specifications Clause 803.				
A)	Lane/centre line/edge line/ transverse marking and any other markings.	Sqm.	18,160.00	1,500.00	27,240,000.00
B)	Directional Arrows, lettering etc. as per Drg. No.61 of MoRT&H Type "Design for Inter-sections on National Highways".	Nr.	1,150.00	100.00	115,000.00
8.02	Supplying and fixing at site retro-reflectorised type sign boards/signs made of encapsulated lense type of reflective sheeting fixed over aluminum sheeting 2.0 mm thick complete including vertical pipes/ angles/ posts etc. all complete as per drawing and Technical Specification.				
	a) Informatory Sign				
	Advance Direction/Destination Signs (800 x 600	sqm	4.80	11,910.00	57,168.00
	Direction Signs /Route Marker Signs (600 x 450)	sqm	2.70	11,910.00	32,157.00
	Reassurance Sign	sqm	1.62	11,910.00	19,294.00
	Place Identification (800x 300)	sqm	0.48	11,910.00	5,717.00
	Expressway Route Marker (600 x 450)	sqm	2.16	11,910.00	25,726.00
	Lane Sign (600 x 450)	sqm	1.62	11,910.00	19,294.00
	Truck Parking	sqm	1.62	11,910.00	19,294.00
	b) Cautionary/Warning Signs				
	Left/Right Curve Sign (900 triangle)	Nr.	11.00	4,394.000	48,334.00
	Median opening (900 triangle)	Nr.	4.00	4,394.000	17,576.00
	Object Hazard Marker (One way) (300 x 900)	Nr.	12.00	3,991.000	47,892.00
	Single Chevron (500 x 600)	Nr.	18.00	5,482.000	98,676.00
	Double Chevron	Nr.	3.00	6,844.000	20,532.00
	c) Mandatory signs				
	Speed Limit (600 dia.)	Nr.	12.00	4,083.00	48,996.00
	No parking / No Stopping Sign (900 triangle)	Nr.	8.00	4,394.00	35,152.00
	No Entry (900 triangle)	Nr.	2.00	4,394.00	8,788.00
	Bullock & Hand Craft Prohibited (900 triangle)	Nr.	4.00	4,394.00	17,576.00
	Cycle Prohibited (900 triangle)	Nr.	6.00	4,394.00	26,364.00
	Give way (900 triangle)	Nr.	4.00	4,394.00	17,576.00
	Pass either side sign (900 triangle)	Nr.	6.00	4,394.00	26,364.00
	Compulsary keep left (600 dia.)	Nr.	2.00	4,083.00	8,166.00
8.03	Providing and fixing retro-reflectorised road delineators complete as per drawing and Technical Specifications Clause 805.				
a)	Road Delineators	Nr	1,500.00	1,250.00	1,875,000.00
b)	Solar Road Studs	Nr.	3,796.00	1,500.00	5,694,000.00
c)	Median Marker	Nr.	811.00	750.00	608,250.00
d)	AFP Reflective Sheeting	Sqm	400.00	500.00	200,000.00
e)	Blinker Lights	Nr.	8.00	5,000.00	40,000.00

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

ABSTRACT OF COST

Bill No. 8 : TRAFFIC SIGNS MARKING AND OTHER APPURTENANCES

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
8.04	Supply and fixing tubular gantry mounted Overhead/cantilever signs. All components of signs & supports, other than the reflective portion shall be throughly descaled, cleaned, primed and painted with two coats of epoxy paint. The sign back side shall be with grey colour and post shall be in black & white alternate bands. The post below ground shall be painted with three coats of red lead paint. The sign shall be made as per IRC-67-2001 and Technical Specificatins Clause 801& 802 or as directed by the Engineer.				
	i) Erection of Over Head Gantry / Cantilever structure as per drawing including steel work in trusses, steel tubes cutting; fixing in position with welding and bolted complete in all respect.	Tonne	26.00	79,882.00	2,076,932.00
	ii) The sign boards made out of 2mm thick aluminum sheet, face to be fully covered by high intensity grade white retro reflective sheeting of encapsulated lens type. The background / border / symbols / legend / arrows shall be made by transparent overlay film of desired colour as per sign details except those in black which shall be of non reflective type. The sign plate shall be fixed with 6mm dia aluminium rivets on MS angle iron frame. The angle iron frame shall be made with angle of size 70mmx70mmx8mm with additional bracing at every 600mm c/c, if any dimension is more than 1200mm.	Sqm	59.00	9,500.00	560,500.00
8.05	Expressway Traffic management System	Km	23.58	1,500,000.00	35,368,500.00
				Total Cost =	**74,378,824.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
ABSTRACT OF COST
Bill No. 9 : MISCELLANEOUS

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
9.01	Providing and fixing reinforced cement concrete M-20 grade boundary stones, hectometre, km and 5th km stones including excavation, foundation concrete in M-10 grade and reinforcement including all inscriptions etc. complete as per drawings and Technical Specificaitons Section 800.				
a)	Hectometer stones	Nr.	189.00	610.00	115,290.00
b)	Kilometer stones	Nr.	38.00	2,252.00	85,576.00
c)	5th Kilometer stones	Nr.	9.00	3,695.00	33,255.00
d)	Boundary stones	Nr.	943.00	900.00	848,700.00
9.02	Supply of colour record photographs with negatives and two colour prints in approved size there from mounted in album as per Technical Specifications Clause 125.	Nr.	300.00	50.00	15,000.00
9.04	Supply of additional prints of coloured photographs of approved size as per Technical Specifications Clause 125.	Nr.	300.00	15.00	4,500.00
9.05	Supplying of colour video cassette records during construction as per Technical Specifications Clause 126.	Set	50.00	3,000.00	150,000.00
9.06	Providing and maintaining vehicles for the Employer including providing driver, POL. etc. complete as per Technical Specifications Clause 124.				
9.07	i) Hard top passenger Car 1 no.	Veh. months	60.00	70,000.00	4,200,000.00
	ii) Hard top Jeeps 4W drive, Maruti	Veh. months	60.00	60,000.00	3,600,000.00
9.08	Providing & Maintaining Mobile Phones of approved Quality as per directions of the Engineer including sim card				
a)	Mobile phones	Nr	20.00	15,000.00	300,000.00
b)	Maintenance of Mobile phones including repair and payment of Monthly Bills	Nr months	1,200.00	2,000.00	2,400,000.00
9.09	Providing Toll Plaza (Barrier Gates Etc.)	No.			
	i) At km 0+000 (Main Toll Plaza 1 No.)	1			140,000,000.00
	ii) At km 24+380 (2 Nos. Toll Plaza)	2			60,000,000.00
9.10	Providing Traffic Aid Post as per drawings	Sqm	200.00	10,000.00	2,000,000.00
9.11	Vehicle rescue post	No.	1.00	2,000,000.00	2,000,000.00
9.12	Administrative operational and maintenance base camp.	No.	1.00	1,500,000.00	1,500,000.00

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
ABSTRACT OF COST
Bill No. 9 : MISCELLANEOUS

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
9.13	Providing Medical Aid Post as per Drawings	Sqm	100.00	9,000.00	900,000.00
9.14	Way Side Amenities	No.			
	i) A Type - 1 No.		1.00	160,000,000.00	160,000,000.00
				8,000,000.00	-
9.15	Truck Parking	No	-	140,000,000.00	-
9.16	Supply, installation, testing and commissioning of lantern lowering type high mast of 20m height, hot dip galvanised complete with lowering / raising gear, galvanised lantern carriage, steel wire rope suitable size, internal electrical cable, electrical control panel, earthing terminal, providing the foundation with suitable anchor plates, feeder pillar, connecting cables between the masts, earthing including supply of light lamps, fixtures similar to Philips cat No. RVP301 or equivalent, obstruction lights, etc. complete as required for achieving the desired lighting levels, all as specified				
		No.	3.00	625,000.00	1,875,000.00
9.17	Providing temporary safety barricades of size 2m x 2.4m (4.8 Sqm) for demarcation during construction at site as per Drawings and Technical Specifications Clause 800 and clause.	Lm			
			5,000.00	3,500.00	17,500,000.00
	Salvage value of barricades	Lm.	500.00	1,000.00	500,000.00
				Total Cost =	**398,027,321.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
ABSTRACT OF COST
Bill No. 10 : HORTICULTURE

Item No.	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
10.01	Turfing of embankment slopes, verge and other locations with rough grassing all complete as per Technical Specifications Clause 307.	Sqm.	347,534.00	21.00	7,298,214.00
10.02	Providing, plantation mainatainace for one Year of flowering plants and shrubs in central verge as per Technical Specifications clause A11	km			
	A) Planting Flowering plants and shurbs		4.00	19,111.00	76,444.00
	B) Maintainace of flowering Plants and shurbs for one Year		4.00	169,394.00	677,576.00
10.03	Planting of trees by the road side (Avenue trees) in 0.60 m dia holes, 1 m deep dug in the ground, mixing the soil with decayed farm yard/sludge manure, planting the saplings, backfilling the trench, watering, fixing the tree guard and maintaining the plants for one year	Nos	800.00	81.00	64,800.00
10.04	Making lawns including ploughing and breaking of clod, removal of rubbish, dressing and supplying doobs grass roots and planting at 15 cm apart, including supplying and spreading of farm yard manure at rate of 0.18 cum per 100 sqm	sqm	2,500.00	13.00	32,500.00
				Total Cost =	**8,149,534.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

ABSTRACT OF COST FOR CROSS DRAINAGE STRUCTURES

Sl. No.	Description	Unit	Total Quantity	Rate (Rs)	Amount (Rs)
	Total culverts	24	Nos.		
1	Earthwork in excavation of foundation for structures including pipe culverts in all types of soil complete as per drawings and Technical Specification Clause 304, 309 and 2903.	cum.	14837.00	41.00	608317
2	Cement concrete in foundation/M-15 grade levelling course on pipe culvert and under approach slab etc.including centering and shuttering all complete as drawing and Technical Specifications Sections 2100 and 2200.	cum.	1689.00	5690.00	9610410
3	Providing and laying filter medium, behind abutments, retaining wall and return wall complete as per drawing and Technical Specifications Clause 2504.	cum.	4993.00	1250.00	6241250
4	Back filling behind abutments, wing walls/ retaining and return walls or any other area with selected granular material of approved quality complete as per drawing and Technical Specification clause 300.	cum.	10113.00	1250.00	12641250
5	M-20 grade Plain cement concrete in foundation and substructure including centering and shuterring but excluding reinforcement, complete as per drawing and Technical Specifications Sections 1500, 1700, 2100, 2200 and 2300.	cum.	2277.00	6218.00	14158386
6	M-25 grade Reinforced cement concrete in Box including centering and shuttering but excluding reinforcement, complete as per drawing and Technical Specifications Sections 1500 ,1700 and 2300.	cum.	7941.00	6488.00	51521208
7	HYSD TMT Fe-500 bar reinforcement for culverts, underpass, retaining walls etc. complete as per drawings and Technical Specifiations Section 1600.	MT	567.00	71284.00	40418028
8	Providing weep holes in abutments, wing walls, retaining walls, return walls etc. complete as per drawing and Technical Specifications Clause 2706.	Nr.	4074.00	250.00	1018500
9	Painting of culvert no. and span arrangement as per Technical Specifications Clause 803	Nr.	48.00	200.00	9600
10	Providing and laying Flexible apron complete as per drawing and Technical Specifications clause 2507	cum.	1923.00	1350.00	2596050
11	Providing and laying Stone apron complete as per drawing and Technical Specifications Clause 2505.				
	a) Stone Flooring.	cum.	143.00	5500.00	786500
	b) PCC M-15	cum.	67.02	5690.00	381344
12	Providing guard post span arrangement a with synthetic enamel as per Technical Specifications Clause 803	Nr.	48.00	500.00	24000
13	Providing cement concrete M-15 grade in cut off wall complete as per drawing and Technical Specifications Sections 1500 & 1700 and Clause 2507.	cum.	957.00	5690.00	5445330
14	Construction of Reinforced cement concrete in Approach Slab including centring, shuttering and reinforcement, complete as per drawing and Technical Specifications Sections 1500 ,1700 and 2300.				
	a) RCC M-30	cum.	1568.70	11022.00	17290211
	b) PCC M-15	cum.	784.35	5690.00	4462952
				Total Amount =	**167,213,336**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka
Bill of Quantities

SI. No.	Description	Unit	106 m	112 m	61 m	72 m	80 m	72 m	52 m	87 m	67 m	36 m	Total Quantity
			1x2.0x2.0	1x2.0x2.0	1x2.0x2.0	1x2.0x2.0	1x2.0x2.0	1x3.0x3.0	1x4.0x3.0	1x4.0x3.0	1x2.0x2.0	1x3.0x2.0	
		Nos	**3 Nos**	**2 Nos**	**4 Nos**	**7 Nos**	**1 Nos**	**2 Nos**	**1 Nos**	**1 Nos**	**1 Nos**	**2 Nos**	**24 Nos**
1	Earthwork in excavation of foundation for structures including pipe culverts in all types of soil complete as per drawings and Technical Specification Clause 304, 309 and 2903.	cum.	2086.00	1435.00	2114.00	3400.00	505.00	1760.00	844.00	1136.00	549.00	1008.00	**14837.00**
2	Cement concrete in foundation/M-15 grade levelling course on pipe culvert and under approach slab etc.including centering and shuttering all complete as drawing and Technical Specifications Sections 2100 and 2200.	cum.	248.00	172.00	225.00	414.00	63.00	198.00	87.00	118.00	60.00	104.00	**1689.00**
3	Providing and laying filter medium, behind abutments, retaining wall and return wall complete as per drawing and Technical Specifications Clause 2504.	cum.	799.00	562.00	634.00	1296.00	204.00	572.00	216.00	346.00	172.00	192.00	**4993.00**
4	Back filling behind abutments, wing walls/ retaining and return walls or any other area with selected granular material of approved quality complete as per drawing and Technical Specification clause 300.	cum.	1487.00	1047.00	1152.00	2375.00	376.00	1535.00	562.00	931.00	313.00	335.00	**10113.00**
5	M-20 grade Plain cement concrete in foundation and substructure including centering and shuterring but excluding reinforcement, complete as per drawing and Technical Specifications Sections 1500, 1700, 2100, 2200 and 2300.	cum.	246.00	164.00	328.00	453.00	64.00	369.00	194.00	212.00	82.00	165.00	**2277.00**
6	M-25 grade Reinforced cement concrete in Box including centering and shuttering but excluding reinforcement, complete as per drawing and Technical Specifications Sections 1500 ,1700 and 2300.	cum.	1269.00	893.00	980.00	1689.00	255.00	917.00	432.00	843.00	267.00	396.00	**7941.00**
7	HYSD TMT Fe-500 bar reinforcement for culverts, underpass, retaining walls etc. complete as per drawings and Technical Specifiations Section 1600.	MT	90.00	63.00	70.00	121.00	18.00	66.00	31.00	60.00	19.00	29.00	**567.00**
8	Providing weep holes in abutments, wing walls, retaining walls, return walls etc. complete as per drawing and Technical Specifications Clause 2706.	Nr.	693.00	486.00	564.00	1134.00	178.00	348.00	135.00	206.00	152.00	178.00	**4074.00**
9	Painting of culvert no. and span arrangement as per Technical Specifications Clause 803	Nr.	6.00	4.00	8.00	14.00	2.00	4.00	2.00	2.00	2.00	4.00	**48.00**
10	Providing and laying Stone apron complete as per drawing and Technical Specifications Clause 2500.												
	a) Stone Filling	cum.	15.00	10.00	19.00	33.00	5.00	20.00	12.00	12.00	5.00	12.00	**143.00**
	b) PCC M-15	cum.	7.00	5.00	10.00	16.00	2.00	10.00	6.00	6.00	2.00	3.02	**67.02**
11	Providing and laying Flexible apron complete as per drawing and Technical Specifications.	cum.	219.00	146.00	292.00	501.00	71.00	217.00	119.00	122.00	73.00	163.00	**1923.00**
12	Providing guard post span arrangement a with synthetic enamel as per Technical Specifications Clause 803	Nr.	6.00	4.00	8.00	14.00	2.00	4.00	2.00	2.00	2.00	4.00	**48.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka
Bill of Quantities

Sl. No.	Description	Unit	106 m	112 m	61 m	72 m	80 m	72 m	52 m	87 m	67 m	36 m	Total Quantity
			1x2.0x2.0	1x2.0x2.0	1x2.0x2.0	1x2.0x2.0	1x2.0x2.0	1x3.0x3.0	1x4.0x3.0	1x4.0x3.0	1x2.0x2.0	1x3.0x2.0	
		Nos	**3 Nos**	**2 Nos**	**4 Nos**	**7 Nos**	**1 Nos**	**2 Nos**	**1 Nos**	**1 Nos**	**1 Nos**	**2 Nos**	**24 Nos**
13	Providing cement concrete M-15 grade in cut off wall complete as per drawing and Technical Specifications Sections 1500 & 1700 and Clause 2507.	cum.	109.00	73.00	145.00	250.00	35.00	108.00	59.00	61.00	36.00	81.00	**957.00**
14	Construction of Reinforced cement concrete in Approach Slab including centering and shuttering but excluding reinforcement, complete as per drawing and Technical Specifications Sections 1500 , 1700 and 2300.												
	a) RCC M-30	Cum	544.95	388.50	411.60	0.00	0.00	0.00	84.00	0.00	139.65	0.00	**1568.70**
	b) PCC M-15	Cum	272.48	194.25	205.80	0.00	0.00	0.00	42.00	0.00	69.83	0.00	**784.35**

ANNEXURE – 4

Abstract of Cost Estimate – Sqm Basis

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

Abstract of Cost : Estimate Based on Sqm Basis

Alignment Option : KD 5								
Design Chainage		Length (m)	Type of Structure	W/D (m)/ Nos	Area (Sqm)	Unit Rate (Rs)	Amount (Rs)	Amount (Cr. Rs)
From	To							
0.000	1800.000	1800.000	Cut & Fill	24	43200	220000	9504000000	950.400
1800.000	2100.000	300.000	Bridge(B0)	24.6	7380.000	125000	922500000	92.250
2100.000	2320.400	220.400	Cut & Fill	24	5289.600	220000	1163712000	116.371
2320.400	2620.400	300.000	ROB & CD	24.6	7380.000	125000	922500000	92.250
2620.400	5578.140	2957.740	Tunnel -1	30	88732.200	115000	10204203000	1020.420
5578.140	5666.380	88.240	Cut & Fill	24	2117.760	220000	465907200	46.591
5666.380	5716.380	50.000	Bridge(B1)	24.6	1230.000	75000	92250000	9.225
5716.380	5799.870	83.490	Cut & Fill	24	2003.760	220000	440827200	44.083
5799.870	7929.290	2129.420	Tunnel -2	30	63882.600	115000	7346499000	734.650
7929.290	8011.480	82.190	Cut & Fill	24	1972.560	220000	433963200	43.396
8011.480	9101.480	1090.000	Bridge(B2)	24.6	26814.000	175000	4692450000	469.245
9101.480	9190.100	88.620	Cut & Fill	24	2126.880	220000	467913600	46.791
9190.100	11302.280	2112.180	Tunnel -3	30	63365.400	115000	7287021000	728.702
11302.280	11402.280	100.000	Cut & Fill	24	2400.000	220000	528000000	52.800
11402.280	11452.280	50.000	Bridge(B3)	24.6	1230.000	75000	92250000	9.225
11452.280	11596.080	143.800	Cut & Fill	24	3451.200	220000	759264000	75.926
11596.080	13467.650	1871.570	Tunnel -4	30	56147.100	115000	6456916500	645.692
13467.650	13652.650	185.000	Cut & Fill	24	4440.000	220000	976800000	97.680
13652.650	14672.650	1020.000	Bridge(B4)	24.6	25092.000	175000	4391100000	439.110
14672.650	14770.000	97.350	Cut & Fill	24	2336.400	220000	514008000	51.401
14770.000	16429.860	1659.860	Tunnel -5	30	49795.800	115000	5726517000	572.652
16429.860	16930.310	500.450	Cut & Fill	24	12010.800	220000	2642376000	264.238
16930.310	17030.310	100.000	Bridge(B5)	24.6	2460.000	120000	295200000	29.520
17030.310	17501.440	471.130	Cut & Fill	24	11307.120	220000	2487566400	248.757
17501.440	17701.440	200.000	Bridge(B6)	24.6	4920.000	120000	590400000	59.040
17701.440	17755.700	54.260	Cut & Fill	24	1302.240	220000	286492800	28.649
17755.700	19656.370	1900.670	Tunnel -6	30	57020.100	115000	6557311500	655.731
19656.370	20362.440	706.070	Cut & Fill	24	16945.680	220000	3728049600	372.805
20362.440	23579.210	3216.770	C/F/VIADUCT	24.6	79132.542	150000	11869881300	1186.988
		7050.000	Access Road	7	49350.000	85000	4194750000	419.475
			Civil Construction Cost - Sub total (A)					9604.063
			Environmental, Land Acquistion & Utility Shifting Cost (LS= 0.3%)					28.812
			Establishment Charges (2.5%)					240.102
			Sub Total					9872.977
				Service Tax 14.5%				1431.582
				Grand Total				11304.558

Prepared for:

सड़क परिवहन और राजमार्ग मंत्रालय
MINISTRY OF ROAD TRANSPORT & HIGHWAYS

Karnataka
Public Works, Ports & Inland Water Transport Department

Project:

Consultancy Services for "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.000 to 261.450 on NH-48 in the State of Karnataka"

Subject:

KD-6 - Draft Detailed Project Report for Final Approved Alignment for Bypass

Volume - VIII: Bill of Quantities

Prepared by:

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Revision History

Rev.	Date	Long Description

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INTRODUCTION

This report is prepared under Contract Agreement clause 2.8; "Key Date No: KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)" after incorporation of Client's observations on earlier submitted "KD5: Kucha Draft Detailed Project Report (KDDPR) "vide letter no. NH/PIU-Tunnel/NH-48/KD-3/2015-16/383-386 dated 14.12.2015".

The present submission (10 Hard Bound Sets and 5 Soft Copies of each) is as de tailed below:

(i) Volume-I, Main Report:

- *Executive summary*
- *Project Description*
- *Socio Economic Profile*
- *Materials Surveys and Investigation*
- *Traffic Surveys and Analysis*
- *Design Standards and Specifications*
- *Alignment Proposals*
- *Summary of EIA/IEE and Action Plan*
- *Summary of Resettlement Plan*
- *Preliminary Cost Estimates*
- *Preliminary Economic Analysis*
- *Preliminary Financial Analysis*
- *Suggested Methods of procurement and packaging*
- *Conclusions and Recommendations*
- *Acknowledgement*
- *Compliance of the Observations*

The basic data obtained from the field studies and investigations and input data used for the detailed engineering design (if any) shall be submitted in a separate volume as an Appendix to Main Report.

(ii) Volume – II : Design Report

Part- I Traffic Study, Analysis and Forecast :

- *Description of Existing Road in Ghat Section*
- *Road and Bridge Inventory*
- *Traffic Surveys, analysis and forecast*
- *Proposed Pavement Design*

Part-II Design of Tunnels :

- *Proposed Tunnel Design, Standards*
- *Structural Analysis- Primary Lining*

Part-III Design of Bridges and Cross-Drainage Structures :

- *Proposed Bridges and Structures Design Basis and*
- *Bridges Dimensioning*

Part-IV Geological Design and Geotechnical Report :

- *Geological Survey and Analysis*
- *Geotechnical Investigations Report*

(iii) Volume-III Materials Report :

(iv) Volume - IV(a) Environmental Assessment Report including Environmental Management Plan (EMP) &

(v) Volume - IV(b) Resettlement Action Plan (RAP) :

(vi) Volume - V Technical Specifications :

(vii) Volume - VI Rate Analysis :

(viii) Volume - VII Cost Estimates :

(ix) Volume - VIII Bill of Quantities :

(x) Volume - IX Drawings (A3 Size) :

a. *Location map*
b. *Layout plans*
c. *General Drawings*
d. *Plan and Profile of Refined Alignment "A"*
e. *Typical Cross Sections showing Pavement details of Cut & Fill Section*
f. *Typical Cross Sections of Tunnel*
g. *Typical Cross Sections of Bridges*
h. *Tunnels- General Arrangement Plan and L-Sections (L&R)*
i. *Viaducts – General Arrangement Plan and L-Section*
j. *Cut & Fill and Viaducts – General Arrangement Plan and L-Section*
k. *GAD for proposed RoB at Railway km 54+650*
l. *Standard Drawings*
m. *Miscellaneous Drawings*
n. *Indicative Land Acquisition Plans*
o. *Detailed Cross Sections @ 100m interval*

(xi) Volume - X Civil Work Contract Agreement :
(xii) Volume - XI Project Clearances :

Volume – VII: Bill of Quantities

1 GENERAL

This Volume - VIII: Bill of Quantities, a part of “KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)” is submitted in accordance with the Contract Agreement and as per requirement specified in Terms of Reference (ToR) for preparation of BOQ of “Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH-48 in the State of Karnataka”.

2 METHODOLOGY

The quantities of earth work in cut and fill were computed after designing horizontal and vertical alignment using Civil3D/MX software. Digital Terrain Modeling (DTM) has been developed using high resolution satellite imaginaries, cartosat1 and preliminary topographic survey data. A number of typical cross sections have been developed for tunnel, bridges, viaducts and road approaches as per site requirements and optimum alignment. Quantities of all other items like subgrade (SG), granular sub-base (GSB), dry lean concrete (DLC), pavement quality concrete (PQC) for project road and wet mix macadam, dense bituminous macadam & bituminous concrete for junctions development, bus bays, rest areas and other minor items, (if required) have been worked out using the typical cross sections adopted in the respective locations. The quantities for cross drainage structures, culverts, bridges, viaducts and tunnels have been calculated from typical GAD's on sqm basis for required construction. Road signage, toll plaza, lighting, avenue plantation etc all items are calculated as per Design Plan and IRC standard

The estimates for utility relocations are based on data collected from site and other utility departments. Tentative cost of land acquisition, Resettlement and Rehabilitation is calculated based on approximate land rate and preliminary screening data on local enquiry. Provisions for physical contingencies, engineering supervision and landscaping etc. have been made as per normal practices.

The rates of various items of works are analyzed keeping in view the basic rates for various inputs and the leads involved. Tentative cost estimates have been prepared for different contracts packages. Detailed methodology is given in the subsequent paragraphs.

3 COST OF VARIOUS COMPONENTS

The cost of work has been worked out component wise as under:

(i) Site Clearance
(ii) Earthworks
(iii) Sub-Base Course & Base Course
(iv) Concrete Works
(v) Bituminous Works
(vi) Cross Drainage works - Culverts
(vii) Major & Minor Bridges, Viaducts, RoBs. Flyover.
(viii) Drainage and Protection Works
(ix) Traffic Signs, Markings & Other Road Appurtenances
(x) Maintenance, construction of access roads during construction
(xi) Truck Laybys & Bus bays
(xii) Tunnels (twin tubes)
(xiii) E & M works for Tunnels
(xiv) Geological Stability, Rock Bolting,
(xv) Slope Protection
(xvi) Lightings,
(xvii) Entry and Exit Intersections,
(xviii) Toll Plaza (if any planned by the Authority)
(xix) Planting and Landscaping and Environmental Mitigation Measures
(xx) Administrative Block and Maintenance Base Camp ,HTMS (if Toll plaza is provided)
(xxi) Rest areas (way side amenities)
(xxii) Miscellaneous works

Under sub head 'site clearance' provision has been made for removal of roots of trees, stumps, shrubs, grass and top organic soil not exceeding 150 mm in depth. Provision has also been made for dismantling of existing structures (if any) and pavement (at takeoff & merging points), salvaging of dismantled materials and removal of unserviceable items, as required. Under sub head 'earth work', the earth work in embankment and in cutting, sub-grade and shoulders for road approaches, tunnels & bridges, and as well as for access roads, has been catered for. Provision has been made for granular subbase for project road under the sub head 'sub base courses'. Under sub head 'bituminous/cement concrete courses', provision has been made for DBM & Bituminous Concrete for access roads and dry lean concrete and cement concrete pavement (PQC) for project road, Truck Terminals and Toll plaza lanes (if any). It is proposed to provide box culverts with adequate water way and structural safety. Besides, some of the temporary bridges need to be constructed for access roads as per site conditions and applicability. New bridges, viaducts and other structures will be constructed for 12m road way as per IRC: SP-84: 2014. Provision for these works has been made under the sub heads 'culverts, bridges and flyovers have been provided SH-114 Gundya – Subramanya road crossings, ROB's have been provided for railway crossings. Works for improvement of road junctions and drainage and protective works have been considered under the respective sub heads. Under sub head 'miscellaneous items', besides road appurtenances and other miscellaneous items of works, provision has also been made for the following:

i) Safety items have been introduced to ensure the project safety during the construction.

ii) Supply of digital color photographs of road works mounted in Albums and also as a computer soft copy.

iii) Supply of digital (VCD/DVD) video graphic record of road before commencement of work, various stages of construction and condition of road after completion of works.

4 CONSTRUCTION QUANTITIES

The quantities of earth work in cut and fill were computed after designing horizontal and vertical alignment using Civil3/MX software. Digital Terrain Modeling (DTM) has been developed using high resolution satellite imaginaries, cartosat1 and preliminary topographic survey data. A number of typical cross sections have been developed for tunnel, bridges, viaducts and road approaches as per site requirements and optimum alignment. Detailed Cross Sections @ 50m interval are generated using MX and TCS adopted in the respective chainages. Provisions are made for the soft and hard rock excavation based on the road inventory and the site investigation. Quantities of all other items like subgrade (SG), granular sub-base (GSB), dry lean concrete (DLC), pavement quality concrete (PQC) for project road and wet mix macadam, dense bituminous macadam & bituminous concrete for junctions development, bus bays, rest areas and other minor items, (if required) have been worked out using the typical cross sections adopted in the respective locations. The quantities for cross drainage structures, culverts, bridges, viaducts and tunnels have been calculated from typical GAD's on sqm basis for required construction. Road signage, toll plaza, lighting, avenue plantation etc all items are calculated as per Design Plan and IRC standard

5 MoRTH GUIDELINES FOR BOQ AND COST METHODOLOGY

The Cost Estimate is worked out on the basis of guidelines given in the Cost Methodology issued by MoRTH for a Highway Project. These are as listed as below:

Step 1- **Bill No. - 1 Site clearance and Dismantling**

This bill includes removing the roots of trees of girth more than 300mm, Clearing & Grubbing which is taken for full width of ROW. Also the dismantling of existing pavement and structures (if any) is considered. The thickness of the existing pavement is taken from the details of site inventory for the existing crust (if any).

Rebate towards the salvage value of dismantled materials is to be considered.

Step 2- **Bill No. -2 Earth Work**

Bill No. -3 Granular Sub Base and Base Courses

Bill No.-4 (A) Bituminous Courses (Flexible Pavement), 4 (B) Rigid Pavement

Quantities are to be estimated based on typical cross sections and the layer thickness based on pavement design as per IRC-37 for flexible pavement and IRC 58 for rigid pavement. The quantity of cut/ fill is worked out using Civil 3d/Mx Road and the pavement quantity is worked out from detailed drawings. The length of structure is deducted while calculating the quantities of earthwork and pavement.

a) It is assumed that approximately 50-70% of the excavated earth can be reused for embankment and 30%-50% is unsuitable for use in embankment.
b) If hard rock is available, then 10% of the quantity out of Excavation is assumed for hard rock and the salvage value of rock is considered in bill no.1. Rest 90% of excavated stuff is considered as ordinary soil; however, this classification may vary with specific location.
c) It is mandatory to use fly ash for Embankment construction, if fly ash is available at the nearest Thermal power plant within a radius of 100 kms. In this case an item rate needs to be analysed for embankment with use of Fly ash with appropriate lead and this, in general, works out to be more expensive than Embankment fill rate from borrow area.
d) The quantity of fly ash (if used) and the Backfill quantity used in construction of RE Wall is finally deducted from the total quantity of embankment.
e) The quantity for Junctions, median opening, Bus bays, Truck Parking and Rigid Pavement for Toll Plaza is considered in Bill No. 2,3 and 4.
f) The median opening is to be considered every 5 km as per codal provision and the quantities worked out accordingly in Bill No. 2, 3 and 4.

Step 3- **Bill No. – 5 Culverts**

Provision of additional new Culverts is based on hydrological investigation. The schedule of widening and providing new culverts are fixed up and accordingly the different types of culverts (viz pipe, slab, box) quantities are worked out from the standard drawings or from the available drawings of the

particular project. A new pipe culvert of size 1200 mm dia – 1 no. each for T & Y junction and 2 No. for each X junction is considered. Further the abstract of Quantities is prepared for all the culverts and the Abstract of cost is prepared by multiplying the rates.

Step 4- **Bill no. -6 Bridges, Viaducts, Tunnels**

Provision of additional new bridges, viaducts and tunnels are based on Hydrological Investigation and the quantities & cost estimate of Bridge is based on GADs. Few bridges of different foundation are worked out to assess the per sqm cost of deck area. This constant of cost is used to estimate the total estimated cost of the bridges based on the span configuration in a tabular form. This step is generally followed in the Feasibility stage. But in the DPR stage, once the design is finalized and all the detailed drawings are ready, the estimate is worked out based on them.

Step 5- Bill No. - 6A Repair and Repair and Rehabilitation of Existing Bridges

The quantities are based on Site assessment & preparation of inventory of the structure for Repair & Rehabilitation of existing bridges: This head is Not Applicable for this project

Step 6- Bill No.-7 Drainage and Protection works

This Bill include types of drains, protection work such as stone pitching, crash barrier, RE wall, RCC Retaining wall, Breast wall , Drainage chutes, River Training Works etc. The Metallic crash Barrier is provided where height of Embankment is more than 3m and the drainage chutes provided where height of embankment is more than 6m. Median drain is provided in the super elevated portion.

Step 7- Bill No. - 8 Junctions

In this bill quantities includes only the chequered Tiles and kerb for junction and Island. Remaining items like earthwork, pavement items are already covered in Bill nos. 2,3 and 4 for Major and Minor Junctions.

Step 8- Bill No. - 9 Traffic Signs, markings and Appurtenances

Traffic signages are provided as given in the drawing. Gantry mounted Can tilever/ Overhead signs are provided and the numbers are based on the Start and End chainage and the location of Major Junction/ Interchanges, Toll Plaza as per provisions in the drawings. The weight of steel truss is taken as 2.5 tonne /No. for 4- Lane and 1.5 tonne / No. for cantilever truss. The lane marking, delineators, road studs, cluster of Red Reflector is con sidered according to the drawings and the details marked on the drawing by Traffic/Highway Engineer.

Step 9- Bill No.- 10 Maintenance

This bill covers Maintenance of existing road items such as pot hole and MSS for road maintenance are considered under this bill. It is also assumed that out of the whole existing road approximately 3-5% length of the road has potholes depending on the road condition. For assessing the perfor mance of the pavement and requirement of re-laying of bituminous layers, the existing pavements are to be subjected to investigations under the Ben

kelman Beam Method under guidelines of IRC 81. This head is Not Appli cable for this project

Step 10- Bill No -11 Various Miscellaneous Items

Various miscellaneous items such as vehicles, mobile phones, Trauma center, Way side amenities, Traffic aid post, Administrative, Operational and Maintenance Base Camp, Vehicle rescue Post, Passenger shelter , ATMS, Toll plaza automatic Barrier including ETC , Landscaping are covered under this bill. The provision for street lighting is taken in urban sections as well as for Flyovers and structures. It is assumed that the poles are placed at 30m c/c. High mast is provided in Toll plaza and Junctions. A temporary Traffic diversion, if necessary, is considered as per requirement. Also traffic safety measures items are considered under this sub head.

Some of items under this head are Not Applicable for this project

The number of photographs for the project is assumed as below

@ 30 Nos per tunnel

@ 10 Nos per bridge and Major Structures

@ 2 Nos per culvert and underpass

@ 4 Nos per km for laying crust

The civil cost is the addition of Bill No. 1 to Bill No. 11.

6 METHODOLOGY FOR FORMULATING TPC

There is guideline in MCA to calculate TPC by adding 25% of Civil Construction Cost to it to account for the financing charges required by the Concessionaire to implement the BOT project. The rational method of formulating the TPC of a BOT project is to get the financial modelling done by a Financial Analyst based on uniform parameters to be applicable for all MORTH projects. The rational method of financial modelling involves the following parameters/components:

(i) Interest on Debt Component (IDC)
(ii) Contingencies
(iii) Escalation during construction
(iv) Financing charges
(v) IC/IE cost borne by the Concessionaire

The rates of these components usually vary from project to project and for different financial consultants. A uniform parameter for deciding the rates of the above mentioned components may be taken as below:

i) Interest on Debt Component (IDC) –

Depending on period and phasing of expenditure during construction, and taking a uniform rate of Rs.11.75% per annum, the impact of IDC varies from 12 to 14% of TPC.

The phasing of expenditure during the construction period may be taken as :

Upto 365 days – 10%

365 to 730 days- 20%

730 to 1095 days – 25%

1095 to 1460 days – 25%

1460 to 1825 days – 20%;

Total 100%

ii) Escalation of Cost during construction:

It depends on phasing of construction period. Usually we take a figure of 5% per annum for this component. On comparing cost analysis of many projects, this component consists of 5% of TPC.

iii) Financing Cost

We may take a figure of 2% of TPC as the financing cost of the project

iv) Contingency

This may be taken as 3% of TPC

v) IC/IE cost borne by the Concessionaire – 1% of TPC

The TPC of a BOT project should be decided by the financial modelling done by the financial consultant on the basis of the uniform parameters as proposed above. It may or may not be within the guideline of the MCA of calculating TPC by adding 25% financing cost to them.

7 SHIFTING OF UTILITIES & TREE CUTTING

Shifting of Utilities like Electrical installations, transformers, H.T/L.T line shifting, High tension towers, Telephone poles, OFC lines, Water pipe lines etc., the required estimates for shifting of these utilities from the concerned Departments will be obtained in detail during Draft DPR stage. Presently, tentative quantities from the road inventory and topography survey data are taken into consideration against shifting of utilities & tree cutting in the costing.

Age old trees with different girths exist on both sides of the existing highway. On an average for all types of Girths, nearly 150 to 200 trees per km are available. Average Tree cutting Cost per tree shall be taken as @ Rs. 700. Average cost of Cutting of trees per Km comes to be Rs. 1.20 Lakhs for the widening portions of existing NH road. In the bypass/new alignment areas this cost shall be less. Salvage value as per the Forest Department norms shall be deducted from the tree cutting cost.

8 MAINTENANCE, LAND ACQUISITION, REHABILITATION & RESETTLEMENT COST

Provision has been included for maintenance of the existing 2-lane road during construction at Rs. 5,00,000 /= per Km per month for 60 months. This covers repair of pot holes and renewal coat by 25mm Mastic Asphalt/ Wearing Coat. Cost of Rehabilitation & Resettlement has been provided for as per initial social impact assessment. Provision for cost of land acquisition and compensation for permanent/temporary buildings and other structures has been made there in. The cost of environmental mitigation has been provided for, as per initial assessment. For specific items that have been used for mitigation of impacts in construction or operation stages including environmental monitoring, training of personnel for implementation of the Environmental Management Plan, logistical support for the implementing agency. General components like RCC, PCC, steel ISMB sections or angle sections etc., required for various mitigation measures have been included in the overall rate for the item. The costs of Resettlement and Rehabilitation were worked out based on the prevailing market rates in Heggade, Maranhally, Shiradi and Gundya, Adda hole villages of Hassan and Mangalore Districts respectively. The land acquisition costs for the properties to be acquired for this project has been worked out based on a market value assessment survey conducted at various locations along the proposed bypass alignments. The property dealers, locals and the government agencies as the revenue department etc. were contacted for this purpose.

9 VALUE OF BUILDING STRUCTURES

For the loss of building structures, either commercial or residential, the titleholders will be compensated at replacement cost. Apart from the replacement value that has been worked out for the structures, the approximate cost of the following has been worked out:

(i) Compound wall at Rs.1500 /= per running metre

(ii) Pump house at Rs.150,000/-

(iii) Residential open well at Rs.250,000/-

No deduction has been made for the depreciation in the values of these structures, as the award criteria shall be the prevailing market price. All the Potential Project Affected Persons (PAP's) would not be legal titleholders and therefore, be entitled for compensation for the loss of land and structures. The squatters and encroachers would fall in this category. The encroachers as a general rule are not eligible for compensation. However, they will be considered for assistance on a case-to-case basis. Assistance shall be provided in the form of support mechanisms such as grants, services etc. to persons or groups such as vulnerable group encroachers, residential squatters, vulnerable group squatters, ambulatory business kiosks etc.

10 TYPICAL CROSS SECTIONS

Typical cross sections are proposed for the tunnels, bridges and cut & fill sections of new road construction keeping in view the site requirements, and schedule of cross sections is presented in main report and drawings

11 PROJECT FACILITIES

The facilities proposed along the project road includes of Service road, Bus-bays and bus shelters, Truck Lay-Bys, Rest Area, Toll Plaza, Street lighting, Pedestrian facilities, and Landscaping and tree plantation, Traffic Management System.

12 SERVICE ROADS

Service road is required at built-up areas and major villages. There is no need of service roads for the project, hence not proposed.

13 BUS-BAYS AND BUS SHELTERS

The project road is going through different villages/towns between Heggade, Maranhally – Gundya, Adda hole section. The bus-bays and bus shelters are proposed along this section and near to Kadagarvalli & Yadakumari railway stations. Proposed bus-bays and bus shelters locations are shown in the main report and drawing volumes.

14 TRUCK LAY-BYS

The track lay-bys are provided at 40 – 50 km interval for a highway project. There is no proposal of Truck lay-bys in this project.

15 REST AREA

Rest areas are not proposed for this project road.

16 TOLL PLAZA & WEIGH BRIDGES

Toll Plaza should be located at such places so as to capture all the traffic to avoid any leakage of revenue. The project is unviable as per financial analysis, hence no toll plaza is proposed in the project area. Weigh bridge is also not proposed along the project road.

17 FLYOVER AND ROB

One Flyover and Two RoB have been proposed for state highway crossing near Gundya and railway tracks crossings at km 54.650 & km 68.500. The details of Flyover & ROB have been given in main report and drawings volumes.

18 HIGHWAY LIGHTING

The lighting facilities shall be provided as per MoRTH guidelines including but not limited to the following:

a) High mast lighting

Provide High mast lighting at major junctions and portals locations of each tunnels.

b) **Street Lighting**

Provide street lighting at flyover, RoB, bus bays, major junctions and portals locations of each tunnels.

c) E & M for tunnels

Provide special E&M arrangements inside all tunnels as per international practice.

19 INDICATIVE ADDITIONAL SPECIFICATIONS

a) Flooring for Underpasses

Flooring for underpass will be of concrete as bitumen construction machineries can not move into the underpasses and concrete pavement requires less maintenance.

b) Safety during construction

As per recent MORTH guidelines, a separate BOQ for safety during construction is considered in the cost estimate. Temporary sign boards on brick works, barricading tapes, cones, provision of flashing light etc are considered. The Contractor shall be insisted to have a Qualified Safety Officer with safety vehicle to maintain and manage the safety during construction.

c) Clearing and Grubbing & Excavation

For ongoing MORTH projects, Consultants have observed ambiguity in interpreting the specifications for measurement of excavation & embankment quantity with clearing and grubbing. This will be made clear in additional specifications.

d) Excavation and Back filling

The ambiguity in interpreting specifications for measurement of excavation for foundation of structures and the back filling the same with the excavated earth / borrow earth will be made clear in the detailed specifications.

e) Lap in Reinforcement

Lap length & quantity varies based on the diameter of the rebar used. No laps shall be paid. Payment shall be made based on the construction drawing quantity only.

f) Profile Corrective Course

Not applicable for this project.

g) Granular Subbase (GSB)

Crushed aggregates are to be used in the construction of Granular sub base. Detailed specifications and required gradation details shall be given in the specifications.

h) Road Furniture and Signage

Detailed specifications and type of Signage will be made clear in the detailed specifications.

i) Modified Bitumen for Bituminous Concrete

Modified Bitumen shall be used as per the MORTH specifications in Bituminous Concrete construction. Specifications will be made clear in the detailed specifications.

j) Concrete Tree Guards

Concrete tree guards shall be introduced instead of Iron tree guards for avenue plantations. Clear cut specifications & cost involved for this item shall be given in the detailed specifications & costing respectively.

20 MISCELLANEOUS ITEMS

1. **Longitudinal Drains**
   Longitudinal Drains shall be provided on both sides of carriageway as per cross section schedule mentioned and confirming to IRC: SP 84 2014.

2. **Protection works**
   The side slopes shall be protected by using suitable slope protection measures stone pitching, drainage Chutes using NP-2 300mm dia RCC semi circular pipes, energy dissipation basin at toe of chutes; wherever required along the Project Highway confirming to IRC: SP 84:2014

3. **Retaining Wall / Breast Wall**
   Retaining wall / breast wall shall be provided as per site suitability and requirement and decided by the Engineer confirming to IRC: SP 84 :2014

4. **Kerb**
   Kerb shall be provided as shown in the cross sections. Kerb with channel shall be provided for super-elevated areas and service roads as per cross section schedule and site requirement and decided by the Engineer confirming to IRC: SP 84:2014

5. **Utilities**
   Provision of accommodating utilities shall be made for both overhead and underground utilities along and across the Project corridor including providing utility ducts of suitable dia of RCC hume pipes NP4 as required confirming to IRC: SP 84:2014.

6. **Retaining Structures**
   Provide Retaining / RE walls in approaches to structures and at any other locations as per site condition to contain the four Lane facilities within the available right of way as per the cross section provisions mentioned confirming to IRC: SP 84:2014.

7. **Rain water Harvesting Structures**
   As per the Ministry of Environment and Forests Notification, New Delhi dated 14.01.1997 (as amended on 13.01.1998, 05.01.1999 & 6.11.2000), the construction of Rain water Harvesting structure is mandatory in and around Water crisis area, notified by the Central Ground Water Board.

8. **Cross road improvements**
   Cross roads shall be required to be connected properly to Project Highway.

9. **At grade Junctions**
   At grade junctions shall be provided at the intersection of service roads and all intersecting roads confirming to the Specifications and Standards as per IRC: SP:84:2014.

10. **RE Wall**
    Reinforced Earth Wall is to be provided for all ROB, Flyover etc, with maximum vertical gradient 3.5% as per IRC:SP:84:2014.

11. **Traffic Aid Posts**
    Traffic aid posts shall be established as per as per IRC:SP:84:2014.

12. Medical Aid Posts

Medical aid posts shall be established as per IRC:SP:84:2014.

13. Vehicle Rescue Posts

Vehicle Rescue posts shall be established as per IRC:SP:84:2014.

14. Telecom System

Telecom System shall be provided as per IRC:SP:84:2014.

15. Operation and Maintenance Centre

Operation and Maintenance Centre shall be established as per IRC:SP:84:2014.

16. Roadside furniture

The roadside furniture shall be provided as per IRC:SP:84:2014., which include, but not limited to, the provision of

i. **Traffic Signs:** Traffic signs include roadside signs, overhead signs and curb mounted signs along the entire Project Highway.

ii. **Overhead signs** : Minimum 4 nos. overhead signs and 5 nos. cantilever overhead signs along the project road. (Excluding overhead sings at toll plaza locations, if any)

iii. **Pavement Markings:** Pavement markings shall cover road marking for the entire Project Highway.

iv. **LED Traffic Beacons:** shall be provided for the entire Project Highway

v. **Crash barrier:**

Provide single W metal beam crash barrier as per provisions in IRC:SP:84:2014 along the project highway at the location specified below:

1. 100m both sides of all major bridges.
2. 50m both sides of all minor bridges.
3. Embankment of height > 3.0m sections.
4. New alignment sections
5. Sharp curves radius less than 500m

vi. **MS Railing:**

MS Railing shall be provided at junctions in between median and separator between main carriageway and access road as per provisions in IRC:SP:84:2014.

vii. **Guard Rails:**

Guard Rails shall be provided at urban sections in between median, at-grade intersections, above separator between service road & main carriageway as per provisions in IRC:SP:84:2014.

viii. **Delineators and studs:** shall be provided for the entire Project Highway as per provisions in IRC:SP:84:2014.

ix. **Boundary stones:** shall be provided for the entire Project Highway as per provisions in IRC:SP:84:2014

x. **Hectometer / Kilometer stones:** shall be provided for the entire Project Highway as per provisions in IRC:SP:84:2014.

xi. **Water Harvesting Structures :** Water harvesting structures to be provided along the road in dray areas as per provisions in IRC:SP:84:2014.

xii. **Utility pipe ducts:** Utility pipe ducts shall be provided for the entire Project Highway as per provisions in IRC:SP:84:2014.

21 LANDSCAPING AND TREE PLANTATION

The landscaping and tree plantation shall include the provision of the;

i. Median Plantation: at locations where the median width is 2.5m and more
ii. Landscaping: at Service area, Interchanges, Entry/Exit ramps.
iii. Tree plantation to the extent of number and species as decided by Environmental / Forest / Revenue authorities for the entire Project Highway along the project length.

22 HIGHWAY TRAFFIC MANAGEMENT SYSTEMS (HTMS)

Provisions may be made for implementation of the Highway Traffic Management Systems covering for the entire Project Highway when Traffic will exceed 40000 PCU. However the cost of HTMS is taken into account while preparation of DPR BOQ. These shall confirm to the specifications mentioned in as per IRC:SP:84:2014.

23 ESTIMATION OF QUANTITIES

Detailed estimation of quantities has been worked out for various items of works. The details are given as Annexure - I:

24 TABLE OF ANNEXURES

Sr. No.	Topic	Pages
1	Bill of Quantities – Road & Bridges	49
2	Bill of Quantities – Tunnels	38

ANNEXURE – 1

Bill of Quantities – Road & Bridges

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 1 : SITE CLEARANCE AND DISMANTLING

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
# # # #	Removal of stumps and roots of girth above 300mm and back filling to required compaction complete as per Technical Specification clause 201 and 305.						
(a	300 mm to 600mm	Nr.	1061				**1,061**
(b	600 mm to 900 mm.	Nr.	884				**884**
(c	900 mm to 1800 mm.	Nr.	955				**955**
(c	1800 mm and above	Nr.	637				**637**
1.02	Clearing and grubbing road land complete as per Technical Specifications Clause 201.	Hct.					
	1) For Cut & Fill Section :		1	4,621.00	60.00	/10000	27.73
	2) For Bridges :		1	6,326.77	60.00	/10000	37.96
	3) For Tunnels Portals:		6	1,000.00	100.00	/10000	60.00
	4) For Interchanges (2 Nos)		2	500.00	200.00	/10000	20.00
	5) For Bus Bays		5	300.00	50.00	/10000	7.50
	6) For Toll Plaza (At Km 1+500)		1	800.00	300.00	/10000	24.00
	7) For Truck Lay Byes (At km 1+300)		1	800.00	50.00	/10000	4.00
	8) For Miscellaneous Works		1	1,000.00	80.00	/10000	8.00
						Total Qty	189.19
						Say	**190.00**
1.03	Dismantling including disposal of unserviceable material and stacking the serviceable material complete as per Technical Specifications Clauses 202 .						
(i)	Brick/Stone Masonry	Cum	LS				100.00
						Say	**100.00**
ii)	Plain Concrete/Reinforced cement concrete structures including cleaning, straightening & cutting of bars and separating them out from RCC/PCC.						
a)	PCC	Cum	LS				**100.00**
b)	RCC	Cum	LS				**100.00**
iii)	Stone Masonry	Cum	LS				**200.00**
iv)	Hand Rail	Lm					
v)	Kilometre Stone	Nr.					
vi)	Hectometre Stone	Nr.					
vii)	Kerb stone	Lm					
viii)	Bituminous course	Cum	LS	500x7x0.05			**175.00**
ix)	Granular course	Cum	LS	500x10x0.15			**750.00**
1.04	Rebate towards salvage value of dismantled materials from pavement and structures as per Technical Specification Clause 202						
(i)	Brick Masonry	Cum					**100.00**
(ii)	Concrete PCC/RCC						

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 1 : SITE CLEARANCE AND DISMANTLING

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
	a) PCC	Cum					**100.00**
	b) RCC	Cum					**100.00**
iii)	Stone Masonry	Cum					**200.00**
iv)	Hand Rail	Lm					-
v)	Kilometre Stone	Nr.					-
vi)	Hectometre Stone	Nr.					-
vii)	Kerb stone	Lm					-
viii)	Bituminous Course	Cum					**175.00**
ix)	Granular course	Cum					**750.00**
1.05	Rebate towards salvage value of Stumps.						
(a	300 mm to 600mm	Nr.					**1,061**
(b	600 mm to 900 mm.	Nr.					**884**
(c	900 mm to 1800 mm.	Nr.					**955**
(c	1800 mm and above	Nr.					**637**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
DETAILS OF QUANTITIES
Bill No. 2 : EARTH WORK

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
2.01	Earthwork in **excavation** necessary for construction of roadway and drainage in all types of soil all complete as per Technical Specifications Clause 301.	Cum.					
	1) For Cut & Fill Sections			{As per Computer Calculation}			960,711.00
	2) For Exit & Entry Intersections with NH-48				10%		96,071.10
	3) For Others				10%		96,071.10
						Total =	1,152,853.20
(i)	Ordinary / Hard soil	Cum		1,152,853.20	x	15%	**172,928.00**
(ii)	Soft/Ordinary Rock	Cum		1,152,853.20	x	25%	**288,213.00**
(iii)	Hard Rock	Cum		1,152,853.20	x	60%	**691,712.00**
2.02	Construction of **embankment with approved material** with all leads and lifts all complete as per drawings and Technical Specifications Clause 305.	Cum.					
	1) For Cut & Fill Sections			{As per Computer Calculation}			512,735.00
	2) For Exit & Entry Intersections with NH-48				10%		51,273.50
	3) For Others				25%		128,183.75
						Total =	692,192.25
	Deductions:-						
	i) Deduct for Reuse Quantity			[Quantity Obtained from Item No.2.03]			(325,644.00)
	ii) Deduct for Backfilling Quantity			[Quantity Obtained from Item No.7.14 (iii			(140,000.00)
	iii) Deduct for Quantity Sand Blanket			[Quantity Obtained from Item No.7.16]			(4,000.00)
						Total Qty	222,548.25
	Total Quantity					**Say**	**222,548.00**
2.03	Construction of **embankment with suitable material obtained from tunnel excavation (muck)** , bridges, drainage excavation etc. with all leads and lifts all complete as per drawings and Technical Specifications Clause 305.	Cum.					
	80% from Excavated Muck of Excavation (Item No. 2			Quantity =	172,928.00	x 80%	138,342.00
	80% of Drainage Excavation (Item No. 2.01 (i))			Quantity =	234,127.00	x 80%	187,302.00
						Total Qty	325,644.00
						Say	**325,644.00**
2.04	Construction of **Subgrade** with approved material satisfying the requirements of minimum soaked CBR value as indicated in the drawings including all leads and lifts complete as per Technical Specifications Clause 305.	Cum.					
	For Sub-Grade :						

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
DETAILS OF QUANTITIES
Bill No. 2 : EARTH WORK

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
	1) For Cut & Fill Section :	Cum.	1	4,621.00	30.00	0.50	69,315.00
	2) For Bridges :	Cum.	1	632.68	30.00	0.50	9,490.16
	3) For Tunnels Portals:	Cum.	1	1,263.14	30.00	0.50	18,947.16
	4) For Interchanges (2 Nos)	Cum.	2	Area =	437.50	0.50	437.50
	5) For Bus Bays	Cum.	5	Area =	1,400.00	0.50	3,500.00
	6) For Toll Plaza (At Km 1+500)	Cum.	1	Area =	3,850.00	0.50	1,925.00
	7) For Truck Lay Byes (At km 1+300)	Cum.	1	Area =	2,800.00	0.50	1,400.00
	8) For Miscellaneous Works	Cum.	1	1000	30.00	0.50	15.00
						Total Qty	105,029.82
						Say	**105,030.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 3 : GRANULAR BASE COURSE AND SUB-BASE

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
3.01	Constructing **Granular Sub-base** complete as per Technical Specifications Clause 401. Grading –I (Table–400-1).						
		Cum.					
	1) For Cut & Fill Section :	Cum.	1	4,621.00	30.00	0.15	20,794.50
	2) For Bridges :	Cum.	1	632.68	24.00	0.15	2,277.64
	3) For Tunnels:	Cum.	1	12,631.44	18.00	0.15	34,104.89
	4) For Interchanges (2 Nos)	Cum.	2	Area =	437.50	0.15	131.25
	5) For Bus Bays	Cum.	5	Area =	1,400.00	0.15	1,050.00
	6) For Toll Plaza (At Km 1+500)	Cum.	1	Area =	3,850.00	0.15	577.50
	7) For Truck Lay Byes (At km 1+300)	Cum.	1	Area =	2,800.00	0.15	420.00
	8) For Miscellaneous Works	Cum.	1	1000	30.00	0.15	4.50
						Total Qty	59,360.28
						Say	**59,360.00**
3.02	Constructing **Wet mix macadam** base complete as per Technical Specifications Clause 406.						
		Cum.					
	1) For Cut & Fill Section :	Cum.	1	4,621.00	24.00	0.15	16,635.60
	2) For Bridges :	Cum.					-
	3) For Tunnels:	Cum.					-
	4) For Interchanges (2 Nos)	Cum.	2	Area =	437.50	0.15	131.25
	5) For Bus Bays	Cum.	5	Area =	1,400.00	0.15	1,050.00
	6) For Toll Plaza (At Km 1+500)	Cum.	1	Area =	3,850.00	0.15	577.50
	7) For Truck Lay Byes (At km 1+300)	Cum.	1	Area =	2,800.00	0.15	420.00
	8) For Miscellaneous Works	Cum.	1	1000	30.00	0.15	4.50
						Total Qty	18,818.85
						Say	**18,819.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 4 A : CEMENT CONCRETE PAVEMENT

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
4A.01	Providing & construction of **Dry Lean Cement Concrete** Base of Grade M15 for cement concrete pavement as per drawing, as directed by the Engineer and as per Technical Specifications Clause 601.						
		Cum					
	1) For Cut & Fill Section :	Cum.	1	4,621.00	24.00	0.15	16,635.60
	2) For Bridges :	Cum.	1	632.68	24.00	0.15	2,277.64
	3) For Tunnels:	Cum.	1	12,631.44	18.00	0.15	34,104.89
	4) For Interchanges (2 Nos)	Cum.	2	Area =	437.50	0.15	131.25
	5) For Bus Bays	Cum.	5	Area =	1,400.00	0.15	1,050.00
	6) For Toll Plaza (At Km 1+500)	Cum.	1	Area =	3,850.00	0.15	577.50
	7) For Truck Lay Byes (At km 1+300)	Cum.	1	Area =	2,800.00	0.15	420.00
	8) For Miscellaneous Works	Cum.	1	1000	30.00	0.15	4.50
						Total Qty	55,201.38
						Say	**55,201.00**
4A.02	Construction of **M40 grade cement concrete pavement** including and providing 2 coats of wax based white pigment complete as per drawing and Technical Specification Clause 602						
		Cum					
	1) For Cut & Fill Section :	Cum.	1	4,621.00	24.00	0.32	35,489.28
	2) For Bridges :	Cum.	1	632.68	24.00	0.32	4,858.96
	3) For Tunnels:	Cum.	1	12,631.44	18.00	0.32	72,757.09
	4) For Interchanges (2 Nos)	Cum.	2	Area =	437.50	0.32	280.00
	5) For Bus Bays	Cum.	5	Area =	1,400.00	0.32	2,240.00
	6) For Toll Plaza (At Km 1+500)	Cum.	1	Area =	3,850.00	0.32	1,232.00
	7) For Truck Lay Byes (At km 1+300)	Cum.	1	Area =	2,800.00	0.32	896.00
	8) For Miscellaneous Works	Cum.	1	1000	30.00	0.32	9.60
						Total Qty	117,762.93
						Say	**117,763.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 3 : GRANULAR BASE COURSE AND SUB-BASE

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
3.01	Constructing **Granular Sub-base** complete as per Technical Specifications Clause 401. Grading –I (Table–400-1).						
		Cum.					
	1) For Cut & Fill Section :	Cum.	1	4,621.00	30.00	0.15	20,794.50
	2) For Bridges :	Cum.	1	632.68	24.00	0.15	2,277.64
	3) For Tunnels:	Cum.	1	########	18.00	0.15	34,104.89
	4) For Interchanges (2 Nos)	Cum.	2	Area =	437.50	0.15	131.25
	5) For Bus Bays	Cum.	5	Area =	1,400.00	0.15	1,050.00
	6) For Toll Plaza (At Km 1+500)	Cum.	1	Area =	3,850.00	0.15	577.50
	7) For Truck Lay Byes (At km 1+300)	Cum.	1	Area =	2,800.00	0.15	420.00
	8) For Miscellaneous Works	Cum.	1	1000	30.00	0.15	4.50
						Total Qty	59,360.28
						Say	**59,360.00**
3.02	Constructing **Wet mix macadam** base complete as per Technical Specifications Clause 406.						
		Cum.					
	1) For Cut & Fill Section :	Cum.	1	4,621.00	24.00	0.15	16,635.60
	2) For Bridges :	Cum.					-
	3) For Tunnels:	Cum.					-
	4) For Interchanges (2 Nos)	Cum.	2	Area =	437.50	0.15	131.25
	5) For Bus Bays	Cum.	5	Area =	1,400.00	0.15	1,050.00
	6) For Toll Plaza (At Km 1+500)	Cum.	1	Area =	3,850.00	0.15	577.50
	7) For Truck Lay Byes (At km 1+300)	Cum.	1	Area =	2,800.00	0.15	420.00
	8) For Miscellaneous Works	Cum.	1	1000	30.00	0.15	4.50
						Total Qty	18,818.85
						Say	**18,819.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
DETAILS OF QUANTITIES
Bill No. 4 A : CEMENT CONCRETE PAVEMENT

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
4A.01	Providing & construction of **Dry Lean Cement Concrete** Base of Grade M15 for cement concrete pavement as per drawing, as directed by the Engineer and as per Technical Specifications Clause 601.						
	1) For Cut & Fill Section :	Cum Cum.	1	4,621.00	24.00	0.15	16,635.60
	2) For Bridges :	Cum.	1	632.68	24.00	0.15	2,277.64
	3) For Tunnels:	Cum.	1	#######	18.00	0.15	34,104.89
	4) For Interchanges (2 Nos)	Cum.	2	Area =	437.50	0.15	131.25
	5) For Bus Bays	Cum.	5	Area =	1,400.00	0.15	1,050.00
	6) For Toll Plaza (At Km 1+500)	Cum.	1	Area =	3,850.00	0.15	577.50
	7) For Truck Lay Byes (At km 1+300)	Cum.	1	Area =	2,800.00	0.15	420.00
	8) For Miscellaneous Works	Cum.	1	1000	30.00	0.15	4.50
						Total Qty	55,201.38
						Say	**55,201.00**
4A.02	Construction of **M40 grade cement concrete pavement** including and providing 2 coats of wax based white pigment complete as per drawing and Technical Specification Clause 602						
	1) For Cut & Fill Section :	Cum Cum.	1	4,621.00	24.00	0.32	35,489.28
	2) For Bridges :	Cum.	1	632.68	24.00	0.32	4,858.96
	3) For Tunnels:	Cum.	1	#######	18.00	0.32	72,757.09
	4) For Interchanges (2 Nos)	Cum.	2	Area =	437.50	0.32	280.00
	5) For Bus Bays	Cum.	5	Area =	1,400.00	0.32	2,240.00
	6) For Toll Plaza (At Km 1+500)	Cum.	1	Area =	3,850.00	0.32	1,232.00
	7) For Truck Lay Byes (At km 1+300)	Cum.	1	Area =	2,800.00	0.32	896.00
	8) For Miscellaneous Works	Cum.	1	1000	30.00	0.32	9.60
						Total Qty	117,762.93
						Say	**117,763.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
DETAILS OF QUANTITIES
Bill No. 4 B: BITUMINOUS COURSE

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
4B.01	Providing and laying Bituminous Emulsion **Prime coat** over granular surface with medium curing cutback complete as per Technical Specifications Clause 502.						
	@ 6.0 to 9.0 kg/10 sq.m. (As per item no 3.02)	Sqm		18,819.00	/0.25		75,276.00
						Say	**75,280.00**
4B.02	Providing and laying **Tack Coat** with Bituminous Emulsion all complete as per Technical Specifications Clause 503.						
	(a) On granular surface treated with primer and dry & hungry bituminous surface.						
	@ 2.5 to 3.0 kg/10 sq.m.	Sqm.		Same As Item No.4B.01			**75,280.00**
	(b) On Bituminous surface.						
	@ 2.0 to 2.5 kg/10 sq.m.	Sqm.	1	219.00	/0.06		**3,650.00**
4B.03	Providing and laying **Dense Graded Bituminous Macadam** Course with 60/70 Bitumen complete as per Technical Specification Clause 521 and confirming to IRC-SP-53.	Cum					
	1) Junction Development At Entry & Exit Intersections						
	Area = (100 x 3.5) + (50 x 3.5 x 1/2) = 437.50 sqm						
	a) At Km 0+000		3	Area =	437.50	0.10	131.25
	b) At Km 23+550		2	Area =	437.50	0.10	87.50
						Total =	218.75
						Say	**219.00**
4B.04	Providing & laying **Bituminous Concrete** wearing course PMB complete as per drawing and Technical Specifications Clause 521 and confirming to IRC-SP-53.	Cum.					
	1) Junction Development At Entry & Exit Intersections						
	Area = (100 x 3.5) + (50 x 3.5 x 1/2) = 437.50 sqm						
	a) At Km 0+000		3	Area =	437.50	0.05	65.63
	b) At Km 24+380		2	Area =	437.50	0.50	437.50
						Total =	503.13
						Say	**503.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 7 : DRAINAGE WORKS AND PROTECTION WORKS

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
7.01	Earthwork in excavation for construction of drains including disposal of surplus excavated earth with all leads Technical Specifications section 300	Cum					
(i)	Shoulder Drains		2	17,252.00	0.550	0.660	12,524.95
	Length, L = 23579 - 6327 (Structure Length) = 17252		2	17,252.00	1/2 x 0.46 x 0.66		5,237.71
(ii)	Utility Duct						
	Length, L = 23579 - 6327 (Structure Length) = 17252		2	17,252.00	0.700	0.350	8,453.48
(iii)	Toe Drain						
	Length, L = 23579 - 6327 (Structure Length) = 17252		1	17,252.00	(2.88+0.6)/2	1.140	34,221.067
	Total Length of Toe Drain = 2x(23579 - 6327) = 34504						
(iv)	Median Drain						
	Length, L = 3389 (Super Ele. Length) = 3389		1	3,389.00	1.100	0.660	2,460.41
(vi)	Drainage Chutes						
	Length, L = 23579 - 6327 (Structure Length) = 17252		2 x 173	346.00	1.100	0.650	85,359.45
	Drainage Chutes at @ 100m = 17252/ 100 = 173						
(vii)	River Training Work		2	500.00	10.000	3.000	30,000.00
(viii)	Nalla Diversion work		6	300.00	10.000	2.000	36,000.00
(ix)	Toe Wall Length (m) , L = 4621 (Cut & Fill Section)		2	4,621.00	2.150	1.000	19,870.30
							234,127.37
						Say	**234,127.00**
7.02	Providing cement concrete for Levelling Course grade below masonry drains, RCC Drains, vertical falls, outfalls, Toe Wall , cut off wall, escape for drainage arrangement as per drawings and Technical Specifications sections 1500, 1700 and 2500.	Cum					
a)	**PCC M-10 grade**						
(i)	Shoulder Drains		2	17,252.00	0.550	0.050	948.86
(ii)	River Training Work		2	500.00	0.550	0.050	27.50
(iii)	Toe Wall		2	4,621.00	2.150	0.150	2,980.55
						Total =	**3,956.91**
						Say	**3,957.00**
b)	**PCC M-15 grade**						
(i)	Utility Duct		2	17,252.00	0.700	0.050	1,207.64

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 7 : DRAINAGE WORKS AND PROTECTION WORKS

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
(ii)	Toe Drain		1	17,252.00	4.620	0.100	7,970.42
(iii)	Median Drain						
		Base	1	3,389.00	1.100	0.100	372.79
		Walls	1x2	3,389.00	0.150	0.500	508.35
(v)	Drainage Chutes		2 x 173	346.00	1.100	0.100	13,132.22
						Total =	23,191.43
						Say	**23,191.00**
7.03	Providing PCC M-20 Grade for Drain, Utility duct, toe wall, drainage chute etc. as per drawing and Technical Specification.	Cum					
	i) Utility Duct		2	17,252.00	0.600	0.300	6,210.72
	Deduction for pipe (C/S Area of Pipe) = 3.14*0.1*0.1	0.031	2	17,252.00	Area =	0.031	(1,083.43)
	ii) Toe Wall		2	4,621.00	((1.95x0.20)+(1.95+1.85)/2 x0.15 +(1.85+0.25)/2 x1.7+(0.25x0.30))		11714.24
						Total =	**16,841.529**
						Say	**16,842.00**
7.04	Providing Reinforced Cement Concrete M-20 Grade for drains and toe wall etc. as per drawing and Technical Specification.	Cum					
	RCC M-20 for Drain						
(i)	Shoulder Drains						
		Base	2	17,252.00	0.400	0.100	1,380.16
		Walls	2	17,252.00	0.800	0.100	2,760.32
			2	17,252.00	0.610	0.100	2,104.74
						Sub total =	6,245.22
(ii)	Drainage Chutes						
		Base	2 x 173	346.00	0.900	0.150	16,116.82
		Walls	= 2x2x173	346.00	0.150	0.400	14,326.06
							30,442.88
						Total =	36,688.10
						Say	**36,688.00**
7.05	Providing & fixing **HYSD Reinforcement** for Drain, Utility duct, toe wall etc. as per drawings & Technical Specifications Section 1600.	MT					
(i)	Shoulder Drains			6,245.22	x 55/1000		343.49
(ii)	Drainage Chutes			30,442.88	x 55/1000		1674.36

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 7 : DRAINAGE WORKS AND PROTECTION WORKS

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
						Total =	2,017.85
						Say	**2,018.00**
7.06	Providing & Fixing of Heavy duty pipe of 200 mm Dia for Utility Duct as per drawings & Technical Specifications.	Lm					
	Utility Duct		2	17,252.00			34,504.00
7.07	Providing PCC / RCC Median Drain at Super elevated portion as per drawing and Technical Specification.						
	Median Drain						
	a) PCC M-15	Cum					
	i) PCC below Median drain		1	3,389.00	1.400	0.100	474.46
	ii) Below Cross outlet Pipe = 3389/200 nos -10 = 7		7	30.00	1.200	0.100	25.20
	iii) At pipe Outlet Chamber		7	2.70	1.800	0.100	3.40
						Total =	**503.06**
						Say	**503.00**
	b) PCC M-20	Cum					
	i) Median Drain Base		1	3,389.00	1.200	0.150	610.02
	Wall		2	3,389.00	0.150	0.700	711.69
	ii) Drainage Chutes @ 5.0 m C/C =3389 / 5 = 678 Nos C/S Area = (2x0.275 + 1x0.45)x0.1 = 0.10 sqm		678	6.000	C/S Area =	0.100	406.80
	iii) Encasing for Outlet Pipe at Super elevation Portion		7	30.00	1.50	0.600	189.00
	Deduction for Outlet pipe area		7	30.00	Area =	0.565	(118.69)
						Total =	1,798.82
						Say	**1,799.00**
	c) RCC M-20	Cum					
	i) Collection Chamber at Median Drain @ 200 m C/C						
	For Bottom Slabs		7	1.80	1.80	0.15	3.40
	For Walls		4x62	1.80	0.15	1.80	13.61
	Deduction for Median Drain Openings		2x62	0.90	0.15	0.70	(1.32)
	Deduction for Pipe Openings		14	Area = 3.14x0.6x0.6		0.15	(2.37)
	ii) Chamber at Culvert						
	For Bottom Slabs		10	1.80	1.80	0.15	4.86
	For Walls		4x10	1.80	0.15	2.00	21.60
	Deduction for Median Drain Openings		1x10	0.90	0.15	0.70	(0.95)
						Total =	**38.83**
						Say	**39.00**
	d) RCC M-25	Cum					
	Top Slab						
	i) Collection Chamber at Median Drain @ 200 m C/C		7	1.80	1.80	0.10	2.27
	ii) Chamber at Culvert		10	1.80	1.80	0.10	3.24

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 7 : DRAINAGE WORKS AND PROTECTION WORKS

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
						Total =	**5.51**
						Say	**6.00**
	e) HYSD Reinforcement	T					
	i) Walls & Bottom Slab			38.83	x 85/1000		3.30
	ii) Cover Slab			5.51	x 85/1000		0.47
							3.77
						Say	**4.00**
	f) 1000 Dia Hume Pipe	Lm	7	30			**210.00**
7.08	Providing Metallic Crash Barrier (W-Type) complete as per Drawings And Technical Specifications Clause 810	Lm					
	a) Double " W " beam at Main CarriageWay						
	1) Main Carriage Way						
	Length, L = 23579 - 6327 (Structure Length) = 17252		2	17,252.00			34,504.00
	2) At Structure Approaches (25m Length on Right Side)						
	Bridges	7	2	100.00			1,400.00
	ROB	1	2	500.00			1,000.00
	Viaducts	1	2	3,216.00			6,432.00
						Total =	**43,336.00**
	b) Single " W " beam						
	2) Access Road (7km)	1	2	7,000.00			14,000.00
						Total =	**14,000.00**
7.09	Filter material underneath stone pitching on slopes complete as per drawing and Technical specifications section 2500	Cum					
	i) For Drainage chute		2 x 173	346.00	2.000	0.100	23,876.77
	ii) At Embankment Slope for River Training Work						-
	iii) Nalla Diversion work		1x2	300.00	3.540	0.300	637.20
						Total =	24,513.97
						Say	**24,514.00**
7.10	Providing and laying stone pitching on Road slopes, Canal Diversion work and river bed for protection against scour with stone boulders complete as per drawing and Technical specification.	Cum					
	i) For Drainage chute		2 x 173	346.00	2.000	0.150	35,815.15
	ii) At Embankment Slope for River Training Work						-
	iii) Nalla Diversion work		1x2	300.00	3.540	0.150	318.60

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 7 : DRAINAGE WORKS AND PROTECTION WORKS

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
						Total =	**36,133.75**
						Say	**36,134.00**
7.11	Providing and laying boulders apron on river bed for protection against scour with stone boulders weighing not less than 40 kg each complete as per drawing and Technical specification.	Cum					
	Apron for River Training Work		2	500.00	3.000	0.400	**1,200.00**
7.12	Providing and fixing 1.2 metres high GI barbed wire fencing with 1.8 m angle iron posts every 3 metres center to center founded in M15 grade cement concrete, wires, fixed with GI staples, turn buckles etc complete as per clause 807	Lm					
	1) For Cut & Fill Section		2	4,621.00			9,242.00
						Total =	9,242.00
						Say	**9,242.00**
7.13	**RCC Retaining Wall**						
	Length of RCC Retaining Wall, L = 4600.0 m { As per Detail Attached}						
i)	Excavation	Cum					58,527.00
ii)	Levelling course. M-15	Cum					2,787.00
iii)	RCC - M30	Cum					35,163.00
iv)	Filter Media Behind Wall	Cum					16,032.00
v)	Weep Hole	Nos					21,900.00
vi)	HYSD Reinforcement	MT					2,813.00
	REINFORCED EARTH WALLS						
7.14	Construction of reinforced earth retaining structures together with construction of earthwork in layers , assembly and erection of reinforcing elements and placing of facing panels and all associated components as per Technical Specifications Section 3100						
(i)	Providing and laying RCC facia panels as per Technical Specifications Clause 3104 and approved design and drawing	Sqm					
	RE wall Length						
	At ROB and Flyover = 2 x 1000 = **2000 m**		1	2000.00	15.00		30000.00
	Behind Abutment of All Bridges		7	60.00	15.00		6300.00
							36300.00
(ii)	Providing reinforced cement concrete M-40 grade crash barrier excluding reinforcement as per drawing and Technical Specifications Clauses 1500, 1600, 1700.	Cum					.

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 7 : DRAINAGE WORKS AND PROTECTION WORKS

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
	For Crash Barrier		1	2000.00	Area =	0.342	684.00
	For Friction Slab		1	2000.00	2.200	0.300	1320.00
	Upper Block of facia panel		1	2000.00	0.700	0.350	490.00
							2494.00
(iii)	Providing and Backfilling behind reinforced earth facia panels with approved selected imported fill material including all leads complete as per drawing and Technical Specifications Clauses 305 and 3103	Cum	1	2000.00	5.00	14.00	**140000.00**
(iv)	Providing HYSD Reinforcement	T					
	a)Crash Barrier @180Kg per Cum (180/1000 =0.18T)			0.18	X	684.00	123.12
	b)Friction Slab @90Kg per cum (90/1000=0.09T)			0.09	X	1320.00	118.80
	c) Upper block of facia panel @70Kg per cum (70/1000 = 0.07 T)			0.07	X	490.00	34.30
							276.22
7.15	Providing and installing sand column for ground improvement at high embankment location by using Prefabricated Vertical Drain of size 500mm diameter and 10m long completed as per Technical specification , drawing and as directed by the engineer-in -charge.	m	14021			10.00	**140210.00**
7.16	Providing drainage blanket on top of Vertical drain and then pre-loading with embankment fill completed as per Technical specification , drawing and as directed by the engineer-in -charge.	Cum		Area =	10000.00	0.40	**4000.00**
	(As per design Calulation the area of Ground Improvement (Sqm) = 10000 sqm)						

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 8 : TRAFFIC SIGNS MARKING AND OTHER APPURTENANCES

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
8.01	Pavement marking with hot applied thermoplastic paints conforming to ASTM D36/BS-3262 (Part - I) as per drawing & Technical Specifications Clause 803.	Sqm.					
A)	Lane/centre line/edge line/ transverse marking and any other markings.						
	1) For Project Road :						
	i) Edge Line		2 x 2	23,579.00	-	0.15	14,147.40
	ii) Centre Line		2 x 2	23,579.00	x 3 / 9	0.10	3,143.87
						Sub Total =	17,291.27
	5) Additional Markings at Road Side and Median etc.			Add 5%			864.56
						Total =	18,155.83
						Say	**18,160.00**
B)	Directional Arrows, lettering etc. as per Drg. No.61 of MoRT&H Type "Design for Inter-sections on National Highways".	Nr.	1150	-	-	-	**1,150**
8.02	Supplying and fixing at site retro-reflectorised type sign boards/signs made of encapsulated lense type of reflective sheeting fixed over aluminum sheeting 2.0 mm thick complete including vertical pipes/ angles/ posts etc. all complete as per drawing and Technical Specification.						
	a) Informatory Sign						
	Advance Direction/Destination Signs (800 x 600)	sqm	10	0.80	0.60		**4.80**
	Direction Signs /Route Marker Signs (600 x 450)	sqm	10	0.60	0.45		**2.70**
	Reassurance Sign	sqm	6	0.60	0.45		**1.62**
	Place Identification (800x 300)	sqm	2	0.80	0.30		**0.48**
	Route Marker (600 x 450)	sqm	8	0.60	0.45		**2.16**
	Lane Sign (600 x 450)	sqm	6	0.60	0.45		**1.62**
	Truck Parking	sqm	6	0.60	0.45		**1.62**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 8 : TRAFFIC SIGNS MARKING AND OTHER APPURTENANCES

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
	b) Cautionary/Warning Signs						
	Left/Right Curve Sign (900 triangle)	Nr.	11				**11**
	Median opening (900 triangle)	Nr.	4				**4**
	Object Hazard Marker (One way) (300 x 900)	Nr.	12				**12**
	Single Chevron (500 x 600)	Nr.	18				**18**
	Double Chevron	Nr.	3				**3**
	c) Mandatory signs						
	Speed Limit (600 dia.)	Nr.	12				**12**
	No parking / No Stopping Sign (900 triangle)	Nr.	8				**8**
	No Entry	Nr.	2				**2**
	Bullock & Hand Craft Prohibited	Nr.	4				**4**
	Cycle Prohibited	Nr.	6				**6**
	Give way (900 triangle)	Nr.	4				**4**
	Pass either side sign (900 triangle)	Nr.	6				**6**
	Compulsary keep left (600 dia.)	Nr.	2				**2**
8.03	Providing and fixing retro-reflectorised road delineators complete as per drawing and Technical Specifications Clause 805.						
a)	Road Delineators	Nr	1500				**1,500**
b)	Solar Road Studs	Nr.					
	Cut & Fill Section						
	i) In Curves Stretches		2 x 2	3,389.00	@ 18 m interval		753
	ii) In Straight Stretches		2 x 2	20,190.00	@ 27 m interval		2,991
	2) Entry & Exit Intersections						
In Curves @ 18 m Interval & in Straight @ 27m interval							
	a) At Km 0+000		1 x 2	300.00	@ 23 m Avg interval		26
	b) At Km 23+550		1 x 2	300.00	@ 23 m Avg interval		26
						Total =	**3,796**
c)	Median Marker	Nr.					
			2	10,948.00	@ 27 m interval		**811**
d)	AFP Reflective Sheeting	Sqm					
	i) ROB		2	Area =	100.00		200
	iii) Flyover		2	Area =	100.00		200
						Total =	**400**
e)	Blinker Lights	Nr.					
	At Intersections		=4x2	-			**8**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Bill No. 8 : TRAFFIC SIGNS MARKING AND OTHER APPURTENANCES

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
8.04	Supply and fixing tubular gantry mounted Overhead/cantilever signs. All components of signs & supports, other than the reflective portion shall be throughly descaled, cleaned, primed and painted with two coats of epoxy paint. The sign back side shall be with grey colour and post shall be in black & white alternate bands. The post below ground shall be painted with three coats of red lead paint. The sign shall be made as per IRC-67-2001 and Technical Specificatins Clause 801& 802 or as directed by the Engineer.						
	i) Erection of Over Head Gantry / Cantilever structure as per drawing including steel work in trusses, steel tubes cutting; fixing in position with welding and bolted complete in all respect.	Tonne					
	1) At Intersections (Start & End of Project)						
	a) at km 0+000		2 Nos	x	2.5 ton		5.00
			2 Nos	x	4.0 ton		8.00
	b) km 23+550		2 Nos	x	2.5 ton		5.00
			2 Nos	x	4.0 ton		8.00
							26.00
						Say	**26.00**
	ii) The sign boards made out of 2mm thick aluminum sheet, face to be fully covered by high intensity grade white retro reflective sheeting of encapsulated lens type. The background / border / symbols / legend / arrows shall be made by transparent overlay film of desired colour as per sign details except those in black which shall be of non reflective type. The sign plate shall be fixed with 6mm dia aluminium rivets on MS angle iron frame. The angle iron frame shall be made with angle of size 70mmx70mmx8mm with additional bracing at every 600mm c/c, if any dimension is more than 1200mm.	Sqm					
	1) At Intersections (Start & End of Project)						
	a) at km 0+000		1	4.500	1.725		7.763
			2	4.000	1.725		13.800
			1	4.500	1.725		7.763
	b) km 23+550		1	4.500	1.725		7.763
			2	4.000	1.725		13.800
			1	4.500	1.725		7.763
							58.65
						Say	**59.00**
8.05	Traffic management System	Km	1	25.579			**25.6**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
DETAILS OF QUANTITIES
Bill No. 9 : MISCELLANEOUS

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
9.01	Providing and fixing reinforced cement concrete M-20 grade boundary stones, hectometre, km and 5th km stones including excavation, foundation concrete in M-10 grade and reinforcement including all inscriptions etc. complete as per drawings and Technical Specificaitons Section 800.						
a)	Hectometer stones	Nr.	189	(2 x 23.579x 1) / 0.2 - km Stn - 5th km s			**189**
b)	Kilometer stones	Nr.	38	(2 x 23.579 x 1) - 5th km stone			**38**
c)	5th Kilometer stones	Nr.	9	(2 x 23.579 x 1)			**9**
d)	Boundary stones	Nr.	943	(2 x 23.579) / 0.05			**943**
9.02	Supply of colour record photographs with negatives and two colour prints in approved size there from mounted in album as per Technical Specifications Clause 125.	Nr.	300				**300**
9.04	Supply of additional prints of coloured photographs of approved size as per Technical Specifications Clause 125.	Nr.	300	-	-	-	**300**
9.05	Supplying of colour video cassette records during construction as per Technical Specifications Clause 126.	Set	50	-	-	-	**50**
9.06	Providing and maintaining vehicles for the Employer including providing driver, POL. etc. complete as per Technical Specifications Clause 124.						
9.07	i) Hard top passenger Car 1 no.	Veh. months					**60**
	ii) Hard top Jeeps 4W drive, Maruti	Veh. months					**60**
9.08	Providing & Maintaining Mobile Phones of approved Quality as per directions of the Engineer including sim card						
a)	Mobile phones	Nr					**20**
b)	Maintenance of Mobile phones including repair and payment of Monthly Bills	Nr months					**1,200**
9.09	Providing Toll Plaza (Barrier Gates Etc.)	No.					
	i) At km 0+000 (Main Toll Plaza 1 No.)		1				**1**
	ii) At km 24+380 (2 Nos. Toll Plaza)		1				**1**
9.10	Providing Traffic Aid Post as per drawings	Sqm					
	a) Buildings						200.00

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
DETAILS OF QUANTITIES
Bill No. 9 : MISCELLANEOUS

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
	b) Rooms for Ambulance & Crane						
						Total =	**200.00**
9.11	Vehicle rescue post	No.					**1**
9.12	Administrative operational and maintenance base camp.	No.					**1**
9.13	Providing Medical Aid Post as per Drawings	Sqm					**100.00**
9.14	Way Side Amenities	No					**1.00**
9.15	Truck Parking	No					**-**
9.16	Supply, installation, testing and commissioning of lantern lowering type high mast of 20m height, hot dip galvanised complete with lowering / raising gear, galvanised lantern carriage, steel wire rope suitable size, internal electrical cable, electrical control panel, earthing terminal, providing the foundation with suitable anchor plates, feeder pillar, connecting cables between the masts, earthing including supply of light lamps, fixtures similar to Philips cat No. RVP301 or equivalent, obstruction lights, etc. complete as required for achieving the desired lighting levels, all as specified						
		No.					
	1) At Intersections (Start & End)						
	a) At Km 0+000		1				1
	b) At Km 23+579		1				1
	2) At Way Side Amenities		1				1
						Total =	**3**
9.17	Providing temporary safety barricades of size 2m x 2.4m (4.8 Sqm) for demarcation during construction at site as per Drawings and Technical Specifications Clause 800 and clause.	Lm					**5,000.00**
	Salvage value of barricades	Lm.					**500.00**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km
DETAILS OF QUANTITIES
Bill No. 10 : HORTICULTURE

Item No.	Description	Unit	No.	Length (m)	Breadth (m)	Height (m)	Quantity
10.01	Turfing of embankment slopes, verge and other locations with rough grassing all complete as per Technical Specifications Clause 307.	Sqm.					
	1) For Cut & Fill Sections :						
			2	4,621.00	18.00		166,356.00
			2	4,621.00	9.00		83,178.00
	4)Access/ Approach Road (7 km)		2	7,000.00	7.00		98,000.00
						Total Qty	347,534.00
						Say	**347,534.00**
10.02	Providing, plantation mainatainace for one Year of flowering plants and shrubs in central verge as per Technical Specifications clause A11	km					
	A) Planting Flowering plants and shurbs						
	Project Length		1	4.00			4.00
							4.00
	B) Maintainace of flowering Plants and shurbs for one Year						**4.00**
10.03	Planting of trees by the road side (Avenue trees) in 0.60 m dia holes, 1 m deep dug in the ground, mixing the soil with decayed farm yard/sludge manure, planting the saplings, backfilling the trench, watering, fixing the tree guard and maintaining the plants for one year	Nos	2	400			**800.00**
10.04	Making lawns including ploughing and breaking of clod, removal of rubbish, dressing and supplying doobs grass roots and planting at 15 cm apart, including supplying and spreading of farm yard manure at rate of 0.18 cum per 100 sqm	sqm					
	1) At Each Intersections (2 Nos)		2	25	50.00		2,500.00
							2,500.00

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Summary of Earthwork Quantity for Cut & Fill Sections

CHAINAGE (m)	Length (m)	AREA(Sqm)		VOLUME (Cum)	
		CUT	FILL	CUT	FILL
0	100	65		6474	
100	100		121		12084
200	100		36		3594
300	100	50		5047	
400	100	118		11818	
500	100	197		19650	
600	100	205		20478	
700	100		88		8815
800	100		156		15557
900	100		65		6513
1000	100		837		83701
1100	100		182		18184
1200	100	189		18853	
1300	100		40		3989
1400	100		333		33340
1500	100		180		17966
1600	100		54		5439
1700	100	25		2484	
2200	100		63		6278
2300	100	34		3421	
2600	100		191		19091
5800	100	235		23462	
9100	100		1099		109887
11400	100	10	302	993	30180
11500	100	5		509	
13500	100	888		88752	
13600	100	2	137	213	13741
14700	100		698		69772
16500	100	247		24661	
16600	100	51	119	5053	11874
16700	100	472		47197	
16800	100	1317		131706	
16900	200	99	33	19734	6554
17100	100	668		66810	
17200	100	753		75273	
17300	100	187	124	18743	12439
17400	100	305	22	30540	2198
17500	100	52	156	5215	15634
19700	100	289		28891	
19800	100	639		63913	
19900	100	421		42052	
20000	100	421		42144	
20100	100	855		85480	
20200	100	663		66259	
20300	100	49	59	4886	5905
Total		**9508**	**5095**	**960711**	**512735**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Retaining Walls

1 **Length = 800.00** LHS = 400.00 RHS = 400.00
Ht = 4.50 **H = 2.50 m**

	Item Description	Unit	Nos.	L (m)	Width (m)	Ht (m)	Qty
1	Excavation	Cum	1	800.00	4.65	2.10	7812.00
2	PCC M15						
	Levelling Course	Cum	1	800.00	4.65	0.10	372.00
3	RCC M-30						
	RCC Raft	Cum	1	800.00	(4.45x0.3)+(4.45+0.80)x0.5x0.50		2118.00
	Retaining Wall	Cum	1	800.00	(0.80+0.30)/2	3.70	1628.00
4	Filter material	Cum	1	800.00	0.60	3.70	1776.00
5	Weep holes	No.	2000				2000
6	Fe-415	MT		3746.00 x 80/1000			299.68

2 **Length = 1000.00** LHS = 500.00 RHS = 500.00
H = 5.50 **H = 3.50 m**

	Item Description	Unit	Nos.	L (m)	Width (m)	Ht (m)	Qty
1	Excavation	Cum	1	1000.00	5.30	2.10	11130.00
2	PCC M15						
	Levelling Course	Cum	1	1000.00	5.30	0.10	530.00
3	RCC M-30						
	RCC Raft	Cum	1	1000.00	(5.10x0.3)+(5.10+0.8)x0.5x0.50		2337.50
	Retaining Wall	Cum	1	1000.00	(0.80+0.30)/2	4.70	2585.00
4	Filter material	Cum	1	1000.00	0.60	4.70	2820.00
5	Weep holes	No.	3500				3500
6	Fe-415	MT		4922.50 x 80/1000			393.80

3 **Length = 1000.00** LHS = 500.00 RHS = 500.00
H = 6.50 **H = 4.50 m**

	Item Description	Unit	Nos.	L (m)	Width (m)	Ht (m)	Qty
1	Excavation	Cum	1	1000.00	5.60	2.10	11760.00
2	PCC M15						
	Levelling Course	Cum	1	1000.00	5.60	0.10	560.00
3	RCC M-30						
	RCC Raft	Cum	1	1000.00	(5.40x0.3)+(5.40+0.9)x0.5x0.6		3510.00
	Retaining Wall	Cum	1	1000.00	(0.90+0.30)/2	5.60	3360.00
4	Filter material	Cum	1	1000.00	0.60	5.60	3360.00

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Retaining Walls

	5	Weep holes	No.	4500			4500
	6	Fe-415	MT		6870.00 x 80/1000		549.60

4 **Length = 600.00** LHS = 300.00 RHS = 300.00
H = 7.50 **H = 5.50 m**

	Item Description	Unit	Nos.	L (m)	Width (m)	Ht (m)	Qty
1	Excavation	Cum	1	600.00	6.70	2.10	8442.00
2	PCC M15 Levelling Course	Cum	1	600.00	6.70	0.10	402.00
3	RCC M-30						
	RCC Raft	Cum	1	600.00	(6.5x0.3)+(6.5+0.9)x0.5x0.7		2724.00
	Retaining Wall	Cum	1	600.00	(0.9+0.30)/2	6.50	2340.00
4	Filter material	Cum	1	600.00	0.60	6.50	2340.00
5	Weep holes	No.	3300				3300
6	Fe-415	MT			5064.0 x 80/1000		405.12

5 **Length = 600.00** LHS = 300.00 RHS = 300.00
H = 8.50 **H = 6.50 m**

	Item Description	Unit	Nos.	L (m)	Width (m)	Ht (m)	Qty
1	Excavation	Cum	1	600.00	7.15	2.10	9009.00
2	PCC M15 Levelling Course	Cum	1	600.00	7.15	0.10	429.00
3	RCC M-30						
	RCC Raft	Cum	1	600.00	(6.95x0.3)+(6.95+1.2)x0.5x0.9		3451.50
	Retaining Wall	Cum	1	600.00	(1.2+0.30)/2	7.30	3285.00
4	Filter material	Cum	1	600.00	0.60	7.30	2628.00
5	Weep holes	No.	3900				3900
6	Fe-415	MT			6736.50 x 80/1000		538.92

6 **Length = 400.00** LHS = 200.00 RHS = 200.00
H = 9.50 **H = 7.50 m**

	Item Description	Unit	Nos.	L (m)	Width (m)	Ht (m)	Qty
1	Excavation	Cum	1	400.00	7.90	2.10	6636.00
2	PCC M15 Levelling Course	Cum	1	400.00	7.90	0.10	316.00
3	RCC M-30						

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

DETAILS OF QUANTITIES

Retaining Walls

	RCC Raft	Cum	1	400.00	(7.7x0.3)+(7.7+1.2)x0.5x0.9		2526.00
	Retaining Wall	Cum	1	400.00	(1.2+0.30)/2	8.30	2490.00
4	Filter material	Cum	1	400.00	0.60	8.30	1992.00
5	Weep holes	No.	3000				3000
6	Fe-415	MT		5016.00 x 80/1000			401.28

7 **Length = 200.00** LHS = 100.00 RHS = 100.00
H = 10.50 **H = 8.50 m**

	Item Description	Unit	Nos.	L (m)	Width (m)	Ht (m)	Qty
1	Excavation	Cum	1	200.00	8.90	2.10	3738.00
2	PCC M15						
	Levelling Course	Cum	1	200.00	8.90	0.10	178.00
3	RCC M-30						
	RCC Raft	Cum	1	200.00	(8.7x0.3)+(8.7+1.2)x0.5x0.9		1413.00
	Retaining Wall	Cum	1	200.00	(1.2+0.30)/2	9.30	1395.00
4	Filter material	Cum	1	200.00	0.60	9.30	1116.00
5	Weep holes	No.	1700				1700
6	Fe-415	MT		2808.00 x 80/1000			224.64

SUMMARY OF QUANTITY

Total Length of Retaining Wall = **4600** m

1	Excavation	Cum		**58527**
2	PCC M15 Levelling Course	Cum		**2787**
3	RCC M-30	Cum		18080
				17083
			Total =	**35163**
4	Filter material	Cum		**16032**
5	Weep holes	No.		**21900**
6	Fe-415	MT		**2813**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

DETAILS OF WAY SIDE AMENITIES (TYPE-A)

S. No.	Descriptions	Unit	No.	Length	Breadth	Height	Quantity	Remarks
(A)	**TOTAL AREA**	Sqm	1	300.00	300.00		90,000.00	
						Total Area =	**90,000.00**	**Sqm**
(B)	**BUILT-UP AREA**							
1	Food Plaza						240.00	
2	Shops (2 Nos.)						210.00	
3	Restaurant						312.00	
4	Passenger oriented Facilities	Sqm					120.00	
5	Cooking Area						230.00	
6	Dormitory (2 Nos.)							
	a) Rest Area	Sqm			As Per Drawing		1,050.00	
	b) Toilet & Bath	Sqm			As Per Drawing		220.00	
7	Travel Information Centre						180.00	
8	Motel / Hotel							
9	Spare Parts Shop						200.00	
10	Fuel Station Plaza						375.00	
11	Highway Patrol Station						450.00	
12	Service Centre						135.00	
	a) Repair,Maintenance & Washing Area	Sqm					875.00	
13	Hospital						500.00	
14	Trauma Building						250.00	
15	Medical / Health Centre						200.00	
10	Shed / Dead Storage	Sqm			As Per Drawing		535.00	
11	Waste / Garbage Dump & Treatment Area	Sqm			As Per Drawing		80.00	
12	Electric Sub-Station	Sqm			As Per Drawing		100.00	
13	Water Reservoir Tank	Sqm			As Per Drawing		60.00	
14	Drinking Water Kiosk	Sqm			As Per Drawing		-	
15	Borewell	Sqm			As Per Drawing		-	
						Total Area =	**6,322.00**	**Sqm**
	TOTAL OPEN AREA [{A} - {B}]	**=**	127500 - 6322				**83,678.00**	**Sqm**
(C)	**Considering 55% Area as Concrete Block Area**	=		83678.00		x 55%	**46,023.00**	**Sqm**
(D)	**Considering 30% as LandScaping Area of Total Area**	=		83678.00		x 30%	**25,103.00**	**Sqm**
(E)	**Considering 15% Paved Area of Total Area**	=		83678.00		x 15%	**12,552.00**	**Sqm**
(F)	**Acceleration Lane**	Sqm	1 x 1/2	90.00	3.75		168.75	
			1	245.00	3.75		918.75	
							1,087.50	**Sqm**
(G)	**Deceleration Lane**	Sqm	1 x 1/2	75.00	3.75		140.63	
			1	120.00	3.75		450.00	
							590.63	**Sqm**
(H)	**Straight Portion**	Sqm	1	300	7.00		**2,100.00**	**Sqm**
TOTAL WAY SIDE AMENITIES (TYPE-A) AREA TO BE PAVED [{E}+{F}+{G}+{H}]						**=**	**16,330.13**	**Sqm**
						Say =	**16,330.00**	**Sqm**

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

ABSTRACT OF COST FOR WAY SIDE AMENITIES (TYPE-A)

Item No.	Description	Unit	Length	Width	Thickness	Quantity	*Rate (Rs)	Amount (Rs)
I)	**Paved Area**		**Area =**	**16,330**	**sqm**			
1	Construction of Subgrade with approved material satisfying the requirements of minimum soaked CBR value as indicated in the drawings including all leads and lifts complete as per Technical Specifications Clause 305.	Cum.	Area =	16,330	0.50	8,165.00	252	2,057,580.00
2	Constructing Granular Sub-base complete as per Technical Specifications Clause 401. Grading –I (Table–400-1).	Cum.	Area =	16,330	0.15	2,449.50	1,263	3,093,718.50
3	Providing & construction of Dry Lean Cement Concrete Base of Grade M15 for cement concrete pavement as per drawing, as directed by the Engineer and as per Technical Specifications Clause 601.	Cum	Area =	16,330	0.15	2,449.50	3,040	7,446,480.00
4	Construction of M40 grade cement concrete pavement including and providing 2 coats of wax based white pigment complete as per drawing and Technical Specification Clause 602	Cum	Area =	16,330	0.30	4,899.00	6,311	30,917,589.00
II)	**Concrete Block Area**		**Area =**	**46,023**	**sqm**			
1	Construction of earth Filling with approved material satisfying the requirements of minimum soaked CBR value as indicated in the drawings including all leads and lifts complete as per Technical Specifications Clause 305.	Cum.	Area =	46,023	0.30	13,806.90	204	2,816,607.60
3	Constructing Granular Sub-base complete as per Technical Specifications Clause 401. Grading –I (Table–400-1).	Cum.	Area =	46,023	0.25	11,505.75	1,263	14,531,762.25
4	Constructing Wet mix macadam base complete as per Technical Specifications Clause 406.	Cum.	Area =	46,023	0.25	11,505.75	1,484	17,074,533.00
5	Laying and Fixing og Concrete Blocks of 100 mm thickness over 50mm thickness of sand in Parking area complete as per Technical Specification.	Cum.	Area =	46,023	0.05	2,301.15	750	1,725,862.50
III)	**Land Scaping** Making lawns including ploughing and breaking of clod, removal of rubbish, dressing and supplying doobs grass roots and planting at 15 cm apart, including supplying and spreading of farm yard manure at rate of 0.18 cum per 100 sqm		**Area =**	**25,103**	**sqm**			
		Sqm	Area =	25,103		25,103.00	100	2,510,300.00
IV)	Construction & Development of Built-up Area	Sqm	Area =	6,322		6,322.00	6,500	41,093,000.00
							Total Cost =	**123,267,432.85**
							Say (In Crore) =	**12.33**

* *Note:- Rates are assumed for Calculating Standard Way side amenities Cost.*

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

DETAILS OF TRUCK LAY BYE / TRUCK PARKING

S. No.	Descriptions	Unit	No.	Length	Breadth	Height	Quantity	Remarks
(A)	**TOTAL AREA**	Sqm	1	300.00	200.00		60,000.00	
						Total Area =	**60,000.00**	**Sqm**
(B)	**BUILT-UP AREA**							
1	Fuel Station Plaza	Sqm		As Per Standard Drawing			450.00	
2	First Aid plus Communication Centre	Sqm		As Per Standard Drawing			250.00	
3	Shopping Plus Communication centre	Sqm		As Per Standard Drawing			187.00	
4	Service Centre							
	a) Repair,Maintenance & Washing Area	Sqm		As Per Standard Drawing			875.00	
	b) Spare Part Shop	Sqm		As Per Standard Drawing			375.00	
5	Dhaba-1							
	a) Toilet with Bath	Sqm		As Per Standard Drawing			80.00	
	b) Store	Sqm		As Per Standard Drawing			80.00	
	c) Cooking Area	Sqm		As Per Standard Drawing			120.00	
	d) Dinning Area	Sqm		As Per Standard Drawing			240.00	
	e) Cloth Drying Area	Sqm		As Per Standard Drawing			-	
6	Dhaba-2							
	a) Toilet with Bath	Sqm		As Per Standard Drawing			90.00	
	b) Store	Sqm		As Per Standard Drawing			105.00	
	c) Cooking Area	Sqm		As Per Standard Drawing			225.00	
	d) Dinning Area	Sqm		As Per Standard Drawing			312.00	
	e) Cloth Drying Area	Sqm		As Per Standard Drawing			-	
7	Dormitory							
	a) Rest Area	Sqm		As Per Standard Drawing			525.00	
	b) Toilet & Bath	Sqm		As Per Standard Drawing			110.00	
8	Maintenance Office Plus Security Room	Sqm		As Per Standard Drawing			225.00	
9	Security Room	Sqm		As Per Standard Drawing			100.00	
10	Shed / Dead Storage	Sqm		As Per Standard Drawing			435.00	
11	Waste / Garbage Dump & Treatment Area	Sqm		As Per Standard Drawing			50.00	
12	Electric Sub-Station	Sqm		As Per Standard Drawing			50.00	
13	Water Reservoir Tank	Sqm		As Per Standard Drawing			25.00	
14	Drinking Water Kiosk	Sqm		As Per Standard Drawing			-	
15	Borewell	Sqm		As Per Standard Drawing			-	
						Total Area =	**4,909.00**	**Sqm**
	TOTAL OPEN AREA [{A} - {B}]	**=**		105000.00 - 4909.00			**55,091.00**	**Sqm**
(C)	**Considering 55% Concrete Block Area of Total Area**	=		55091.00		x 55%	**30,300**	**Sqm**
(D)	**Considering 25% LandScaping Area of Total Area**	=		55091.00		x 25%	**13,773**	**Sqm**
(E)	**Considering 20% Paved Area of Total Area**	=		55091.00		x 20%	**11,018.00**	**Sqm**
(F)	**Acceleration Lane**	Sqm	1 x 1/2	90.00	3.75		168.75	
			1	200.00	3.75		750.00	
							918.75	**Sqm**
(G)	**Deceleration Lane**	Sqm	1 x 1/2	75.00	3.75		140.63	
			1	120.00	3.75		450.00	
							590.63	**Sqm**
(H)	**Straight Portion**	Sqm	1	300	7.00		**2,100.00**	**Sqm**
OTAL TRUCK PARKING / TRUCK LAY BYE AREA TO BE PAVED [{E}+{F}+{G}+(H)]						**=**	**14,627.38**	**Sqm**
						Say =	**14,627.00**	**Sqm**

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
	9300								
	1200	9.3	3	1.2	33.48				
	9300	9.3	3						
Cap	500	3.5	3		9.253				
	3500			0.5					
	3500	3.5	3						
	500	2.5	2		3.791				
	2500			0.5		7	14	**651.3**	m 3
	2500								
	11290					9.09			
	15490					13.29			
	13740					11.54			
shaft 1	11970	2.5	2		5	9.77			
	10240					8.04			
	8490					6.29			
	8760					6.56			
						64.58	129.16	**645.8**	m 3
	0								
						0			
						0			
shaft 2(if any)	0	0	0		0	0			
						0			
						0			
						0	0	**0.0**	m 3
	0	0	0						
	0	0	0		0.000				
Footing 1	0			0					
	0								
	0				0				
		0	0	0		0	0	**0.0**	m 3
	3500	3.5	8						
	500	6	8		18.777				
Footing 2	6000			0.5					
	6000								
	1500				72				
		6	8	1.5		7	14	**1270.9**	m 3
Pedestal									
	1000				0.19				
	200	1	0.95	0.2		24	48	**9.1**	m 3
Bearing	Fixed(capacity 650t)						6	**12**	nos.
	Guided (capacity 650t)						12	**24**	nos.
	Free (capacity 650t)						6	**12**	nos.
Dirt wall	12300								
	3000				18.45				
		12.3	0.5	3					
	12300	12.3	0.5						
	500	9.3	0.5		2.691				
	9300			0.5		2	4	**84.6**	m 3
Approach slab	End A1	8	11.4	0.3	27.36				
incld. pcc	End A1	5	11.4	0.3	17.1		2	**88.92**	m 3
Re wall	30000								
	11290								
		30	11.29		338.7				

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
	12300								
		10490	12.3	10.49	129.027				
	15000								
		8760							
		15		8.76	131.4				
	12300								
		7960	12.3	7.96	97.908			**697.035**	m 2
Fill		169.35 x		12.3	+				
		65.7 x		12.3	+			**2891.12**	
Friction slab(cappin	45000	45			1.055		4	**189.9**	m 3
	Inculding diaphragm,brackets,anchorages, plinth and stiches,erection etc								
Deck/Box	*4.45 m^2/box/m*1.15 for misc conc*								
		300			4.45	3070.5	2	**6141**	m 3
Drainage spout						100	2	**200**	nos
Parapet		300				600	2	**1200**	m
Hand rail		300				600	2	**1200**	m
Pedestrian railing		300				300	2	**600**	m
Painting on railing		300			1.3	780	2	**1560**	m 2
Wearing Surface (inculding water proofing)									
	a)65 thk	300	9.6	0.065	187.2		2	**374.4**	m 3
	b) 25 thk	300	1.5	0.025	11.25		2	**22.5**	m 3
Expansion Joint (strip seal)	At free pier only.	12.3				**4**	8	**98.4**	m
Prestressing	superstructure.							**337.755**	t
Reinforcement Fe500	Footing					127.1			
	Shaft 2					0.0			
	Shaft 1					129.2			
	Cap					162.8			
	Pedestal					0.9			
	Dirtwall					7.2			
	Approach slab					7.6			
	Friction slab					16.1			
	Deck					921.2			
	Parapets					51.8			
						1423.9	1	**1423.9**	t

Bridge No 1 , Length 50m
Bill of Quantities

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
	9300								
		1200 9.3	3	1.2	33.48				
Cap	9300	9.3	3						
		500 3.5	3		9.253				
	3500			0.5					
	3500	3.5	3						
		500 2.5	2		3.791				
	2500			0.5		2	4	**186.1**	m 3
	2500								
		11830				9.63			
		5140				2.94			
shaft 1		2.5	2		5				
						12.57	25.14	**125.7**	m 3
	0								
						0			
						0			
shaft 2(if any)	0	0	0		0	0			
						0			
						0			
						0	0	**0.0**	m 3
	0	0	0						
	0	0	0		0.000				
Footing 1	0			0					
	0								
	0				0				
		0	0	0		0	0	**0.0**	m 3
	3500	3.5	8						
	500	6	8		18.777				
Footing 2	6000			0.5					
	6000								
	1500				72				
		6	8	1.5		2	4	**363.1**	m 3
Pedestal									
	1000				0.19				
	200	1	0.95	0.2		4	8	**1.5**	m 3
Bearing	Fixed(capacity 650t)						1	**2**	nos.
	Guided (capacity 650t)						2	**4**	nos.
	Free (capacity 650t)						1	**2**	nos.
Dirt wall	12300								
	3000				18.45				
		12.3	0.5	3					
	12300	12.3	0.5						
	500	9.3	0.5		2.691				
	9300			0.5		2	4	**84.6**	m 3
Approach slab	End A1	8	11.4	0.3	27.36				
incld. pcc	End A1	5	11.4	0.3	17.1		2	**88.92**	m 3
Re wall	30000								

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
		11830							
		30	11.83		354.9				
	12300								
		11030	12.3	11.03	135.669				
	5000								
		5140							
		5	5.14		25.7				
	12300								
		4340	12.3	4.34	53.382			**569.651**	m 2
Fill		177.45	x	12.3	+				
		12.85	x	12.3	+			**2340.69**	
Friction slab(cappi	35000	35			1.055		4	**147.7**	m 3
	Inculding diaphragm,brackets,anchorages, plinth and stiches,erection etc								
	*4.45 m^2/box/m*1.15 for misc conc*								
Deck		50			4.45	511.75	2	**1023.5**	m 3
Drainage spout						17	2	**34**	nos
Parapet		50				100	2	**200**	m
Hand rail		50				100	2	**200**	m
Pedestrian railing		50				50	2	**100**	m
Painting on railing		50			1.3	130	2	**260**	m 2
Wearing Surface (inculding water proofing)	a)65 thk	50	9.6	0.065	31.2		2	**62.4**	m 3
	b) 25 thk	50	1.5	0.025	1.875		2	**3.8**	m 3
Expansion Joint (strip seal)	At free pier only.	12.3				**1**	2	**24.6**	m
Prestressing	superstructure.							**56.2925**	t
Reinforcement Fe500	Footing					36.3			
	Shaft 2					0.0			
	Shaft 1					25.1			
	Cap					46.5			
	Pedestal					0.2			
	Dirtwall					7.2			
	Approach slab					7.6			
	Friction slab					12.6			
	Deck					153.5			
	Parapets					8.6			
						297.6	1	**297.6**	t

Bridge No 2 , Length 1090m
Bill of Quantities

	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit	remarks
	17625									
	30000					30				
	210000					210				8 piers
shaft 1		17.625	6		105.75	240				
	less:-									
	13440.00									
					64.512					10% increased
	4800	13.44	4.8			240		**10886.832**	m 3	due to cap
	15000									
	0					0				
	120000					120				
	26450					26.45				
	15500					15.5				
	4500					4.5				
shaft 2(if any)		15	7.5		112.5	166.45				
	less:-									
	11400									
					58.14					10% increased due to diaphragm
	5100	11.4	5.1			166.45		**9953.0442**	m 3	
	18000									
	20000					20				
	40000					40				
	12500					12.5				
shaft 3(if any)		18	9		162	72.5				
	less:-									
	14400									
					95.04					10% increased
	6600	14.4	6.6			72.5		**5340.06**	m 3	
								26179.936		
Footing 1	17000									
	11000				374					
		17	11	2		**1**		**374.0**	m 3	
Footing 2	20000									
	12500				500					
		20	12.5	2		**4**		**2000.0**	m 3	
Footing 3	23000									
	14000				644					
		23	14	2		**3**		**1932.0**	m 3	
Pedestal	1000									
	200	1	0.95	0.2	0.19	**56**		**10.6**	m 3	
Bearing	Fixed(capacity 650t)						12	**12**	nos.	
	Guided (capacity 650t)						28	**28**	nos.	
	Free (capacity 650t)						16	**16**	nos.	

	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit	remarks
	26100									
Dirt wall	3000				39.15					
		26.1	0.5	3						
	26100	26.1	0.5							
	500	23.25	0.5		6.165					
	23250			0.5		**2**	2	**90.6**	m 3	
Approach slab	End A1	10	25.1	0.3	75.3					
incld. pcc	End A1	10	25.1	0.3	75.3		1	**150.6**	m 3	
	45000									
	30000	45	30		1350					
	26100									
	29200	26.1	29.2		762.12					
Re wall										
	100000									
	34000	100	34		3400					
	26100									
	33200	26.1	33.2		866.52			**6378.64**	m 2	
Fill		675 x		26.1	+					
		1700 x		26.1	+			**61987.50**	m 3	
Friction slab(cappi	145000	145			1.055		4	**611.9**	m 3	
	*4.45 m^2/box/m*1.15 for misc conc*									
box/deck		300			4.45	3070.5	2	**6141**	m 3	
Drainage spout						100	2	**200**	nos	
Parapet		300				600	2	**1200**	m	
Hand rail		300				600	2	**1200**	m	
Pedestrian railing		300				300	2	**600**	m	
Painting on railing		300			1.3	780	2	**1560**	m2	
Wearing Surface (inculding water proofing)	a)65 thk	300	9.6	0.065	187.2		2	**374.4**	m 3	
	b) 25 thk	300	1.5	0.025	11.25		2	**22.5**	m 3	
Expansion Joint (strip seal)	At free pier only.	24.6				**5**	5	**123**	m	
Prestressing	superstructure + Y Pier							**337.755**	t	
Reinforcement Fe500	Footing					430.6				
	Shaft					5236.0				
	Cap					0.0				
	Pedestal					1.1				
	Dirtwall					7.7				
	Approach slab					12.8				
	Deck					921.2				
	Parapets					57.6				
					Total Steel Quantity	6666.9	1	**6666.9**	t	

Bridge No 2 , Length 1090m
Bill of Quantities

Special Span

	Description		LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit	remarks
		19125									
		422576					422.576				4 piers 2 arms common pier
		30000					30				
Y-Pier			19.125	6		114.75	452.576				
	less:-										
		12495.00									
						54.978					20% increased due to diaphragm
		4400	12.495	4.4			452.576		**32461.647**	m 3	
		15000									
		30000					30				
		30000					30				
		30000					30				
		30000					30				
		30000					30				
shaft 2(if any)			15	7.5		112.5	150				
	less:-										
		11400									
						58.14					10% increased due to diaphragm
		5100	11.4	5.1			150		**8969.4**	m 3	
		18000									
		35000					35				
		59000					59				
		42000					42				
		30000					30				
shaft 3(if any)		60000					60				Common Pier
			18	9		162	226				
	less:-										
		14400									
						95.04					10% increased
		6600	14.4	6.6			226		**16646.256**	m 3	
Footing 1		28000									
		20000	28	20	2.5	1400	**4**		**5600.0**	m 3	
Footing 2		20000									
		12500				500					na
			20	12.5	2		**1**		**500.0**	m 3	
Footing 3		23000									
		14000				644					na
			23	14	2		**0**		**0.0**	m 3	
Pedestal		1000									
		200	1	0.95	0.2	0.19	**8**		**1.5**	m 3	na
Bearing	Fixed(capacity 650t)							0	**0**	nos.	na
	Guided (capacity 650t)							4	**4**	nos.	na
	Free (capacity 650t)							4	**4**	nos.	na

	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit	remarks
	26100									
Dirt wall	3000				39.15					
		26.1	0.5	3						
	26100	26.1	0.5							
	500	23.25	0.5		6.165					
	23250			0.5		2	0	**0.0**	m 3	naa
Approach slab	End A1	10	25.1	0.3	75.3					
incld. pcc	End A1	10	25.1	0.3	75.3		0	**0**	m 3	na
	50000									
	23000									
		50	23		1150					
	26100									
	22200	26.1	22.2		579.42					
Re wall										
	78000									
	34000									
		78	34		2652					
	26100									
	33200	26.1	33.2		866.52			**0**	m 2	na
Fill		575 x		26.1	+					
		1326 x		26.1	+			**0.00**		na
	*4.45 m^2/box/m*1.15 for misc conc*									
box/deck		740			4.45	7573.9	2	**15147.8**	m 3	
Drainage spout						247	2	**494**	nos	
Parapet		740				1480	2	**2960**	m	
Hand rail		740				1480	2	**2960**	m	
Pedestrian railing		740				740	2	**1480**	m	
Painting on railing		740			1.3	1924	2	**3848**	m2	
Wearing Surface (inculding water proofing)	a)65 thk	740	9.6	0.065	461.76		2	**923.5**	m 3	
	b) 25 thk	740	1.5	0.025	27.75		2	**55.5**	m 3	
Expansion Joint (strip seal)	At free pier only.	24.6				1	1	**24.6**	m	na
Prestressing	superstructure incld tie							**984.607**	t	
Reinforcement Fe500	Footing					610.0				
	Shaft					11615.5				
	Cap					0.0				
	Pedestal					0.2				
	Dirtwall					0.0				
	Approach slab					0.0				
	Deck					2272.2				
	Parapets					142.1				
					Total Steel Quantity	14639.9	1	**14639.9**	t	
Structural Steel		23.316			0.1184	24	520.365			
					0.054	24				25% Increased due to fabricatio
		65					661.621	**1477.5**	t	n etc

Bridge No 3 , Length 50m
Bill of Quantities

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
	9300								
	1200	9.3	3	1.2	33.48				
Cap	9300	9.3	3						
	500	3.5	3		9.253				
	3500			0.5					
	3500	3.5	3						
	500	2.5	2		3.791				
	2500			0.5		**2**	4	**186.1**	m 3
	2500								
	3000					0.8			
	10590					8.39			
shaft 1		2.5	2		5				
						9.19	18.38	**91.9**	m 3
	0								
						0			
						0			
shaft 2(if any)	0	0	0		0	0			
						0			
						0			
						0	0	**0.0**	m 3
	0	0	0						
	0	0	0		0.000				
Footing 1	0			0					
	0								
	0				0				
		0	0	0		**0**	0	**0.0**	m 3
	3500	3.5	8						
	500	6	8		18.777				
Footing 2	6000			0.5					
	6000								
	1500				72				
		6	8	1.5		**2**	4	**363.1**	m 3
Pedestal									
	1000				0.19				
	200	1	0.95	0.2		**4**	8	**1.5**	m 3
Bearing	Fixed(capacity 650t)						1	**2**	nos.
	Guided (capacity 650t)						2	**4**	nos.
	Free (capacity 650t)						1	**2**	nos.
Dirt wall	12300								
	3000				18.45				
		12.3	0.5	3					
	12300	12.3	0.5						
	500	9.3	0.5		2.691				
	9300			0.5		**2**	4	**84.6**	m 3
Approach slab	End A1		8	11.4	0.3	27.36			
incld. pcc	End A1		5	11.4	0.3	17.1	2	**88.92**	m 3

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
Re wall	5000								
	3000								
		5	3		15				
	12300								
	2200	12.3	2.2		27.06				
	15000								
	10590								
		15	10.59		158.85				
	12300								
	9790	12.3	9.79		120.417			**321.327**	m 2
Fill		7.5	x	12.3	+				
		79.425	x	12.3	+			**1069.18**	
Friction slab(cappi	20000	20			1.055		4	**84.4**	m 3
	Inculding diaphragm,brackets,anchorages, plinth and stiches,erection etc								
Deck	*4.45 m^2/box/m*1.15 for misc conc*								
		50			4.45	511.75	2	**1023.5**	m 3
Drainage spout						17	2	**34**	nos
Parapet		50				100	2	**200**	m
Hand rail		50				100	2	**200**	m
Pedestrian railing		50				50	2	**100**	m
Painting on railing		50			1.3	130	2	**260**	m 2
Wearing Surface (inculding water proofing)	a)65 thk	50	9.6	0.065	31.2		2	**62.4**	m 3
	b) 25 thk	50	1.5	0.025	1.875		2	**3.8**	m 3
Expansion Joint (strip seal)	At free pier only.	12.3				**1**	2	**24.6**	m
Prestressing	superstructure.							**56.2925**	t
Reinforcement Fe500	Footing					36.3			
	Shaft 2					0.0			
	Shaft 1					18.4			
	Cap					46.5			
	Pedestal					0.2			
	Dirtwall					7.2			
	Approach slab					7.6			
	Friction slab					7.2			
	Deck					153.5			
	Parapets					8.6			
						285.5	1	**285.5**	t

Bridge No 4 , Length 1020m
Bill of Quantities
Approach Span

Item	Description		LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit	remarks
		17625									
		23000					23				
		30000					390				13 piers
shaft 1			17.625	6		105.75	413				
	less:-										
		13440.00									
						64.512					10% increased
		4800	13.44	4.8			413		**18734.423**	m 3	due to cap
		15000									
		0					0				
		17000					17				
		150000					150				
		149000					149				
shaft 2(if any)			15	7.5		112.5	316				
	less:-										
		11400									
						58.14					10% increased due to diaphrag
		5100	11.4	5.1			316		**18895.536**	m 3	m
		18000									
		2500					2.5				
		22500					22.5				
		28500					28.5				
		2500					2.5				
shaft 3(if any)		3500					3.5				
			18	9		162	59.5				
	less:-										
		14400									
						95.04					10%
		6600	14.4	6.6			59.5		**4382.532**	m 3	increased
									42012.491		
Footing 1		17000									
		11000									30
			17	11	2	374	**1**		**374.0**	m 3	
Footing 2		20000									
		12500									>30 60
			20	12.5	2	500	**8**		**4000.0**	m 3	
Footing 3		23000									
		14000									>60
			23	14	2	644	**5**		**3220.0**	m 3	
Pedestal		1000									
		200	1	0.95	0.2	0.19	**104**		**19.8**	m 3	
Bearing	Fixed(capacity 650t)							24	**24**	nos.	
	Guided (capacity 650t)							52	**52**	nos.	
	Free (capacity 650t)							28	**28**	nos.	
		26100									

Item	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit	remarks
Dirt wall	3000									
		26.1	0.5	3	39.15					
	26100	26.1	0.5							
	500	23.25	0.5		6.165					
	23250			0.5		**2**	2	**90.6**	m 3	
Approach slab	End A1	10	25.1	0.3	75.3					
incld. pcc	End A1	10	25.1	0.3	75.3		1	**150.6**	m 3	
	50000									
	23000	50	23		1150					
	26100									
	22200	26.1	22.2		579.42					
Re wall										
	78000									
	34000	78	34		2652					
	26100									
	33200	26.1	33.2		866.52			**5247.94**	m 2	
Fill		575 x		26.1	+					
		1326 x		26.1	+			**49616.10**	m 3	
Friction slab(cappi	128000	128			1.055		4	**540.16**	m 3	
	*4.45 m^2/box/m*1.15 for misc conc*									
box/deck		600			4.45	6141	2	**12282**	m 3	
Drainage spout						200	2	**400**	nos	
Parapet		600				1200	2	**2400**	m	
Hand rail		600				1200	2	**2400**	m	
Pedestrian railing		600				600	2	**1200**	m	
Painting on railing		600			1.3	1560	2	**3120**	m2	
Wearing Surface (inculding water proofing)	a)65 thk	600	9.6	0.065	374.4		2	**748.8**	m 3	
	b) 25 thk	600	1.5	0.025	22.5		2	**45.0**	m 3	
Expansion Joint (strip seal)	At free pier only.	24.6				**8**	8	**196.8**	m	
Prestressing	superstructure.							**798.33**	t	
Reinforcement Fe500	Footing					759.4				
	Shaft					8402.5				
	Cap					0.0				
	Pedestal					2.0				
	Dirtwall					7.7				
	Approach slab					12.8				
	Deck					1842.3				
	Parapets					115.2				
					Total Steel Quantity	11141.9	1	**11141.9**	t	

Bridge No 4 , Length 1020m
Bill of Quantities
Special Span

Item	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit	remarks
	19125									
	211288					211.288				2 piers 2 arms
Y-Pier		19.125	6		114.75	211.288				
	less:-									
	12495.00									
					54.978					20% increased due to diaphragm
	4400	12.495	4.4			211.288		**15154.928**	m 3	
	15000									
	30000					30				
	30000					30				
shaft 2(if any)		15	7.5		112.5	60				
	less:-									
	11400									
					58.14					10% increased due to diaphragm
	5100	11.4	5.1			60		**3587.76**	m 3	
	18000									
	38065					38.065				
	18000					18				
shaft 3(if any)		18	9		162	56.065				
	less:-									
	14400									
					95.04					10% increased
	6600	14.4	6.6			56.065		**4129.5236**	m 3	
Footing 1	28000									
	20000				1400					
		28	20	2.5		**2**		**2800.0**	m 3	
Footing 2	20000									
	12500				500					na
		20	12.5	2		**0**		**0.0**	m 3	
Footing 3	23000									na
	14000				644					
		23	14	2		**0**		**0.0**	m 3	
Pedestal	1000									
	200	1	0.95	0.2	0.19	**0**		**0.0**	m 3	na
Bearing	Fixed(capacity 650t)						0	**0**	nos.	na
	Guided (capacity 650t)						0	**0**	nos.	na
	Free (capacity 650t)						0	**0**	nos.	na
	26100									

Item	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit	remarks
Dirt wall		3000								
		26.1	0.5	3	39.15					
	26100	26.1	0.5							
		500 23.25	0.5		6.165					
	23250			0.5		**2**	0	**0.0**	m 3	na
Approach slab	End A1	10	25.1	0.3	75.3					
incld. pcc	End A1	10	25.1	0.3	75.3		0	**0**	m 3	na
	50000									
	23000									
		50	23		1150					
	26100									
	22200	26.1	22.2		579.42					
Re wall										
	78000									
	34000									
		78	34		2652					
	26100									
	33200	26.1	33.2		866.52			**0**	m 2	na
Fill		~~575 x~~		~~26.1~~	+					
		1326 x		26.1	+			**0.00**	m 3	na
	*4.45 m^2/box/m*1.15 for misc conc*									
box/deck		370			4.45	3786.95	2	**7573.9**	m 3	
Drainage spout						124	2	**248**	nos	
Parapet		370				740	2	**1480**	m	
Hand rail		370				740	2	**1480**	m	
Pedestrian railing		370				370	2	**740**	m	
Painting on railing		370			1.3	962	2	**1924**	m2	
Wearing Surface (inculding water proofing)	a)65 thk	370	9.6	0.065	230.88		2	**461.8**	m 3	
	b) 25 thk	370	1.5	0.025	13.875		2	**27.8**	m 3	
Expansion Joint (strip seal)	At free pier only.	24.6				**0**	0	**0**	m	na
Prestressing	superstructure incld tie							**492.3035**	t	
Reinforcement Fe500	Footing					280.0				
	Shaft					4574.4				
	Cap					0.0				
	Pedestal					0.0				
	Dirtwall					0.0				
	Approach slab					0.0				
	Deck					1136.1				
	Parapets					71.0				
					Total Steel Quantity	6061.6	1	**6061.6**	t	
Structural Steel		23.316			0.1184	12	260.182			
					0.054	12				25% Increased due to fabricatio
		65					330.810	**738.7**	t	n etc

Bridge No 5 , Length 100m
Bill of Quantities

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
	9300								
	1200	9.3	3	1.2	33.48				
	9300	9.3	3						
Cap	500	3.5	3		9.253				
	3500			0.5					
	3500	3.5	3						
	500	2.5	2		3.791				
	2500			0.5		**3**	6	**279.1**	m 3
	2500								
	3930					1.73			
	20000					17.8			
shaft 1	9010	2.5	2		5	6.81			
						26.34	52.68	**263.4**	m 3
	5000								
	5730	5	4		20	5.73			
shaft 2(if any)						5.73	11.46	**229.2**	m 3
	5500	5.5	10						
	500	8	10		33.555				
Footing 1	8000			0.5					
	8000								
	2000	8	10	2	160	**1**	2	**387.1**	m 3
	3500	3.5	8						
	500	6	8		18.777				
Footing 2	6000			0.5					
	6000								
	1500	6	8	1.5	72	**2**	4	**363.1**	m 3
Pedestal									
	1000								
	200	1	0.95	0.2	0.19	**8**	16	**3.0**	m 3
Bearing	Fixed(capacity 650t)						2	**4**	nos.
	Guided (capacity 650t)						4	**8**	nos.
	Free (capacity 650t)						2	**4**	nos.
Dirt wall	12300								
	3000	12.3	0.5	3	18.45				
	12300	12.3	0.5						
	500	9.3	0.5		2.691				
	9300			0.5		**2**	4	**84.6**	m 3
Approach slab	End A1	5	11.4	0.3	17.1				
incld. pcc	End A1	5	11.4	0.3	17.1		2	**68.4**	m 3
Re wall	10000								
	4000	10	4		40				

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
	12300								
		3200	12.3	3.2	39.36				
	10000								
		9000							
			10	9	90				
	12300								
		8200	12.3	8.2	100.86			**270.22**	m 2
Fill			20 x	12.3	+				
			45 x	12.3	+			**799.50**	
Friction slab(cappi	20000		20		1.055		4	**84.4**	m 3
	Inculding diaphragm,brackets,anchorages, plinth and stiches,erection etc								
Deck	*4.45 m^2/box/m*1.15 for misc conc*								
			100		4.45	1023.5	2	**2047**	m 3
Drainage spout						34	2	**68**	nos
Parapet			100			200	2	**400**	m
Hand rail			100			200	2	**400**	m
Pedestrian railing			100			100	2	**200**	m
Painting on railing			100		1.3	260	2	**520**	m2
Wearing Surface (inculding water proofing)					62.4				
	a)65 thk		100	9.6	0.065		2	**124.8**	m 3
					3.75				
	b) 25 thk		100	1.5	0.025		2	**7.5**	m 3
Expansion Joint (strip seal)	At free pier only.		12.3			**2**	4	**49.2**	m
Prestressing	superstructure.							**112.585**	t
Reinforcement Fe500	Footing					75.0			
	Shaft 2					45.8			
	Shaft 1					52.7			
	Cap					69.8			
	Pedestal					0.3			
	Dirtwall					7.2			
	Approach slab					5.8			
	Friction slab					7.2			
	Deck					307.1			
	Parapets					17.3			
						588.1	1	**588.1**	t

Bridge No 6 , Length 200m
Bill of Quantities

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
	9300								
	1200	9.3	3	1.2	33.48				
Cap	9300	9.3	3						
	500	3.5	3		9.253				
	3500			0.5					
	3500	3.5	3						
	500	2.5	2		3.791				
	2500			0.5		5	10	**465.2**	m 3
	2500								
	0								
	17300					15.1			
	20000					17.8			
shaft 1	20000	2.5	2		5	17.8			
	20000					17.8			
						68.5	137	**685**	m 3
	5000								
	0					0			
	0					0			
shaft 2(if any)	13760	5	4		20	13.76			
	24240					24.24			
	4140					4.14			
						42.14	84.28	**1685.6**	m 3
	5500	5.5	10						
	500	8	10		33.555				
Footing 1	8000			0.5					
	8000								
	2000								
		8	10	2	160	2	4	**774.2**	m 3
	3500	3.5	8						
	500	6	8		18.777				
Footing 2	6000			0.5					
	6000								
	1500				72				
		6	8	1.5		3	6	**544.7**	m 3
Pedestal									
	1000				0.19				
	200	1	0.95	0.2		16	32	**6.1**	m 3
Bearing	Fixed(capacity 650t)						4	**8**	nos.
	Guided (capacity 650t)						8	**16**	nos.
	Free (capacity 650t)						4	**8**	nos.
Dirt wall	12300								
	3000				18.45				
		12.3	0.5	3					
	12300	12.3	0.5						
	500	9.3	0.5		2.691				
	9300			0.5		2	4	**84.6**	m 3
Approach slab	End A1		8	11.4	0.3	27.36			
incld. pcc	End A1		10	11.4	0.3	34.2	2	**123.12**	m 3
Re wall	3000								
	1000								
		3	1		3				

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
	12300								
		400	12.3	0.4	4.92				
	15000								
		24140							
			15	24.14	362.1				
	12300								
		23340	12.3	23.34	287.082			**657.102**	m 2
Fill			1.5 x		12.3 +				
			181.05 x		12.3 +			**2245.37**	
Friction slab(cappi	18000		18		1.055		4	**75.96**	m 3
Deck	Inculding diaphragm,brackets,anchorages, plinth and stiches,erection etc								
	*4.45 m^2/box/m*1.15 for misc conc*								
		200			4.45	2047	2	**4094**	m 3
Drainage spout						67	2	**134**	nos
Parapet		200				400	2	**800**	m
Hand rail		200				400	2	**800**	m
Pedestrian railing		200				200	2	**400**	m
Painting on railing		200			1.3	520	2	**1040**	m 2
Wearing Surface (inculding water proofing)	a)65 thk	200	9.6	0.065	124.8		2	**249.6**	m 3
	b) 25 thk	200	1.5	0.025	7.5		2	**15.0**	m 3
Expansion Joint (strip seal)	At free pier only.	12.3				**3**	6	**73.8**	m
Prestressing	superstructure.							**225.17**	t
Reinforcement Fe500	Footing					131.9			
	Shaft 2					337.1			
	Shaft 1					137.0			
	Cap					116.3			
	Pedestal					0.6			
	Dirtwall					7.2			
	Approach slab					10.5			
	Friction slab					6.5			
	Deck					614.1			
	Parapets					34.6			
						1395.7	1	**1395.7**	t

Bill of Quantities

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
	9300								
	1200	9.3	3	1.2	33.48				
	9300	9.3	3						
Cap	500	3.5	3		9.253				
	3500			0.5					
	3500	3.5	3						
	500	2.5	2		3.791				
	2500			0.5		**5**	10	**465.2**	m 3
	2500								
	4900					1.8			
	10700					8.5			
	17100					14.9			
shaft 1	16600	2.5	2		5	14.4			
	10000					7.8			
						47.4	94.8	**474**	m 3
	0								
						0			
						0			
shaft 2(if any)	0	0	0		0	0			
						0			
						0			
						0	0	**0.0**	m 3
	0	0	0						
	0	0	0		0.000				
Footing 1	0			0					
	0								
	0				0				
		0	0	0		**0**	0	**0.0**	m 3
	3500	3.5	8						
	500	6	8		18.777				
Footing 2	6000			0.5					
	6000								
	1500				72				
		6	8	1.5		**5**	10	**907.8**	m 3
Pedestal									
	1000				0.19				
	200	1	0.95	0.2		**16**	32	**6.1**	m 3
Bearing	Fixed(capacity 650t)						4	**8**	nos.
	Guided (capacity 650t)						8	**16**	nos.
	Free (capacity 650t)						4	**8**	nos.
Dirt wall	12300								
	3000								
		12.3	0.5	3	18.45				
	12300	12.3	0.5						
	500	9.3	0.5		2.691				
	9300			0.5		**2**	4	**84.6**	m 3
Approach slab	End A1		8	11.4	0.3	27.36			
incld. pcc	End A1		8	11.4	0.3	27.36	2	**109.44**	m 3
Re wall	15000								
	4000								
		15	4		60				

Items	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit
	12300								
		3200	12.3	3.2	39.36				
	15000								
		10000							
		15	10		150				
	12300								
		9200	12.3	9.2	113.16			**362.52**	m 2
Fill		30 x		12.3	+				
		75 x		12.3	+			**1291.50**	
Friction slab(cappi	30000	30			1.055		4	**126.6**	m 3
	Inculding diaphragm,brackets,anchorages, plinth and stiches,erection etc								
	*4.45 m^2/box/m*1.15 for misc conc*								
Deck		200			4.45	2047	2	**4094**	m 3
Drainage spout						67	2	**134**	nos
Parapet		200				400	2	**800**	m
Hand rail		200				400	2	**800**	m
Pedestrian railing		200				200	2	**400**	m
Painting on railing		200			1.3	520	2	**1040**	m 2
Wearing Surface (inculding water proofing)	a)65 thk	200	9.6	0.065	124.8		2	**249.6**	m 3
	b) 25 thk	200	1.5	0.025	7.5		2	**15.0**	m 3
Expansion Joint (strip seal)	At free pier only.	12.3				**3**	6	**73.8**	m
Prestressing	superstructure.							**225.17**	t
Reinforcement Fe500	Footing					90.8			
	Shaft 2					0.0			
	Shaft 1					94.8			
	Cap					116.3			
	Pedestal					0.6			
	Dirtwall					7.2			
	Approach slab					9.3			
	Friction slab					10.8			
	Deck					614.1			
	Parapets					34.6			
						978.4	1	**978.4**	t

Gundiya Viaduct , Length 3216.77m
Bill of Quantities

Item	Description	LENGTH (m)	WIDTH(m)	DEPTH(m)	section VOL/Area	nos/length	total nos / length	Total quantity	unit	remarks
	17625									
	10460					10.46				
	21690					21.69				
	1620000					1620				54 piers
	26990					26.99				
	20760					20.76				
	14320					14.32				
	7800					7.8				
shaft 1										
		17.625	6		105.75	1722.02				
	less:-									
	13440.00									
					64.512					10% increased due to
	4800	13.44	4.8			1722.02		**78113.9**	m 3	cap
	15000									
	8800					8.8				
	24800					24.8				
	1020000					1020				
	140443					140.443				
	180257					180.257				
shaft 2(if any)										
		15	7.5		112.5	1374.3				
	less:-									
	11400									
					58.14					10% increased due to diaphrag
	5100	11.4	5.1			1374.3		**82177.6**	m 3	m
	18000									
	9260					9.26				
	392220					392.22				
shaft 3(if any)										
		18	9		162	401.48				
	less:-									
	14400									
					95.04					10%
	6600	14.4	6.6			401.48		**29571.4**	m 3	increased
Footing 1	17000									30m
	11000				374					
		17	11	2		**6**		**2244.0**	m 3	
Footing 2	20000									>30 60
	12500				500					
		20	12.5	2		**25**		**12500.0**	m 3	
Footing 3	23000									>30
	14000				644					
		23	14	2		**29**		**18676.0**	m 3	
Pedestal	1000				0.19	**472**				
	200	1	0.95	0.2				**89.7**	m 3	
Bearing	Fixed(capacity 650t)						116	**116**	nos.	
	Guided (capacity 650t)						236	**236**	nos.	
	Free (capacity 650t)						120	**120**	nos.	
	26100									
Dirt wall	3000				39.15					
		26.1	0.5	3						
	26100	26.1	0.5							
	500	23.25	0.5		6.165					
	23250			0.5		**2**	2	**90.6**	m 3	
Approach slab	End A1	10	25.1	0.3	75.3					
incld. pcc	End A1	10	25.1	0.3	75.3		1	**150.6**	m 3	
	87000									
	10500									
		87	10.5		913.5					

		26100									
			9700	26.1	9.7		253.17				
Re wall											
		10000									
			7900								
				10	7.9		79				
		26100									
			7100	26.1	7.1		185.31			**1431.0**	m 2
Fill				456.75	x		26.1	+			
				39.5	x		26.1	+		**12952.1**	m 3
Friction slab(cappi		97000		97			1.055		4	**409.34**	m 3
	*7.46 m^2/box/m*1.15 for misc conc*										
Box/deck				2950			7.46	25308.05	2	**50616.1**	m 3
Drainage spout								984	2	**1968.0**	nos
Parapet				2950				5900	2	**11800.0**	m
Hand rail				2950				5900	2	**11800.0**	m
Pedestrian railing				2950				2950	2	**5900.0**	m
Painting on railing				2950			1.3	7670	2	**15340**	m2
Wearing Surface (inculding water proofing)	a)65 thk			2950	9.6	0.065	1840.8		2	**3681.6**	m 3
	b) 25 thk			2950	1.5	0.025	110.625		2	**221.3**	m 3
Expansion Joint (strip seal)	At free pier only.			24.6				**29**	29	**713.4**	m
Prestressing	superstructure.									**2783.9**	t
Reinforcement Fe500	Footing							3342.0			
	Shaft							37972.6			
	Cap							0.0			
	Pedestal							9.0			
	Dirtwall							7.7			
	Approach slab							12.8			
	Deck							7592.4			
	Parapets							566.4			
							Total Steel Quantity	49502.9	1	**49502.9**	t

PROJECT: Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

Design Ch 0+000 to Ch 23+579 , Length = 23.579km

Abstract : Bill of Quantities for Bridges, ROB and Viaduct

Items	Unit	Bridge 0	Bridge1	Bridge 2	Bridge 2 - Spl	Bridge 3	Bridge 4	Bridge 4 - Spl	Bridge 5	Bridge 6	ROB	Via Duct	Total
Foundation	Cum	56250.0	9375.0	204375.0	102187.5	9375.0	191250.0	95625.0	18750.0	37500.0	56250.0	603000.0	1383937.5
Cap	Cum	651.3	186.1			186.1			279.1	465.2	465.2		2233.1
Shaft - Minor Bridges	Cum	645.8	125.7			91.9			492.6	2370.6	474.0		4200.6
Y-Pier	Cum				32461.6			15154.9					47616.6
Cap Tall Piers	Cum			10886.8			18734.4					78113.9	107735.2
Shaft -Tall Piers	Cum			15293.1	25615.7		23278.1	7717.3				111749.1	183653.2
Footing	Cum	1270.9	363.1	4306.0	6100.0	363.1	7594.0	2800.0	750.2	1318.9	907.8	33420.0	59194.0
Pedestal	Cum	9.1	1.5	10.6	1.5	1.5	19.8	0.0	3.0	6.1	6.1	89.7	149.0
Bearing													
Fixed(capacity 650t)	Nos.	12.0	2.0	12.0	0.0	2.0	24.0	0.0	4.0	8.0	8.0	116.0	188.0
Guided (capacity 650t)	Nos.	24.0	4.0	28.0	4.0	4.0	52.0	0.0	8.0	16.0	16.0	236.0	392.0
Free (capacity 650t)	Nos.	12.0	2.0	16.0	4.0	2.0	28.0	0.0	4.0	8.0	8.0	120.0	204.0
Dirt wall	Cum	84.6	84.6	90.6	0.0	84.6	90.6	0.0	84.6	84.6	84.6	90.6	779.3
Approach slab	Cum	88.9	88.9	150.6	0.0	88.9	150.6	0.0	68.4	123.1	109.4	150.6	1019.5
RE Wall	Sqm	697.0	569.7	6378.6	0.0	321.3	5247.9	0.0	270.2	657.1	362.5	1431.0	15935.4
Back Fill	Cum	2891.1	2340.7	61987.5	0.0	1069.2	49616.1	0.0	799.5	2245.4	1291.5	12952.1	135193.1
Friction slab(capping wall)	Cum	189.9	147.7	611.9		84.4	540.2		84.4	76.0	126.6	409.3	2270.4
Deck/Box - M60	Cum				15147.8			7573.9					22721.7
Deck/Box - M45	Cum	6141.0	1023.5	6141.0		1023.5	12282.0		2047.0	4094.0	4094.0	50616.1	87462.1
Drainage spout	Nos.	200.0	34.0	200.0	494.0	34.0	400.0	248.0	68.0	134.0	134.0	1968.0	3914.0
Parapet	LM	1200.0	200.0	1200.0	2960.0	200.0	2400.0	1480.0	400.0	800.0	800.0	11800.0	23440.0
Hand rail	LM	1200.0	200.0	1200.0	2960.0	200.0	2400.0	1480.0	400.0	800.0	800.0	11800.0	23440.0
Pedestrian railing	LM	600.0	100.0	600.0	1480.0	100.0	1200.0	740.0	200.0	400.0	400.0	5900.0	11720.0
Painting on railing	Sqm	1560.0	260.0	1560.0	3848.0	260.0	3120.0	1924.0	520.0	1040.0	1040.0	15340.0	30472.0
Wearing Surface (inculding water proofing)	Cum	396.9	66.2	396.9	979.0	66.2	793.8	489.5	132.3	264.6	264.6	3902.9	7752.8
Expansion Joint (strip seal)	LM	98.4	24.6	123.0	24.6	24.6	196.8	0.0	49.2	73.8	73.8	713.4	1402.2
Prestressing	MT	337.8	56.3	337.8	984.6	56.3	798.3	492.3	112.6	225.2	225.2	2783.9	6410.1
Reinforcement Fe500	MT	1423.9	297.6	6666.9	14639.9	285.5	11141.9	6061.6	588.1	1395.7	978.4	49502.9	92982.2
Structural Steel	MT				1477.5			738.7					2216.2
Miscellaneous Items	LS												100

ANNEXURE – 2

Bill of Quantities – Tunnels

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

QUANTITY ESTIMATION SUMMARY

ITEM NO.	ITEM DESCRIPTION	UNIT	TOTAL QUANTITY
A102	**Underground Excavation**		
A1021	Underground Excavation - Blasting (Rock)	m^3	18141
A1022	Underground Excavation - Excavator(Soil/Soil Like) & Rock Breaker	m^3	0
A106	**Shotcrete - M25**	m^3	2862
A107	**SFR Shotcrete - M25**	m^3	0
A108	**Wire mesh, Fy = 500 N/mm2**		
A1081	Wire mesh, 150/150/6 mm	m^2	16011
A1082	Wire mesh, 150/150/8 mm	m^2	0
A110	**Rock bolts, SW type**		
A1101	3m length	m	0
A1102	4m length	m	0
A1103	6m length	m	0
A111	**Rock bolts, SN type**		
A1111	3m length	m	0
A1112	4m length	m	0
A1113	6m length	m	0
A112	**Rock bolts, SD type**		
A1122	4m length	m	0
A1123	6m length	m	9072
A1124	9m length	m	2017
A1125	12m length	m	0
A115	**Lattice Girders, Fe 500**		
A1153	95/20/25	t	47
A1154	130/25/32	t	0
A1161	**Forepoling, SN type**	m	0
A1162	**Forepoling, rebar rammed**	m	0
A117	**Forepoling, SD type**	m	27292
A118	**Forepoling, MS Pipes**		
A1182	32mm dia, 4m length	m	0
A119	**Pipe roof, length 12m, dia 76mm**	m	0
A129	**Drilling and Grouting**		
A1292	Drilling for consolidation grouting in tunnels	m	0
A1293	Drilling of Probe holes	m	0
B153	**Backfill material/pea gravel**	m^3	0
B154	**Backfill/grouting incl drilling into segement**	m^3	0
B155	**Drainage Pipes**	m	0
B158	**Weep Holes**	m	0
B170	**Waterproofing Membrane**	m^2	8352

Total 9 No. Cross Passages

Notes:

1) Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation
2) Invert Concrete (Cradle) - Values as per drawings
3) for reinforcement calculations (RCC Cradle) - 100 kg/m3 considered throughout the tunnel section

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

QUANTITY CALCULATIONS

			Total	CP
Tunnel Section Length		m	270	270
Support	**S1**	m	270.0	100%
	Checksum		OK	1.00

Item No.	Description		Unit	Total	CP
A102	**Theoretical Excavation Volume**				
A1021	Underground Excavation - Blasting (Rock)		m^3	18141	18141
A1022	Underground Excavation - Excavator (Soil/Soil like)		m^3	0	0
A106	**M25 - Shotcrete**				
A1061	50mm thickness		m^3	680	680
A1062	100mm thickness		m^3	0	0
A1063	150mm thickness		m^3	0	0
A1064	200mm thickness		m^3	0	0
A1065	250mm thickness		m^3	2181	2181
A1066	300mm thickness		m^3	0	0
A107	**M25 - SFR Shotcrete**				
A1071	50mm thickness		m^3	0	0
A1072	100mm thickness		m^3	0	0
A1073	150mm thickness		m^3	0	0
A1074	200mm thickness		m^3	0	0
A1075	250mm thickness		m^3	0	0
A1076	300mm thickness		m^3	0	0
A108	**Wire Mesh, Fy = 500 N/mm2**				
A1081	150/150/6mm		m^2	16011	16011
A1082	150/150/8mm		m^2	0	0
A110	**Rock bolts, SW type**				
A1101	3m length		pcs	0	0
A1102	4m length		pcs	0	0
A1103	6m length		pcs	0	0
A111	**Rock bolts, SN type**				
A1111	3m length		pcs	0	0
A1112	4m length		pcs	0	0
A1113	6m length		pcs	0	0
A112	**Rock bolts, SD type**				
A1122	4m length		pcs	0	0
A1123	6m length		pcs	1512	1512
A1124	9m length		pcs	224	224
A1125	12m length		pcs	0	0
A115	**Lattice Girder, Fe 500**				
A1153	95/20/25		m	4123	4123
A1154	130/32/25		m	0	0
A116	**Forepoling**				
A1161	32mm dia, 4m length, SN type		pcs	0	0
A1162	32mm dia, 4m length, rammed		pcs	0	0
A117	**Forepoling, SD type**				
A1172	25mm dia, 4m length		pcs	0	0
A1173	32mm dia, 4m length		pcs	6823	6823
A1174	32mm dia, 5m length		pcs	0	0
A118	**Forepoling, MS Pipes**				
A1182	32mm dia, 4m length		pcs	0	0
A119	**Pipe roof, length 12m**		m	0	0
A1293	**Drilling of Probe holes**		m	0	0
B153	**Backfill material/pea gravel**		m^3	0	0
B154	**Backfill/grouting**		m^3	0	0
B155	**Drainage Pipes**		pcs	0	0
B156	**Base Drainage pipe, 300mm dia**		m	0	0
B157	**Plugging concrete for base drainage pipe**		m^3	0	0
B158	**Weep Holes**		pcs	0	0
B170	**Waterproofing Membrane**		m^2	8352	8351.559

Notes:

1) Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation
2) Invert Concrete (Cradle) - Values as per drawings
3) for reinforcement calculations (RCC Cradle) -
   100 kg/m3 considered throughout the tunnel section

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-I

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	1.25	
Top Heading	A1021	Theoretical Excavation Volume		m^3	52.66	10%
	A106	M25 - Shotcrete of thickness as				
	A1065		250mm	m^3	4.77	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	38.18	10%
	A112	Fy>=230kN, Rock Bolts SD type, Length				
	A1123		6m	pcs	5.60	
	A115	Fe 500, Lattice Girder of size				
	A1153		95/20/25	m	15.27	
	A117	Forepoling, SD Bolts				
	A1173	32mm dia	4m	pcs	25.27	
	A106	M25 - Shotcrete of thickness as				
	A1061		50mm	m^2	2.10	20%
	A112	Face Bolts SD type, Length				
	A1124		9m	pcs	0.83	
		Round Length		m	2.50	
Invert	A1021	Theoretical Excavation Volume		m^3	8.42	10%
	A106	M25 - Shotcrete of thickness as				
	A1065		250mm	m^3	1.96	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	15.73	10%
	B155	Drainage Pipes		pcs	0.00	
	B158	Weep Holes		pcs	0.00	

Item No.	Description	Unit	Unit Quantity
A1021	Excavation Volume	m^3	67.19
A1061	Shotcrete, 50mm	m^3	2.52
A1065	Shotcrete, 250mm	m^3	8.08
A1081	Wire mesh, 150/150/6mm	m^2	59.30
A1123	Rock bolts, SD type- 6m	pcs	5.60
A1124	Rock bolts, SD type- 9m	pcs	0.83
A1153	Lattice Girder, 95/20/25	m	15.27
A1173	Forepoling, SD Bolts	m	25.27
B155	Drainage Pipes	pcs	0.00
B158	Weep Holes	pcs	0.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

QUANTITY ESTIMATION SUMMARY

ITEM NO.	ITEM DESCRIPTION	UNIT	TOTAL QUANTITY
A102	**Underground Excavation**		
A1021	Underground Excavation - Blasting (Rock)	m^3	38224
A1022	Underground Excavation - Excavator(Soil/Soil Like) & Rock Breaker	m^3	0
A106	**Shotcrete - M25**	m^3	3782
A107	**SFR Shotcrete - M25**	m^3	0
A108	**Wire mesh, Fy = 500 N/mm2**		
A1081	Wire mesh, 150/150/6 mm	m^2	15899
A1082	Wire mesh, 150/150/8 mm	m^2	0
A110	**Rock bolts, SW type**		
A1101	3m length	m	0
A1102	4m length	m	0
A1103	6m length	m	0
A111	**Rock bolts, SN type**		
A1111	3m length	m	0
A1112	4m length	m	15444
A1113	6m length	m	0
A112	**Rock bolts, SD type**		
A1122	4m length	m	0
A1123	6m length	m	0
A1124	9m length	m	0
A1125	12m length	m	0
A115	**Lattice Girders, Fe 500**		
A1153	95/20/25	t	95
A1154	130/25/32	t	0
A1161	**Forepoling, SN type**	m	0
A1162	**Forepoling, rebar rammed**	m	0
A117	**Forepoling, SD type**	m	43200
A118	**Forepoling, MS Pipes**		
A1182	32mm dia, 4m length	m	0
A119	**Pipe roof, length 12m, dia 76mm**	m	0
A129	**Drilling and Grouting**		
A1292	Drilling for consolidation grouting in tunnels	m	0
A1293	Drilling of Probe holes	m	0
B154	**Backfill/grouting incl drilling into segement**	m^3	0
B155	**Drainage Pipes**	m	0
B158	**Weep Holes**	m	0
B170	**Waterproofing Membrane**	m^2	27839

Total 30 No. Cross Passages

Notes:

1) Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation
2) Invert Concrete (Cradle) - Values as per drawings
3) for reinforcement calculations (RCC Cradle) - 100 kg/m3 considered throughout the tunnel section

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

QUANTITY CALCULATIONS

			Total	CPs 2	CPs 3	CPs 4	CPs 5	CPs 6
Tunnel Section Length		m	900	210	210	180	150	150
Support	**S1**	m	900.0	100%	100%	100%	100%	100%
	Checksum		OK	1.00	1.00	1.00	1.00	1.00

Item No.	Description		Unit	Total	CPs 2	CPs 3	CPs 4	CPs 5	CPs 6
A102	**Theoretical Excavation Volume**								
A1021	Underground Excavation - Blasting (Rock)		m^3	38224	8919	8919	7645	6371	6371
A1022	Underground Excavation - Excavator (Soil/Soil like)		m^3	0	0	0	0	0	0
A106	**M25 - Shotcrete**								
A1061	50mm thickness		m^3	1191	278	278	238	199	199
A1062	100mm thickness		m^3	0	0	0	0	0	0
A1063	150mm thickness		m^3	2590	604	604	518	432	432
A1064	200mm thickness		m^3	0	0	0	0	0	0
A1065	250mm thickness		m^3	0	0	0	0	0	0
A1066	300mm thickness		m^3	0	0	0	0	0	0
A107	**M25 - SFR Shotcrete**								
A1071	50mm thickness		m^3	0	0	0	0	0	0
A1072	100mm thickness		m^3	0	0	0	0	0	0
A1073	150mm thickness		m^3	0	0	0	0	0	0
A1074	200mm thickness		m^3	0	0	0	0	0	0
A1075	250mm thickness		m^3	0	0	0	0	0	0
A1076	300mm thickness		m^3	0	0	0	0	0	0
A108	**Wire Mesh, Fy = 500 N/mm2**								
A1081	150/150/6mm		m^2	15899	3710	3710	3180	2650	2650
A1082	150/150/8mm		m^2	0	0	0	0	0	0
A110	**Rock bolts, SW type**								
A1101	3m length		pcs	0	0	0	0	0	0
A1102	4m length		pcs	0	0	0	0	0	0
A1103	6m length		pcs	0	0	0	0	0	0
A111	**Rock bolts, SN type**								
A1111	3m length		pcs	0	0	0	0	0	0
A1112	4m length		pcs	3861	901	901	772	644	644
A1113	6m length		pcs	0	0	0	0	0	0
A112	**Rock bolts, SD type**								
A1122	4m length		pcs	0	0	0	0	0	0
A1123	6m length		pcs	0	0	0	0	0	0
A1124	9m length		pcs	0	0	0	0	0	0
A1125	12m length		pcs	0	0	0	0	0	0
A115	**Lattice Girder, Fe 500**								
A1153	95/20/25		m	8226	1919	1919	1645	1371	1371
A1154	130/32/25		m	0	0	0	0	0	0

Item No.	Description		Unit	Total	CPs 2	CPs 3	CPs 4	CPs 5	CPs 6
A116	**Forepoling**								
A1161	25mm dia, 4m length, SN type		pcs	0	0	0	0	0	0
A1162	25mm dia, 4m length, rammed		pcs	0	0	0	0	0	0
A117	**Forepoling, SD type**								
A1172	25mm dia, 4m length		pcs	10800	2520	2520	2160	1800	1800
A1173	32mm dia, 4m length		pcs	0	0	0	0	0	0
A1174	32mm dia, 5m length		pcs	0	0	0	0	0	0
A118	**Forepoling, MS Pipes**								
A1182	32mm dia, 4m length		pcs	0	0	0	0	0	0
A119	**Pipe roof, length 12m**		m	0	0	0	0	0	0
A1293	**Drilling of Probe holes**		m	0	0	0	0	0	0
B154	**Backfill/grouting**		m^3	0	0	0	0	0	0
B155	**Drainage Pipes**		pcs	0	0	0	0	0	0
B156	**Base Drainage pipe, 300mm dia**		m	0	0	0	0	0	0
B157	**Plugging concrete for base drainage pipe**		m^3	0	0	0	0	0	0
B158	**Weep Holes**		pcs	0	0	0	0	0	0
B170	**Waterproofing Membrane**		m^2	27839	6495.657	6495.657	5567.706	4639.755	4639.755

Notes:

1) Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation
2) Invert Concrete (Cradle) - Values as per drawings
3) for reinforcement calculations (RCC Cradle) -
   100 kg/m3 considered throughout the tunnel section

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-I

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	1.75	
Top Heading	A1021	Theoretical Excavation Volume		m^3	38.61	10%
	A106	M25 - Shotcrete of thickness as				
	A1063		150mm	m^3	2.40	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	16.06	10%
	A111	Fy>=230kN, Rock Bolts SN type, Length				
	A1112		4m	pcs	4.29	
	A115	Fe 500, Lattice Girder of size				
	A1153		95/20/25	m	9.14	
	A117	Forepoling, SD Bolts				
	A1172	32mm dia	4m	pcs	12.00	
	A106	M25 - Shotcrete of thickness as				
	A1061		50mm	m^3	1.10	20%
	B155	Drainage Pipes		pcs	0.00	
	B158	Weep Holes		pcs	0.00	

Item No.	Description	Unit	Unit Quantity
A1021	Excavation Volume	m^3	42.47
A1061	Shotcrete, 50mm	m^3	1.32
A1063	Shotcrete, 150mm	m^3	2.88
A1081	Wire mesh, 150/150/6mm	m^2	17.67
A1112	Rock bolts, SN type- 4m	pcs	4.29
A1153	Lattice Girder, 95/20/25	m	9.14
A1172	Forepoling, SD Bolts	m	12.00
B155	Drainage Pipes	pcs	0.00
B158	Weep Holes	pcs	0.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

QUANTITIES FOR INSTRUMENTATION & MONITORING

S.No.	Description	Unit	per section	Tunnel 1	Tunnel 2	Tunnel 3	Tunnel 4	Tunnel 5	Tunnel 6	Total
				2894.88	**2056.93**	**2083.02**	**1902.15**	**1695.98**	**1991.54**	
1	3D Target	No.	7	1058	755	764	696	619	722	**4614**
2	Rock Bolt Load Cell	No.	5	29	21	21	19	17	20	**126**
3	Strain Gauges	No.	14	81	58	58	53	47	56	**353**
4	Pressure Cell, Radial	No.	5	29	21	21	19	17	20	**126**
5	Pressure Cell, Tangential	No.	5	29	21	21	19	17	20	**126**
6	Junction Box	No.	5	29	21	21	19	17	20	**126**
7	Switch Box	No.	2	12	8	8	8	7	8	**50**
8	6Core Cable	No.	150	868	617	625	571	509	597	**3787**
9	4CORE Cable	No.	100	579	411	417	380	339	398	**2525**
10	Data Logger for Load Cell	No.	1	1	1	1	1	1	1	**6**
11	Data Logger for Vibrating Wire	No.	1	1	1	1	1	1	1	**6**
12	Seepage Measurement System	No.	1	1	1	1	1	1	1	**6**
13	Total Station with Accessories	No.	1	1	1	1	1	1	1	**6**
14	3D Monitoring Software	No.	1	1	1	1	1	1	1	**6**
15	Data Management Software	No.	1	1	1	1	1	1	1	**6**

	SMS	20	m
	MMS	500	m
Cross Passages	T1	9	No.
	T2	7	No.
	T3	7	No.
	T4	6	No.
	T5	5	No.
	T6	5	No.

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

QUANTITIES FOR INSTRUMENTATION & MONITORING

S.No.	Description	Unit	per section	Tunnel 1	Tunnel 2	Tunnel 3	Tunnel 4	Tunnel 5	Tunnel 6	Total
				2837.63	2002.12	2025.22	1927.66	1649.91	1605.31	
1	3D Target	No.	7	993	701	709	675	577	562	**4217**
2	Rock Bolt Load Cell	No.	5	28	20	20	19	16	16	**120**
3	Strain Gauges	No.	14	79	56	57	54	46	45	**337**
4	Pressure Cell, Radial	No.	5	28	20	20	19	16	16	**120**
5	Pressure Cell, Tangential	No.	5	28	20	20	19	16	16	**120**
6	Junction Box	No.	5	28	20	20	19	16	16	**120**
7	Switch Box	No.	2	11	8	8	8	7	6	**48**
8	6Core Cable	No.	150	851	601	608	578	495	482	**3614**
9	4CORE Cable	No.	100	568	400	405	386	330	321	**2410**
10	Data Logger for Load Cell	No.	1	1	1	1	1	1	1	**6**
11	Data Logger for Vibrating Wire	No.	1	1	1	1	1	1	1	**6**
12	Seepage Measurement System	No.	1	1	1	1	1	1	1	**6**
13	Total Station with Accessories	No.	1	1	1	1	1	1	1	**6**
14	3D Monitoring Software	No.	1	1	1	1	1	1	1	**6**
15	Data Management Software	No.	1	1	1	1	1	1	1	**6**

SMS 20 m
MMS 500 m

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

QUANTITY ESTIMATION SUMMARY

ITEM NO.	ITEM DESCRIPTION	UNIT	TOTAL QUANTITY
A102	**Underground Excavation**		
A1021	Underground Excavation - Blasting (Rock)	m^3	1833091
A1022	Underground Excavation - Excavator(Soil/Soil Like) & Rock Breaker	m^3	129976
A106	**Shotcrete - M25**	m^3	84713
A107	**SFR Shotcrete - M25**	m^3	0
A108	**Wire mesh, Fy = 500 N/mm2**		
A1081	Wire mesh, 150/150/6 mm	m^2	498828
A1082	Wire mesh, 150/150/8 mm	m^2	0
A110	**Rock bolts, SW type**		
A1101	3m length	m	19007
A1102	4m length	m	0
A1103	6m length	m	0
A111	**Rock bolts, SN type**		
A1111	3m length	m	0
A1112	4m length	m	129139
A1113	6m length	m	33540
A112	**Rock bolts, SD type**		
A1122	4m length	m	0
A1123	6m length	m	68070
A1124	9m length	m	39480
A1125	12m length	m	0
A115	**Lattice Girders, Fe 500**		
A1153	95/20/25	t	254
A1154	130/25/32	t	406
A1161	**Forepoling, SN type**	m	44179
A1162	**Forepoling, rebar rammed**	m	0
A117	**Forepoling, SD type**	m	163039
A118	**Forepoling, MS Pipes**		
A119	**Pipe roof, length 12m, dia 76mm**	m	0
A129	**Drilling and Grouting**		
A1292	Drilling for consolidation grouting in tunnels	m	0
A1293	Drilling of Probe holes	m	0
B154	**Backfill/grouting incl drilling into segement**	m^3	0
B155	**Drainage Pipes**	m	13478
B156	**Base Drainage pipe, 300mm dia**	m	27774
B157	**Plugging concrete for base drainage pipe**	m^3	1894
B158	**Weep Holes**	m	13729
B169	**Collector Drainage Pipe, 200m dia**	m	12625
B170	**Waterproofing Membrane**	m^2	390497
C100	**Concrete - Inner Lining**	m^3	227186
C101	**Steel - Inner Lining Reinforcement**	t	7607

Notes:

1) Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

QUANTITY CALCULATIONS

			Total	Tunnel 1	Tunnel 2	Tunnel 3	Tunnel 4	Tunnel 5	Tunnel 6
Tunnel Section Length		m	12624.5	2894.88	2056.93	2083.02	1902.15	1695.98	1991.54
Support Class	**R1**	m	5759.8	46%	54%	52%	41%	47%	33%
	R2	m	4618.3	41%	35%	34%	37%	32%	38%
	R3	m	1434.4	7%	4%	6%	14%	13%	27%
	R4	m	148.6	3%	3%	0%	0%	0%	0%
	R5	m	663.4	3%	4%	8%	8%	8%	2%
	Checksum		OK	1.00	1.00	1.00	1.00	1.00	1.00

Item No.	Description		Unit	Total	Tunnel 1	Tunnel 2	Tunnel 3	Tunnel 4	Tunnel 5	Tunnel 6
A102	**Theoretical Excavation Volume**									
A1021	Underground Excavation - Blasting (Rock)		m^3	1833091	432173	303497	292226	267555	238339	299301
A1022	Underground Excavation - Excavator (Soil/Soil like)		m^3	129976	17014	16119	32647	29812	26581	7803
A106	**M25 - Shotcrete**									
A1061	50mm thickness		m^3	13030	2227	1812	2685	2652	2342	1312
A1062	100mm thickness		m^3	21288	4922	4105	4003	2882	2946	2429
A1063	150mm thickness		m^3	25493	6552	3974	3909	3885	2996	4177
A1064	200mm thickness		m^3	11360	1605	652	990	2109	1746	4259
A1065	250mm thickness		m^3	2157	1261	896	0	0	0	0
A1066	300mm thickness		m^3	11385	1490	1412	2860	2611	2328	683
A107	**M25 - SFR Shotcrete**									
A1071	50mm thickness		m^3	0	0	0	0	0	0	0
A1072	100mm thickness		m^3	0	0	0	0	0	0	0
A1073	150mm thickness		m^3	0	0	0	0	0	0	0
A1074	200mm thickness		m^3	0	0	0	0	0	0	0
A1075	250mm thickness		m^3	0	0	0	0	0	0	0
A1076	300mm thickness		m^3	0	0	0	0	0	0	0
A108	**Wire Mesh, Fy = 500 N/mm2**									
A1081	150/150/6mm		m^2	498828	111912	80733	84614	78027	69476	74065
A1082	150/150/8mm		m^2	0	0	0	0	0	0	0
A110	**Rock bolts, SW type**									
A1101	3m length		pcs	6336	1465	1222	1191	858	877	723
A1102	4m length		pcs	0	0	0	0	0	0	0
A1103	6m length		pcs	0	0	0	0	0	0	0
A111	**Rock bolts, SN type**									
A1111	3m length		pcs	0	0	0	0	0	0	0
A1112	4m length		pcs	32285	7787	4577	4274	5001	3936	6709
A1113	6m length		pcs	5590	1106	576	425	905	750	1828
A112	**Rock bolts, SD type**									
A1122	4m length		pcs	0	0	0	0	0	0	0
A1123	6m length		pcs	11345	1485	1407	2850	2602	2320	681
A1124	9m length		pcs	4387	608	566	1083	989	882	259
A1125	12m length		pcs	0	0	0	0	0	0	0
A115	**Lattice Girder, Fe 500**									
A1153	95/20/25		m	22089	4774	2602	1600	3409	2822	6883
A1154	130/32/25		m	23088	3022	2863	5799	5296	4722	1386
A116	**Forepoling**									
A1161	25mm dia, 4m length, SN type		pcs	11045	1560	634	962	2051	1698	4140
A1162	32mm dia, 4m length, rammed		pcs	0	0	0	0	0	0	0
A117	**Forepoling, SD type**									
A1172	25mm dia, 4m length		pcs	0	0	0	0	0	0	0
A1173	32mm dia, 4m length		pcs	40760	6791	5990	9432	8613	7679	2254
A1174	32mm dia, 5m length		pcs	0	0	0	0	0	0	0
A118	**Forepoling, MS Pipes**									
A1182	32mm dia, 4m length		pcs	0	0	0	0	0	0	0
A119	**Pipe roof, length 12m**		m	0	0	0	0	0	0	0
A1293	**Drilling of Probe holes**		m	0	0	0	0	0	0	0
B154	**Backfill/grouting**		m^3	0	0	0	0	0	0	0
B155	**Drainage Pipes**		pcs	8986	1505	905	1166	1674	1425	2310
B156	**Base Drainage pipe, 300mm dia**		m	12625	2895	2057	2083	1902	1696	1992
B157	**Plugging concrete for base drainage pipe**		m^3	1894	434	309	312	285	254	299
B158	**Weep Holes**		pcs	27459	6253	3785	3999	4489	3595	5337
B169	**Collector Drainage Pipe, 200m dia**		m	12625	2895	2057	2083	1902	1696	1992
B170	**Waterproofing Membrane**		m^2	390497	89544	63624	64431	58837	52460	61602
C100	**Concrete - Inner Lining**		m^3	227186	51902	37197	37991	34692	30932	34473
C101	**Steel - Inner Lining Reinforcement**		kg	7606802	1726298	1256200	1302104	1189042	1060164	1072994

Notes:

1) Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-I

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	3.00	
Top Heading	A1021	Theoretical Excavation Volume		m^3	79.70	10%
	A106	M25 - Shotcrete of thickness as				
	A1062		100mm	m^3	2.20	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	22.40	10%
	A110	Fy>=200kN, Rock Bolts SW type, Length				
	A1101		3m	pcs	1.10	
		Round Length		m	6.00	
Benching	A1021	Theoretical Excavation Volume		m^3	58.10	10%
	A106	M25 - Shotcrete of thickness as				
	A1062		100mm	m^3	0.88	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	8.80	10%
	B155	Drainage Pipes		pcs	0.00	
	B158	Weep Holes		pcs	0.00	

Item No.	Description	Unit	Unit Quantity
A1021	Excavation Volume	m^3	151.58
A1062	Shotcrete, 100mm	m^3	3.70
A1081	Wire mesh, 150/150/6mm	m^2	34.32
A1101	Rock bolts, SW type- 3m	pcs	1.10
B155	Drainage Pipes	pcs	0.00
B156	Base Drainage pipe, 300mm dia	m	1
B157	Plugging concrete for base drainage pipe	m^3	0.15
B158	Weep Holes	pcs	0.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-II

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	2.25	
Top Heading	A1021	Theoretical Excavation Volume		m^3	80.80	10%
	A106	M25 - Shotcrete of thickness as				
	A1063		150mm	m^3	3.30	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	22.50	10%
	A111	Fy>=230kN, Rock Bolts SN type, Length				
	A1112		4m	pcs	5.10	
		Round Length		m	4.50	
Benching	A1021	Theoretical Excavation Volume		m^3	58.60	10%
	A106	M25 - Shotcrete of thickness as				
	A1063		150mm	m^3	1.30	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	8.80	10%
	B155	Drainage Pipes		pcs	0.00	
	B158	Weep Holes		pcs	4.00	

Item No.	Description	Unit	Unit Quantity
A1021	Excavation Volume	m^3	153.34
A1063	Shotcrete, 150mm	m^3	5.52
A1081	Wire mesh, 150/150/6mm	m^2	34.43
A1112	Rock bolts, SN type- 4m	pcs	5.10
B155	Drainage Pipes	pcs	0.00
B156	Base Drainage pipe, 300mm dia	m	1
B157	Plugging concrete for base drainage pipe	m^3	0.15
B158	Weep Holes	pcs	4.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-III

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	1.75	
Top Heading	A1021	Theoretical Excavation Volume		m^3	82.40	10%
	A106	M25 - Shotcrete of thickness as				
	A1064		200mm	m^3	4.90	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	26.90	10%
	A115	Fe 500, Lattice Girder of size				
	A1153		95/20/25	m	12.80	
	A111	Fy>=230kN, Rock Bolts SN type, Length				
	A1112		4m	pcs	3.10	
	A1113		6m	pcs	3.40	
	A116	Forepoling, SN Bolts				
	A1161	32mm dia, 4m length	4m	pcs	7.70	
	A106	M25 - Shotcrete of thickness as				
	A1061		50mm	m^2	1.10	20%
		Round Length		m	3.50	
Benching	A1021	Theoretical Excavation Volume		m^3	59.00	10%
	A106	M25 - Shotcrete of thickness as				
	A1064		200mm	m^3	1.70	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	8.80	10%
	A111	Fy>=230kN, Rock Bolts SN type, Length				
	A1112		4m	pcs	2.20	
	B155	Drainage Pipes		pcs	4.00	
	B158	Weep Holes		pcs	4.00	

Item No.	Description	Unit	Unit Quantity
A1021	Excavation Volume	m^3	155.54
A1061	Shotcrete, 50mm	m^3	1.32
A1064	Shotcrete, 200mm	m^3	7.92
A1081	Wire mesh, 150/150/6mm	m^2	39.27
A1112	Rock bolts, SN type- 4m	pcs	5.30
A1113	Rock bolts, SN type- 6m	pcs	3.40
A1153	Lattice Girder, 95/20/25	m	12.80
A1161	Forepoling, SN Bolts	pcs	7.70
B155	Drainage Pipes	pcs	4.00
B156	Base Drainage pipe, 300mm dia	m	1
B157	Plugging concrete for base drainage pipe	m^3	0.15
B158	Weep Holes	pcs	4.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-IV

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	1.25	
Top Heading	A1021	Theoretical Excavation Volume		m^3	83.50	10%
	A106	M25 - Shotcrete of thickness as				
	A1065		250mm	m^3	6.00	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	49.40	10%
	A115	Fe 500, Lattice Girder of size				
	A1153		95/20/25	m	18.10	
	A111	Fy>=230kN, Rock Bolts SN type, Length				
	A1112		4m	pcs	4.40	
	A1113		6m	pcs	4.80	
	A117	Forepoling, SD Bolts				
	A1173	32mm dia, 4m length	4m	pcs	21.60	
	A112	Face Bolts SD type, Length				
	A1124		9m	pcs	0.50	
	A106	M25 - Shotcrete of thickness as				
	A1061		50mm	m^3	6.20	20%
		Round Length		m	2.50	
Bench	A1021	Theoretical Excavation Volume		m^3	69.40	10%
	A106	M25 - Shotcrete of thickness as				
	A1065		250mm	m^3	2.20	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	17.60	10%
	A115	Fe 500, Lattice Girder of size				
	A1153		95/20/25	m	7.00	
	A111	Fy>=250kN, Rock Bolts SN type, Length				
	A1112		4m	pcs	3.20	
		Round Length		m	5.00	
Invert	A1021	Theoretical Excavation Volume		m^3	23.00	10%
	A106	M25 - Shotcrete of thickness as				
	A1065		250mm	m^3	3.90	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	16.00	10%
	B155	Drainage Pipes		pcs	4.00	
	B158	Weep Holes		pcs	4.00	

Item No.	Description	Unit	Unit Quantity
A1021	Excavation Volume	m^3	193.49
A1061	Shotcrete, 50mm	m^3	7.44
A1065	Shotcrete, 250mm	m^3	14.52
A1081	Wire mesh, 150/150/6mm	m^2	91.30
A1112	Rock bolts, SN type- 4m	pcs	7.60
A1113	Rock bolts, SN type- 6m	pcs	4.80
A1124	Rock bolts, R38N SD type- 9m	pcs	0.50
A1153	Lattice Girder, 95/20/25	m	25.10
A1173	Forepoling, SD Bolts	pcs	21.60
B155	Drainage Pipes	pcs	4.00
B156	Base Drainage pipe, 300mm dia	m	1
B157	Plugging concrete for base drainage pipe	m^3	0.15
B158	Weep Holes	pcs	4.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-V

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	0.90	
Top Heading	A1022	Theoretical Excavation Volume		m^3	84.50	10%
	A106	M25 - Shotcrete of thickness as				
	A1066		300mm	m^3	7.00	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	49.20	10%
	A115	Fe 500, Lattice Girder of size				
	A1154		130/25/32	m	25.20	
	A112	Fy>=230kN, Rock Bolts SD type, Length				
	A1123		6m	pcs	10.5	
	A1124		9m	pcs	5.50	
	A117	Forepoling, SD Bolts				
	A1173	32mm dia	4m	pcs	56.60	
	A112	Face Bolts SD type, Length				
	A1124		9m	pcs	1.00	
	A106	M25 - Shotcrete of thickness as				
	A1061		50mm	m^3	8.60	20%
Temp Invert	A1022	Theoretical Excavation Volume		m^3	13.20	10%
	A106	M25 - Shotcrete of thickness as				
	A1061		50mm	m^3	4.00	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	16.20	10%
		Round Length		m	1.80	
Bench	A1022	Theoretical Excavation Volume		m^3	56.60	10%
	A106	M25 - Shotcrete of thickness as				
	A1066		300mm	m^3	2.60	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	17.40	10%
	A115	Fe 500, Lattice Girder of size				
	A1154		130/25/32	m	9.60	
	A112	Rock Bolts SD type, Length				
	A1123	32mm dia	6m	pcs	6.60	
		Round Length		m	3.60	
Invert	A1022	Theoretical Excavation Volume		m^3	23.80	10%
	A106	M25 - Shotcrete of thickness as				
	A1066		300mm	m^3	4.70	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	16.20	10%
	B155	Drainage Pipes		pcs	4.00	
	B158	Weep Holes		pcs	4.00	

Item No.	Description	Unit	Unit Quantity
A1022	Excavation Volume	m^3	195.91
A1061	Shotcrete, 50mm	m^3	15.12
A1066	Shotcrete, 300mm	m^3	17.16
A1081	Wire mesh, 150/150/6mm	m^2	108.90
A1123	Rock bolts, SD type- 6m	pcs	17.10
A1124	Rock bolts, SD type- 9m	pcs	6.50
A1154	Lattice Girder, 130/25/32	m	34.80
A1173	Forepoling, SD Bolts	pcs	56.60
B155	Drainage Pipes	pcs	4.00
B156	Base Drainage pipe, 300mm dia	m	1
B157	Plugging concrete for base drainage pipe	m^3	0.15
B158	Weep Holes	pcs	4.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

QUANTITY ESTIMATION SUMMARY

ITEM NO.	ITEM DESCRIPTION	UNIT	TOTAL QUANTITY
A102	**Underground Excavation**		
A1021	Underground Excavation - Blasting (Rock)	m^3	1747417
A1022	Underground Excavation - Excavator(Soil/Soil Like) & Rock Breaker	m^3	124932
A106	**Shotcrete - M25**	m^3	80973
A107	**SFR Shotcrete - M25**	m^3	0
A108	**Wire mesh, Fy = 500 N/mm2**		
A1081	Wire mesh, 150/150/6 mm	m^2	469046
A1082	Wire mesh, 150/150/8 mm	m^2	0
A110	**Rock bolts, SW type**		
A1101	3m length	m	18266
A1102	4m length	m	0
A1103	6m length	m	0
A111	**Rock bolts, SN type**		
A1111	3m length	m	0
A1112	4m length	m	122197
A1113	6m length	m	31069
A112	**Rock bolts, SD type**		
A1122	4m length	m	0
A1123	6m length	m	66233
A1124	9m length	m	38418
A1125	12m length	m	0
A115	**Lattice Girders, Fe 500**		
A1153	95/20/25	t	236
A1154	130/25/32	t	395
A1161	**Forepoling, SN type**	m	40595
A1162	**Forepoling, rebar rammed**	m	0
A117	**Forepoling, SD type**	m	158696
A118	**Forepoling, MS Pipes**		
A1182	32mm dia, 4m length	m	0
A119	**Pipe roof, length 12m, dia 76mm**	m	0
A129	**Drilling and Grouting**		
A1292	Drilling for consolidation grouting in tunnels	m	0
A1293	Drilling of Probe holes	m	0
B154	**Backfill/grouting incl drilling into segement**	m^3	0
B155	**Drainage Pipes**	m	12653
B156	**Base Drainage pipe, 300mm dia including overlapping**	m	26505
B157	**Plugging concrete for base drainage pipe**	m^3	1807
B158	**Weep Holes**	m	13025
B169	**Collector Drainage Pipe, 200m dia**	m	12048
B170	**Waterproofing Membrane**	m^2	372660
C100	**Concrete - Inner Lining**	m^3	217054
C101	**Steel - Inner Lining Reinforcement**	t	7282

Notes:

1) Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

QUANTITY CALCULATIONS

			Total	Tunnel 1	Tunnel 2	Tunnel 3	Tunnel 4	Tunnel 5	Tunnel 6
Tunnel Section Length		m	12047.85	2837.63	2002.12	2025.22	1927.66	1649.91	1605.31
Support	**R1**	m	5535.1	46%	54%	52%	41%	47%	33%
	R2	m	4404.0	41%	35%	34%	37%	32%	38%
	R3	m	1318.0	7%	4%	6%	14%	13%	27%
	R4	m	145.2	3%	3%	0%	0%	0%	0%
	R5	m	645.5	3%	4%	8%	8%	8%	2%
	Checksum		OK	1.00	1.00	1.00	1.00	1.00	1.00

Item No.	Description		Unit	Total	Tunnel 1	Tunnel 2	Tunnel 3	Tunnel 4	Tunnel 5	Tunnel 6
A102	**Theoretical Excavation Volume**									
A1021	Underground Excavation - Blasting (Rock)		m^3	1747417	423626	295410	284117	271143	231864	241256
A1022	Underground Excavation - Excavator (Soil/Soil like)		m^3	124932	16475	15499	31355	29845	25545	6214
A106	**M25 - Shotcrete**									
A1061	50mm thickness		m^3	12581	2183	1763	2610	2688	2279	1058
A1062	100mm thickness		m^3	20458	4824	3996	3892	2921	2866	1958
A1063	150mm thickness		m^3	24310	6422	3868	3801	3937	2914	3367
A1064	200mm thickness		m^3	10439	1573	634	962	2137	1699	3433
A1065	250mm thickness		m^3	2108	1236	872	0	0	0	0
A1066	300mm thickness		m^3	11078	1461	1374	2780	2646	2265	551
A107	**M25 - SFR Shotcrete**									
A1071	50mm thickness		m^3	0	0	0	0	0	0	0
A1072	100mm thickness		m^3	0	0	0	0	0	0	0
A1073	150mm thickness		m^3	0	0	0	0	0	0	0
A1074	200mm thickness		m^3	0	0	0	0	0	0	0
A1075	250mm thickness		m^3	0	0	0	0	0	0	0
A1076	300mm thickness		m^3	0	0	0	0	0	0	0
A108	**Wire Mesh, Fy = 500 N/mm2**									
A1081	150/150/6mm		m^2	469046	108661	77606	80293	77194	65981	59310
A1082	150/150/8mm		m^2	0	0	0	0	0	0	0
A110	**Rock bolts, SW type**									
A1101	3m length		pcs	6089	1436	1189	1158	869	853	583
A1102	4m length		pcs	0	0	0	0	0	0	0
A1103	6m length		pcs	0	0	0	0	0	0	0
A111	**Rock bolts, SN type**									
A1111	3m length		pcs	0	0	0	0	0	0	0
A1112	4m length		pcs	30549	7633	4455	4156	5068	3829	5408
A1113	6m length		pcs	5178	1084	561	413	918	729	1474
A112	**Rock bolts, SD type**									
A1122	4m length		pcs	0	0	0	0	0	0	0
A1123	6m length, 250 kN		pcs	11039	1456	1369	2771	2637	2257	549
A1124	9m length, 200 kN		pcs	4269	596	551	1053	1002	858	209
A1125	12m length, 400kN		pcs	0	0	0	0	0	0	0
A115	**Lattice Girder, Fe 500**									
A1153	95/20/25		m	20515	4679	2533	1555	3454	2745	5548
A1154	130/32/25		m	22465	2962	2787	5638	5367	4593	1117
A116	**Forepoling**									
A1161	32mm dia, 4m length, SN type		pcs	10149	1529	617	936	2078	1652	3337
A1162	32mm dia, 4m length, rammed		pcs	0	0	0	0	0	0	0
A117	**Forepoling, SD type**									
A1172	25mm dia, 4m length		pcs	0	0	0	0	0	0	0
A1173	32mm dia, 4m length		pcs	39674	6657	5830	9170	8728	7471	1817
A1174	32mm dia, 5m length		pcs	0	0	0	0	0	0	0
A118	**Forepoling, MS Pipes**									
A1182	32mm dia, 4m length		pcs	0	0	0	0	0	0	0
A119	**Pipe roof, length 12m**		m	0	0	0	0	0	0	0
A1293	**Drilling of Probe holes**		m							
B154	**Backfill/grouting**		m^3	0	0	0	0	0	0	0
B155	**Drainage Pipes**		pcs	8435	1476	881	1134	1696	1386	1862
B156	**Base Drainage pipe, 300mm dia**		m	12048	2838	2002	2025	1928	1650	1605
B157	**Plugging concrete for base drainage pipe**		m^3	1807	426	300	304	289	247	241
B158	**Weep Holes**		pcs	26051	6129	3684	3888	4549	3498	4302
B169	**Collector Drainage Pipe, 200m dia**		m	12048	2838	2002	2025	1928	1650	1605
B170	**Waterproofing Membrane**		m^2	372660	87772.71987	61928.975	62643.5	59625.8	51034.52	49654.97
C100	**Concrete - Inner Lining**		m^3	217054	50875	36206	36937	35157	30092	27787
C101	**Steel - Inner Lining Reinforcement**		kg	7282114	1692158	1222727	1265973	1204988	1031365	864903

Notes:

1) Losses have been considered for the following items
   Wire mesh
   Shotcrete
   Excavation

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-I

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	3.00	
Top Heading	A1021	Theoretical Excavation Volume		m^3	79.70	10%
	A106	M25 - Shotcrete of thickness as				
	A1062		100mm	m^3	2.20	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	22.40	10%
	A110	Fy>=200kN, Rock Bolts SW type, Length				
	A1101		3m	pcs	1.10	
		Round Length		m	6.00	
Benching	A1021	Theoretical Excavation Volume		m^3	58.10	10%
	A106	M25 - Shotcrete of thickness as				
	A1062		100mm	m^3	0.88	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	8.80	10%
	B155	Drainage Pipes		pcs	0.00	
	B158	Weep Holes		pcs	0.00	

Item No.	Description	Unit	Unit Quantity
A1021	Excavation Volume	m^3	151.58
A1062	Shotcrete, 100mm	m^3	3.70
A1081	Wire mesh, 150/150/6mm	m^2	34.32
A1101	Rock bolts, SW type- 3m	pcs	1.10
B155	Drainage Pipes	pcs	0.00
B156	Base Drainage pipe, 300mm dia	m	1
B157	Plugging concrete for base drainage pipe	m^3	0.15
B158	Weep Holes	pcs	0.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-II

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	2.25	
Top Heading	A1021	Theoretical Excavation Volume		m^3	80.80	10%
	A106	M25 - Shotcrete of thickness as				
	A1063		150mm	m^3	3.30	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	22.50	10%
	A111	Fy>=230kN, Rock Bolts SN type, Length				
	A1112		4m	pcs	5.10	
		Round Length		m	4.50	
Benching	A1021	Theoretical Excavation Volume		m^3	58.60	10%
	A106	M25 - Shotcrete of thickness as				
	A1063		150mm	m^3	1.30	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	8.80	10%
	B155	Drainage Pipes		pcs	0.00	
	B158	Weep Holes		pcs	4.00	

Item No.	Description	Unit	Unit Quantity
A1021	Excavation Volume	m^3	153.34
A1063	Shotcrete, 150mm	m^3	5.52
A1081	Wire mesh, 150/150/6mm	m^2	34.43
A1112	Rock bolts, SN type- 4m	pcs	5.10
B155	Drainage Pipes	pcs	0.00
B156	Base Drainage pipe, 300mm dia	m	1
B157	Plugging concrete for base drainage pipe	m^3	0.15
B158	Weep Holes	pcs	4.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-III

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	1.75	
Top Heading	A1021	Theoretical Excavation Volume		m^3	82.40	10%
	A106	M25 - Shotcrete of thickness as				
	A1064		200mm	m^3	4.90	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	26.90	10%
	A115	Fe 500, Lattice Girder of size				
	A1153		95/20/25	m	12.80	
	A111	Fy>=230kN, Rock Bolts SN type, Length				
	A1112		4m	pcs	3.10	
	A1113		6m	pcs	3.40	
	A116	Forepoling, SN Bolts				
	A1161	25mm dia, 4m length	4m	pcs	7.70	
	A106	M25 - Shotcrete of thickness as				
	A1061		50mm	m^2	1.10	20%
		Round Length		m	3.50	
Benching	A1021	Theoretical Excavation Volume		m^3	59.00	10%
	A106	M25 - Shotcrete of thickness as				
	A1064		200mm	m^3	1.70	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	8.80	10%
	A111	Fy>=230kN, Rock Bolts SN type, Length				
	A1112	25mm dia	4m	pcs	2.20	
	B155	Drainage Pipes		pcs	4.00	
	B158	Weep Holes		pcs	4.00	

Item No.	Description	Unit	Unit Quantity
A1021	Excavation Volume	m^3	155.54
A1061	Shotcrete, 50mm	m^3	1.32
A1064	Shotcrete, 200mm	m^3	7.92
A1081	Wire mesh, 150/150/6mm	m^2	39.27
A1112	Rock bolts, SN type- 4m	pcs	5.30
A1113	Rock bolts, SN type- 6m	pcs	3.40
A1153	Lattice Girder, 95/20/25	m	12.80
A1161	Forepoling, SN Bolts	pcs	7.70
B155	Drainage Pipes	pcs	4.00
B156	Base Drainage pipe, 300mm dia	m	1
B157	Plugging concrete for base drainage pipe	m^3	0.15
B158	Weep Holes	pcs	4.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-IV

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	1.25	
Top Heading	A1021	Theoretical Excavation Volume		m^3	83.50	10%
	A106	M25 - Shotcrete of thickness as				
	A1065		250mm	m^3	6.00	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	49.40	10%
	A115	Fe 500, Lattice Girder of size				
	A1153		95/20/25	m	18.10	
	A111	Fy>=230kN, Rock Bolts SN type, Length				
	A1112		4m	pcs	4.40	
	A1113		6m	pcs	4.80	
	A117	Forepoling, SD Bolts				
	A1173	32mm dia, 4m length	4m	pcs	21.60	
	A112	Face Bolts SD type, Length				
	A1124		9m	pcs	0.50	
	A106	M25 - Shotcrete of thickness as				
	A1061		50mm	m^3	6.20	20%
		Round Length		m	2.50	
Bench	A1021	Theoretical Excavation Volume		m^3	69.40	10%
	A106	M25 - Shotcrete of thickness as				
	A1065		250mm	m^3	2.20	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	17.60	10%
	A115	Fe 500, Lattice Girder of size				
	A1153		95/20/25	m	7.00	
	A111	Fy>=250kN, Rock Bolts SN type, Length				
	A1112		4m	pcs	3.20	
		Round Length		m	5.00	
Invert	A1021	Theoretical Excavation Volume		m^3	23.00	10%
	A106	M25 - Shotcrete of thickness as				
	A1065		250mm	m^3	3.90	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	16.00	10%
	B155	Drainage Pipes		pcs	4.00	
	B158	Weep Holes		pcs	4.00	

Item No.	Description	Unit	Unit Quantity
A1021	Excavation Volume	m^3	193.49
A1061	Shotcrete, 50mm	m^3	7.44
A1065	Shotcrete, 250mm	m^3	14.52
A1081	Wire mesh, 150/150/6mm	m^2	91.30
A1112	Rock bolts, SN type- 4m	pcs	7.60
A1113	Rock bolts, SN type- 6m	pcs	4.80
A1124	Rock bolts, R32N SD type- 9m	pcs	0.50
A1153	Lattice Girder, 95/20/25	m	25.10
A1173	Forepoling, SD Bolts	pcs	21.60
B155	Drainage Pipes	pcs	4.00
B156	Base Drainage pipe, 300mm dia	m	1
B157	Plugging concrete for base drainage pipe	m^3	0.15
B158	Weep Holes	pcs	4.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-V

From Drawing

Section	Item No.	Description		Unit	Unit Quantity	Loss Factor
		Round Length		m	0.90	
Top Heading	A1022	Theoretical Excavation Volume		m^3	84.50	10%
	A106	M25 - Shotcrete of thickness as				
	A1066		300mm	m^3	7.00	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	49.20	10%
	A115	Fe 500, Lattice Girder of size				
	A1154		130/25/32	m	25.20	
	A112	Fy>=230kN, Rock Bolts SD type, Length				
	A1123		6m	pcs	10.5	
	A1124		9m	pcs	5.50	
	A117	Forepoling, SD Bolts				
	A1173	32mm dia	4m	pcs	56.60	
	A112	Face Bolts SD type, Length				
	A1124		9m	pcs	1.00	
	A106	M25 - Shotcrete of thickness as				
	A1061		50mm	m^3	8.60	20%
Temp Invert	A1022	Theoretical Excavation Volume		m^3	13.20	10%
	A106	M25 - Shotcrete of thickness as				
	A1061		50mm	m^3	4.00	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	16.20	10%
		Round Length		m	1.80	
Bench	A1022	Theoretical Excavation Volume		m^3	56.60	10%
	A106	M25 - Shotcrete of thickness as				
	A1066		300mm	m^3	2.60	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	17.40	10%
	A115	Fe 500, Lattice Girder of size				
	A1154		130/25/32	m	9.60	
	A112	Rock Bolts SD type, Length				
	A1123	32mm dia	6m	pcs	6.60	
		Round Length		m	3.60	
Invert	A1022	Theoretical Excavation Volume		m^3	23.80	10%
	A106	M25 - Shotcrete of thickness as				
	A1066		300mm	m^3	4.70	20%
	A108	Fy=500N/mm^2, Wire Mesh				
	A1081		150/150/6 mm	m^2	16.20	10%
	B155	Drainage Pipes		pcs	4.00	
	B158	Weep Holes		pcs	4.00	

Item No.	Description	Unit	Unit Quantity
A1022	Excavation Volume	m^3	193.53
A1061	Shotcrete, 50mm	m^3	15.12
A1066	Shotcrete, 300mm	m^3	17.16
A1081	Wire mesh, 150/150/6mm	m^2	96.72
A1123	Rock bolts, SD type- 6m	pcs	17.10
A1124	Rock bolts, SD type- 9m	pcs	6.50
A1154	Lattice Girder, 130/25/32	m	34.80
A1173	Forepoling, SD Bolts	pcs	56.60
B155	Drainage Pipes	pcs	4.00
B156	Base Drainage pipe, 300mm dia	m	1
B157	Plugging concrete for base drainage pipe	m^3	0.15
B158	Weep Holes	pcs	4.00

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-I

From Drawing

Item No.	Description		Unit	Unit Quantity	Loss Factor
Support Quantities					
A106	M25 - Shotcrete	Slopes	m^3	1132.00	20%
		Surface Drainage Channel	m^3	904.00	20%
A108	Fy=500N/mm^2, Wire Mesh 150/150/6 mm		m^2	6990.00	10%
A190	Bolts SD type, R32N	6m	pcs	20.00	
		9m	pcs	293.00	
A195	Bolts SD type, R38N	6m	pcs	30.00	
		9m	pcs	141.00	
		12m	pcs	21.00	
		15m	pcs	573.00	
A200	Rebars	12mm dia	MT	0.50	
		16mm dia	MT	3.70	
Portal Collar Quantities					
A106	M25 - Shotcrete	Collar	m^3	20.00	20%
A108	Fy=500N/mm^2, Wire Mesh 150/150/6 mm		m^2	131.00	10%

Item No.	Description	Unit	Unit Quantity
A106	Shotcrete	m^3	2467.20
A108	Wire mesh, 150/150/6mm	m^2	7833.10
A190	Bolts, SD R32N type- 6m	m	120
	Bolts, SD R32N type- 9m	m	2637
A195	Bolts, SD R38N type- 6m	m	180
	Bolts, SD R38N type- 9m	m	1269
	Bolts, SD R38N type- 12m	m	252
	Bolts, SD R38N type- 15m	m	8595
A200	Rebars	MT	4.20

Note: Items numbers must be arranged in ascending order

PROJECT: I6060 - Feasibility-Cum-GeoTechnical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH - 48 in the State of Karnataka

EXCAVATION AND SUPPORT QUANTITIES FOR SUPPORT TYPE-I

From Drawing

Item No.	Description		Unit	Unit Quantity	Loss Factor
Apporximate Support Quantities Portal Area					
A106	M25 - Shotcrete, 100mm	Slopes	m^3	143.40	20%
		Surface Drainage Channel	m^3	2.40	20%
A108	Fy=500N/mm^2, Wire Mesh 150/150/6 mm		m^2	1434.00	10%
A111	Bolts SN type, 25mm dia	4m	pcs	325.00	
Apporximate Support Quantities Buildings Area					
A106	M25 - Shotcrete	Slopes	m^3	185.30	20%
A111	Bolts SN type, 25mm dia	4m	pcs	463.00	
A108	Fy=500N/mm^2, Wire Mesh 150/150/6 mm		m^2	1853.00	10%
Apporximate Portal Collar Quantities					
A106	M25 - Shotcrete, 200mm	Portal Collar	m^3	14.00	20%
A111	Bolts SN type, 32mm dia	6m	pcs	44.00	
A108	Fy=500N/mm^2, Wire Mesh 150/150/6 mm		m^2	130.00	10%

Item No.	Description	Unit	Unit Quantity	Total
A106	Shotcrete 100mm	m^3	397.32	4370.52
A106	Shotcrete 200mm	m^3	16.8	184.8
A108	Wire mesh, 150/150/6mm	m^2	3758.70	41345.70
A111	Bolts, SN type- 4m	m	3152	34672
A111	Bolts, SN type- 6m	m	264	2904

Note: Items numbers must be arranged in ascending order

Prepared for:

सड़क परिवहन और राजमार्ग मंत्रालय
MINISTRY OF ROAD TRANSPORT & HIGHWAYS
Government of India

Karnataka
Public Works, Ports &
Inland Water Transport Department

Project:

Consultancy Services for "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.000 to 261.450 on NH-48 in the State of Karnataka"

Subject:

KD-6 - Draft Detailed Project Report for Final Approved Alignment for Bypass

Volume - X: Civil Work Contract Agreement

Prepared by:

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Revision History

Rev.	Date	Long Description

INTRODUCTION

This report is prepared under Contract Agreement clause 2.8; "Key Date No: KD 6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR)" after incorporation of Client's observations on earlier submitted "KD5: Kucha Draft Detailed Project Report (KDDPR)" vide letter no. NH/PIU-Tunnel/NH-48/KD-3/2015-16/383-386 dated 14.12.2015.

The present submission (10 Hard Bound Sets and 5 Soft Copies of each) is as detailed below:

(i) Volume-I, Main Report:

- *Executive summary*
- *Project Description*
- *Socio Economic Profile*
- *Materials Surveys and Investigation*
- *Traffic Surveys and Analysis*
- *Design Standards and Specifications*
- *Alignment Proposals*
- *Summary of EIA/IEE and Action Plan*
- *Summary of Resettlement Plan*
- *Preliminary Cost Estimates*
- *Preliminary Economic Analysis*
- *Preliminary Financial Analysis*
- *Suggested Methods of procurement and packaging*
- *Conclusions and Recommendations*
- *Acknowledgement*
- *Compliance of the Observations*

The basic data obtained from the field studies and investigations and input data used for the detailed engineering design (if any) shall be submitted in a separate volume as an Appendix to Main Report.

(ii) Volume – II : Design Report;

Part -I : Traffic Study, Analysis and Forecast

- *Description of Existing Road in Ghat Section*
- *Road and Bridge Inventory*
- *Traffic Surveys, analysis and forecast*
- *Proposed Pavement Design*

Part-II : *Design of Tunnels*

- *Proposed Tunnel Design, Standards*
- *Structural Analysis- Primary Lining*

Part-III : *Design of Bridges and Cross-Drainage Structures*

- *Proposed Bridges and Structures Design Basis and*
- *Bridges Dimensioning*

Part-IV : Geological Design and Geotechnical Report

- *Geological Survey and Analysis*
- *Geotechnical Investigations Report*

(iii) Volume – III : Materials Report;

(iv) Volume – IV (a) : Environmental Assessment Report including Environmental Management Plan (EMP) &

(v) Volume – IV (b): Resettlement Action Plan (RAP)

(vi) Volume – V : Technical Specifications;

(vii) Volume – VI : Rate Analysis;

(viii) Volume – VII : Cost Estimates;

(ix) Volume – VIII : Bill of Quantities

(x) Volume – IX : Drawings (A3 Size)

a. *Location map*
b. *Layout plans*
c. *General Drawings*
d. *Plan and Profile of Refined Alignment "A"*
e. *Typical Cross Sections showing Pavement details of Cut & Fill Section*
f. *Typical Cross Sections of Tunnel*
g. *Typical Cross Sections of Bridges*
h. *Tunnels- General Arrangement Plan and L-Sections (L&R)*
i. *Viaducts – General Arrangement Plan and L-Section*
j. *Cut & Fill and Viaducts – General Arrangement Plan and L-Section*
k. *GAD for proposed RoB at Railway km 54+650*
l. *Standard Drawings*
m. *Miscellaneous Drawings*
n. *Indicative Land Acquisition Plans*
o. *Detailed Cross Sections @ 100m interval*

(xi) Volume – X : Civil Work Contract Agreement:

(xii) Volume-XI: Project Clearances:

Volume – X: Civil Work Contract Agreement

1 General

This Volume - X: Civil Work Contract Agreement, a part of KD6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR) is submitted in accordance with the Contract Agreement for Preparation of "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH-48 in the State of Karnataka".

Volume- I

Package- SG

सड़क परिवहन और राजमार्ग मंत्रालय
MINISTRY OF ROAD TRANSPORT & HIGHWAYS

Karnataka
Public Works, Ports &
Inland Water Transport Department

Bypass to Shiradi Ghat Tunnel Project, Sakleshpur; NH-48

INTERNATIONAL COMPETITIVE BIDDING DOCUMENTS

VOLUME-I

CONDITIONS OF CONTRACT

Contract No: MoRTH/NH-KPWD/SG/2016

Construction of 4-lane Bypass to Shiradi Ghat Tunnel Project from Heggade , Maranhally (km 236.400) to Adda hole, Gundya (km 263.400) in the state of Karnataka

(Construction Package-SG)

Office of the Executive Engineer,

NH - 48 Project Implementation Unit (World Bank),

ShiradiGhat Tunnel Construction Division,

Sakaleshapur - 573134

(Ministry of Road Transport & Highways)

Government of India

May 2016

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STANDARD BIDDING DOCUMENTS

PROCUREMENT OF CIVIL WORKS

MINISTRY OF ROAD, TRANSPORT & HIGHWAYS

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INSTRUCTIONS

The Standard Bidding Documents are intended to serve as a model for the ad measurement (unit price or unit rate) type of contract, which is the common in our civil works contracts. Use of these documents requires among other things completing the specific details in all the places indicated. The following directions should be observed when using the documents: -

(i) Specific details, such as the name of the Employer, address for bid submission, etc., shall be furnished in the spaces indicated by italicized notes inside parentheses.

(ii) The footnotes and "boxed" notes in the sample documents and italicized notes preceding each sample document and preceding or incorporated in the text are not part of the contract documents, but contain guidance and instructions for the user. Do not incorporate them in actual bidding documents.

(iii) When using the FIDIC Conditions of Contract, "Part I - General Conditions" should be retained intact to facilitate perusal by bidders. Modifications to the General Conditions have been introduced in Part II -' Conditions of Particular Application. If any other modification is required to be introduced, it should be got approved from the Competent Authority.

(iv) Prequalification of bidders is required for most civil works contracts to ensure that only technically and financially capable firms will be invited to submit bids. (These standard bidding documents assume prequalification).

(v) Available bid capacity of the bidders, before financial bid opening, is required to be updated, after confirming from all the concerned officers dealing with procurement of civil works in Programme in MORTH.

2. The process of prequalification of bidders is not covered in these sample documents. Refer to the standard documents on Prequalification of Civil Works Contractors.

Ministry of Road, Transport & Highways

(MoRTH)

Invitation for Bid (IFB)

(International Competitive Bidding)

1. The Ministry of Road, Transport & Highways, (hereinafter called "the Employer") invites sealed bids from eligible pre-qualified bidders for the construction of Works detailed in the Table below: -

Sl. No.	Name of Works	Contract[@] Package No.	Approximate value of works (Rs. In Crore)	Bid Security (Rs. Crore)*	Completion Period
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
1	Construction of 4-lane Bypass to Shiradi Ghat Tunnel Project from Heggade , Maranhally (km 236.400) to Adda hole, Gundya (km 263.400) in the state of Karnataka	**S-G**	**10000**	**10.0**	**60 months**

2. Bidders may bid for anyone or several of the above contract packages for which they have been pre-qualified.
3. Bidders may obtain further information from, and inspect and acquire the bidding documents, at the office of the Ministry of Road, Transport & Highways, **from Office of the Executive Engineer, NH-48 Project Implementation Unit (WB), ShiradiGhat Tunnel Construction Division, Sakaleshapur-573134**.
4. A complete set of bidding documents may be purchased by interested bidders on submission of a written application to the above office, and upon payment of a non-refundable fee of Rs. 50,000/- or US$ 1200 (for each package) in the form of Demand Draft from any scheduled Bank in favor of Ministry of Road, Transport & Highways. New Delhi, payable at New Delhi, for each work separately during working hours from_____ and up to _____ (1700 hrs).
5. All bids must be accompanied by Bid Security of the amount specified for the Works in the above Table payable at New Delhi and drawn in favor of **Ministry of Road,**

Transport & Highways, New Delhi. Bid Security will have to be in anyone of the forms as specified in Clause 17 of ITB (Instructions to Bidders).

6. The bidder's attention is invited to the letter confirming approval of his prequalification for the above contract package(s); bidding shall be subject to the conditions as indicated therein.
7. All Bids must be delivered to **Office of the Executive Engineer, NH-48 Project Implementation Unit (World Bank), ShiradiGhat Tunnel Construction Division, Sakaleshapur - 573134** not later than 11:00 hrs on_____.
8. The Technical Bids will be opened at 11 :30 hrs on _____++ at in the presence of bidders or their representatives who choose to attend. In the event of the specified date of bid submission/opening being declared a holiday for the Employer, the bids shall be received/opened on the next working day at the same place and the same time.
9. The Financial Bid of bidders whose technical bids have been determined responsive and who have the required bid capacity will be opened in the serial order as listed in the Invitation of Bid on the date to be intimated later.

Office of the Executive Engineer,

NH-48 Project Implementation Unit (World Bank)

ShiradiGhat Tunnel Construction Division,

Sakaleshapur - 573134

@ The serial order of contract packages shall be in the descending order of the value of Works (given in col. 4).

• ~~The bid security shall be 1 (one) percent of the value of Works.~~

++ The opening date shall be the last day of submission as at para 7 *above.*

MINISTRY OF ROAD, TRANSPORT & HIGHWAYS

Section I- Instruction to Bidders (ITB)

A. General

1. Scope of Bid

1.1. The Ministry of Road, Transport & Highways (MORTH) hereinafter called "the Employer" invites bids for the construction of works (as defined in these documents, hereinafter referred to as 'the works") detailed in the table given in the IFB

1.2. The Works consist of:

a.) Construction of new 4-lane road approaches, tunnel, bridges with rigid pavement from km 0/000 to km 23/600,i.e., a total of about 23.6 km.

1.3. Construction of tunnels, viaducts, major & mnor bridges, culverts, road approaches, flyover, rail over bridges, road furniture, road side amenities etc.

1.4. The works under this Contract shall be carried out in accordance with the bidding documents constituting the contract and shall consist of various salient items as generally described below:

1.4.1. Road Works

a.) conducting geotechnical investigations including analysis, interpretation and reporting of the results thereof in accordance with the provisions of IRC:75-1979 (Guidelines for the Design of High Embankments) and IRC Special Publication 19 (Manual for survey, Investigation and Preparation of road Projects;

b.) carry out special tests as directed;

c.) Site clearance, removal of tree stumps and dismantling of obstructions, encroachments etc. before commencement of the Works;

d.) True and proper setting out and layout of the works, setting of bench marks, preparation of working drawings where required and provisions of all necessary labor, instruments, and appliances

e.) Widening and strengthening/reconstruction of the existing carriageway including raising;

f.) construction of new road/bypasses/detours, service roads;

g.) remodeling/construction of junctions, intersections including grade separators, bus stops, laybyes;

h.) construction of toll plaza complex, with requisite plant and equipment.

i.) construction of culverts, minor bridges, underpasses and approaches and other related items of works;

j.) providing road markings, road signs and kilometer stones;

k.) construction of protective works, crash barriers, guard rails, guard

posts;

l.) construction of reinforced earth retaining structures;

m.) plantation in the median, roadside, slope protection, turfing and environmental measures.

n.) maintenance of existing road during the construction period

o.) any other item of work as may be required to be carried out for completing the road works in all respects in accordance with the provisions of the Contract.

1.4.2. Bridge Works

a) site clearance, dismantling of obstructions etc.

b) true and proper setting out and layout of the Works, bench marks, preparation of working drawings where required;

c) construction of open/well/pile foundations for piers and abutments and conducting detailed sub-surface explorations in accordance with IRC 78-1983 (Indian Roads Congress Standards Specifications and Code of Practice for Road Bridges-Section VII-Foundations and Substructures) for the purpose of ascertaining the continuity/ stability of the founding strata and determining the final founding level;

d) construction of piers and abutments, including bearings;

e) construction of prestressed/ reinforced cement concrete superstructure;

f) providing footways/ verges, wearing coat, crash barriers, hand-railings, expansion joints, approach slabs, drainage spouts/ downtake pipes, arrangements for fixing light posts, water mains and utilities.

g) construction of protective works, gabions, guide bunds etc;

h) providing wing walls, return walls, dirt walls, back fill, filter media, weep holes etc.;

i) providing road markings, road signs;

j) providing suitable access for inspection of bearings, expansion joints and underside of bridge deck after completion of the bridge;

k) construction of approaches on either side of the bridge, RCC retaining walls/ reinforced earth walls;

l) rehabilitation/repair/widening of existing bridges.

m) maintenance of existing bridges during construction

n) any other Item of work as may be required to be carried out for completion of the bridge (s) in all respects in accordance with the provisions of

the Contract and/or to ensure the structural stability and safety of the bridge (s) during and after construction;

1.4.3. Other Works - General

a) coordinate with service provider/concerned authorities for cutting of trees, shifting of utilities and removal of encroachments etc. and making the site unencumbered from the project construction area required for completion *of* work. This will include initial and frequent ~follow-up meetings / actions / discussions with concerned service provider / authorities. The contractor will not be entitled for any payment for the coordination work.

   Payment for cutting of trees and shifting *of* utilities as required by the concerned department shall be made by the Employer. The Employer will also assist for expediting and facilitating cutting *of* trees, shifting of utilities and removal of encroachment etc.

b) carry out the work of tree cutting, utility shifting, reallocation of religious places, wells, tanks etc. and payment for the same shall be made on the basis of proposals/estimate submitted by concerned state authorities and as per the Engineer's assessment.

c) during the period of the Contract, all existing roads within the Right of Way (ROW) shall be kept open for traffic and maintained in a safe and usable condition. Residents along and adjacent to the Works are to be provided with safe convenient access to their properties at all times. Traffic control and traffic diversions shall be provided and maintained as necessary to protect the Works as directed by the Engineer. Traffic safety measures during construction shall be provided in accordance with MoRT&H / IRC guidelines.

d) ensure quality assurance of various components of the Works.

e) providing traffic signals and road lights etc.

f) providing and maintaining fully equipped laboratory for testing and site office, including the supply of testing equipment and consumables; all as prescribed I in the relevant specifications.

g) rectification of the defects In the completed works during the Defects Liability Period;

h) submission of Completion Drawings/as built drawings and other related documents;

i) supply and maintenance of vehicles for use by the Engineer and the Employer.

j) providing and maintaining wireless communication system for the Engineer and the Employer where mobile telephone facility is not available.

k) any other item as directed by the Engineer including insurance cover.

l) All stipulated measures regarding labour employment and their welfare are to be complied with.

m) clearing of site before handing over of the Works;

1.5. Availability of the Project Area:

The Employer shall provide the right-of-way for road and bridge works and other appurtenant works to the contractor as per details in Schedule A in Section VIII. However, the contractor shall have to make his own arrangements for the land required by him for borrow areas, quarries, site offices, installation of HMP, crusher, concrete batching plant, casting yard, testing laboratories, labour camps, other camps, etc.

1.6. The successful bidder is required to complete the work within the period stipulated in IFB from the date of the commencement of the work,

1.7. The Employer shall engage a Supervision Consultant or any other person to act as Engineer for the project. There will also be a Project Director of the Employer acting as the Employer's representative.

2. Source of Funds

2.1. The expenditure on these Works will be met by Ministry of Road, Transport & Highways.

3. Eligible Bidders

3.1. This invitation for bids is open to bidders who have been earlier prequalified by written notification for the contract packages and within whose bid capacity the estimated value of work(s) falls and who meet the following requirements:

(a) A bidder (including all members of a joint venture and all subcontractors of a bidder) shall not be affiliated with a firm or entity which;

i. has provided consulting services during the preparatory stages of the Works or of the project of which the Works form a part (the details given in Sub Clause 3.2), or

ii. has been hired (or is proposed to be hired) by the Employer as Engineer for the Contract.

(b) A bidder shall not be under a declaration of ineligibility for corrupt or fraudulent practice.

3.2. The detail of Design Consultants engaged by MORTH on various contract packages:-

S. No.	Name of Works	Name of Design Consultants engaged for project preparation

1	Consultancy Services for Preparation of Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH-48 in the State of Karnataka	GEOCONSULT India Pvt.Ltd. Plot 473, Industrial Estate Udyog Vihar, Sector 19 Phase V 122 016 Gurgaon INDIA

3.3. Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer as the Employer shall reasonably request.

4. Eligible Material, Equipment and Services

4.1. At the Employer's request, the bidder having offered the lowest evaluated bid may be required to provide evidence of the origin of materials, equipment, and services to the satisfaction of the Employer.

4.2. For purposes of Sub Clause 4.1, "origin" means the place where the materials are mined, grown, produced or manufactured; similarly for equipments and from where the services are provided.

5. Qualification of the Bidder

5.1. To be qualified for award of Contract, bidders shall:

a) submit a written power of attorney authorizing the signatory of the bid to commit the bidder; and

b) have adequate experience, financial capacity, adequate available bid capacity and technical capability to undertake the Contract. Confirmation of these matters may involve the updating, verification and reassessment of information, which may previously have been considered during prequalification.

c) the bidder shall submit the following Information on eligibility and qualification duly updated including any changes since prequalification (on the forms given in Section IX):-

(i) general information

(ii) evidence of access to a revolving line of credit (minimum 10% of the value of work)

(iii) undertaking for making available the required key equipment as per Schedule 8, Section-VIII.

(iv) undertaking for making available the required key personnel as per Schedule C, Section-VIII

(v) annual audited turnover

(vi) current contract commitments/works in progress.

(vii) financial data

(viii) additional information regarding litigation, debarment, arbitration, etc.

(ix) joint venture agreement in case the bidder is joint venture

(x) work programme - supported with details as per Sub Clause 5.1 (d).

(xi) affidavit.

d) Submit proposed methodology in sufficient detail and programme of construction backed with equipment planning and deployment duly supported with broad output calculation and quality assurance procedures proposed to be adopted justifying the adequacy of the bidder's proposal to meet the technical specification and the completion of work within the stipulated period of completion.

5.2. The Employer has notified the eligibility of bidders for the packages along with overall bid capacity on the basis of particulars furnished by the bidder. The bidders current bid capacity shall be updated, which should be more than the estimated value of the Work(s) and only then their bids will be considered responsive for further evaluation.

5.3. The Bids submitted by a Joint Venture (JV) shall comply with the following requirements:

a) There shall be a Joint Venture Agreement between the constituent firms specific for the contract packages for which the bids are submitted. The JV Agreement shall include among other things, the joint venture's objectives, the proposed management structure, the proposed distribution of responsibilities both financial as well as technical for execution of the work, the contribution of each' partner to the joint venture operation, the commitment of the partners to joint and several liability for due performance, recourse/sanctions within the joint venture in the event of default or withdrawal of any partner and arrangements for providing the required indemnities.

b) The most experienced partner will be the Lead Partner and nominated as the partner-in-charge; and this authorization shall be evidenced by submitting a power of attorney signed by the legally authorized signatories of all the partners. The most experienced partner (lead partner) will be the one defined as such in the communication approving the prequalification.

c) The most experienced partner(Lead Partner) of the Joint Venture will provide suitable experienced personnel for at least 3 (three) positions at site for the purpose of general planning, site management and plant operations, during the whole period of contract execution and a statement to this effect should be included in the Joint Venture Agreement.

d) The bid, and in the case of the successful bidder, the Form of Agreement, shall be signed and / or executed in such a manner as may be required for making it legally binding on all partners (including operative parts of the ensuing Contract in respect of Arbitration Agreement etc.).

e) The partner-in-charge shall be authorized to incur liabilities and to receive instructions for and on behalf of all partners of the Joint Venture and the entire execution

of the Contract including payment shall be carried out exclusively through the partner-in-charge. A statement to this effect should be included in the joint venture agreement.

f) All partners of the Joint Venture shall be liable jointly and severally for the execution of the Contract in accordance with the Contract terms, and a statement to this effect shall be included in the joint venture agreement.

g) Bid Security as required can be furnished by any partner but it should be in the name of joint venture.

h) Performance guarantee, as required, will be furnished by all partner(s), out of their accounts, in proportion to their participation in Joint Venture.

i) Joint Venture Agreement shall contain a clause to the effect that there shall be a separate JV Bank Account (distinct from the Bank Accounts of the individual partners) to which the individual partner shall contribute their share capital and/or working capital.

j) Joint Venture Agreement shall also contain a clause to the effect that the financial obligations of the JV shall be discharged through the said JV Bank Account only and also all the payments received by the JV from the Employer shall be through that account alone.

k) In the event of default by the most experienced partner (Lead Partner), it shall be construed as default of the Contractor; and Employer will take action under Clause 63 of the Conditions of Contract.

l) In the event of any other partner leaving the JV, it shall be intimated to the Employer within 30 days by the other partner(s). Failure to do so shall be construed as default of the Contractor and the Employer may take action under Clause 63 of the Conditions of Contract.

m) In case the joint venture agreement is not acceptable to the Employer, the joint venture will modify the agreement so as to be acceptable to the Employer.

n) The bid submitted shall include all information as required under the provisions of Sub Clause 5.1 and furnished separately for each partner.

5.4. Disqualification

Even though the Bidders may meet the above criteria, they are subject to be disqualified for any of the following reasons:

a) misleading or false representation in the forms, statements and attachments submitted and included in PQ application.

b) record of poor performance such as abandoning the work, rescinding of contract for which the reasons are attributable to the non-performance of the contractor,

consistent history of litigation awarded against the applicant or financial failure due to bankruptcy.

c) has been identified by the Employer as poor performer in implementation of ongoing MORTH works.

5.5. Debarment/Black listing

Notwithstanding the above, the Employer may debar or blacklist any of the bidder(s) for their misleading or false representations in the forms statements etc. for the period to be decided by the Employer.

6. One Bid per Bidder

6.1. Each bidder shall submit only one bid per contract package either by himself or as a partner in a joint venture. A bidder who submits or participates in more than one bid for a contract package will be disqualified.

7. Cost of Bidding

7.1. The bidder shall bear all costs associated with the preparation and submission of his bid and the Employer will in no case be responsible or liable for those costs.

8. Site Visit

8.1. The bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the bidder's own expense.

8.2. The bidder and any of its personnel or agents will be granted permission by the Employer to enter its premises and lands for the purpose of such inspection, but only upon the express condition that the bidder, its personnel and agents, will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of the inspection.

B. Bidding Documents

9. Contents of Bidding Documents

9.1. The set of bidding documents comprises the documents listed below and should be read in conjunction with any Addenda issued in accordance with Clause 11:

Volume 1

Invitation for Bids (IFB)

Section I Instructions to Bidders (ITB)

Section II General Conditions of Contract - Part I

Section III Conditions of Particular Application: - Part II

Volume 2

Section IV Technical Specifications Volume 3

Volume 3

Section V Form of Bid and Appendix to Bid

Section VI Bill of Quantities

Section VII Form of Bid Security (BG), Form of Performance Security (BG), Form of Advance Payment Security (BG), Form of Agreement

Section VIII Schedules for supplementary information

Section IX Sample Forms for updating qualification information etc.

Volume 4

Section X Drawings

Volume 5

Section XI Documents to be furnished by the Bidder.

9.2. The bidder is expected to examine carefully the contents of all the above bid documents. Failure to comply with the requirements of bid documents will be at the bidder's own risk. Pursuant to Clause 26 and 28, bids which are not substantially responsive to the requirements of the bidding documents will be rejected.

10. Clarification of Bidding Documents

10.1. A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing or by fax (hereinafter, the term "fax" is deemed to include electronic transmission such as facsimile, cable and telex) at the Employer's address indicated in the Invitation for Bid. The Employer will respond to any request for clarification, which he receives prior to holding of Pre-Bid Meeting. Copies of the Employer's response will be forwarded to all purchasers of the bidding documents, including a description of the enquiry but without identifying its

source.

11. Amendment of Bidding Documents

11.1. At any time prior to the deadline for submission of bids, the Employer may, for any reason, whether at his own initiative or in response to a clarification requested by a prospective bidder, amend the bidding documents by issuing Addendum.

11.2. Any Addendum thus issued shall be part of the bidding documents pursuant to Sub Clause 9.1, and shall be communicated in writing or by fax to all purchasers of the bidding documents. Prospective bidders shall acknowledge receipt of each addendum by fax to the Employer.

11.3. To afford prospective bidders reasonable time in which to take an Addendum into account in preparing their bids, the Employer may extend as necessary the deadline for submission of bids, in accordance with Clause 22.

C. Preparation of Bids

12. Language of Bid

12.1. The bid, and all correspondence and documents related to the bid exchanged between the bidder and the Employer shall be written in the English language. Supporting documents and printed literature furnished by the bidder may be in another language provided they are accompanied by an accurate translation of the relevant passages In the English language, In which case, for purposes of interpretation of the bid, the English translation shall prevail.

13. Documents comprising the Bid

13.1. The bids shall be submitted as Volume 5 in two parts which comprise the following documents: -

Part-1 Technical Bid

i) Bid Security for an amount as specified in the Invitation for Bids (IFB) and in the form specified in Clause 17.

ii) Power of Attorney

iii) Information as specified in Sub Clause 5.1 (c).

iv) Any other material/information required to be submitted in accordance with these Instructions to Bidders (ITB).

The Technical Bid shall be bound and all pages machine numbered.

Part-II Financial Bid:

(i) Form of Bid and Appendix to Bid - duly filled in and signed on each page

(ii) Priced Bill of Quantities - duly filled in and signed on each page

Each part shall be separately sealed and marked in accordance with the sealing and marking instruction in Clause 21.

13.2. The documents listed under Section V, VI, IX, and VII for Bid Security of Sub Clause 9.1 shall be filled in without exception in the given format.

13.3. The bidder shall prepare and submit only one copy of the bid.

13.4. The following documents are deemed to be part of the Bid. However, these are not required to be submitted:

Volume 1

Invitation for Bids (IFB)

Section I - Instructions to Bidders (ITB)

Section II - General Conditions of Contract - Part I

Section III - Conditions of Particular Application - Part II

Volume 2

Section IV -Technical Specifications

Volume 4

Section X - Drawings

14. Bid Prices

14.1. Unless stated otherwise in the bidding documents, the Contract shall be for the whole Works as described in bidding documents, based on the unit rates and prices in the Bill of Quantities submitted by the bidder.

14.2. The bidder shall fill in rates and prices and line item total (both in figures and words) for all items of the Works provided in the Bill of Quantities along with total bid price (both in figures and words). Items (for which quantity has been provided) against which no rate or price is entered by the bidder will not be paid for by the Employer when executed and shall be deemed covered by the rates and prices for other items in the Bill of Quantities.

Corrections, if any, shall be made by crossing out, initialing, dating and rewriting.

The rates and prices and line item total (both in figures and words) filled in by the Bidder shall be laminated and any corrections shall be made by initialing dating and **I**re-writing which shall also be laminated.

All pages of the Bill of Quantities shall be initialed.

14.3. All duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause as of the date 28 days prior to the deadline for submission of the bids, shall be included in the rates and prices and the total bid price submitted by the bidder and the evaluation and comparison of bids by the Employer shall be made accordingly.

14.4. The rates and prices quoted by the bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of Clause 70 of the Conditions of Particular Application.

15. Currencies of Bid and Payment

15.1. The unit rates. and the prices shall be quoted by the bidder entirely in Indian Rupees

15.2. All payments Including advances, If any, shall be made In Indian Rupees.

16. Bid Validity

16.1. Bids shall remain valid for a period of 120 days (one hundred twenty days) after the deadline date for bid submission specified in Clause 22. A bid valid for a shorter period shall be rejected by the Employer as non-responsive.

16.2. In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request the bidders to extend the period of validity for a specified additional period. The request and the responses thereto shall be made in writing or by fax. A bidder may refuse the request without forfeiting his bid security. A bidder agreeing to the request will not be required or permitted to modify his bid but will be required to extend the validity of his Bid Security for the period of the

extension, and in compliance with Clause 17 in all respects.

17. Bid Security

17.1. The bidder shall furnish as part of its Bid, a Bid Security in the amount as stipulated in the Invitation for Bid (IFB) for particular work(s). The Bid Security shall be in favour of Ministry of Road, Transport & Highways and may be in one of the following forms:

a) Deposit-at-call Receipt from any scheduled Indian Bank or a foreign Bank located in India and approved by the Reserve Bank of India (RBI).

b) Bank Guarantee from any nationalized Indian/IDBI/ICICI/Foreign bank with counter guarantee from any nationalized Indian Bank/any RBI approved scheduled commercial bank having net worth of more than Rs.500 crore of Indian operation and acceptable to Employer.

The format of Bank Guarantee shall be in accordance with the sample form of Bid Security included in the bid document (Section VII).

c) Fixed Deposit Receipt, a certified cheque or an irrevocable letter of credit, issued by any Scheduled Indian Bank or a foreign Bank approved by the Reserve Bank of India.

17.2. Bank guarantees (and other instruments having fixed validity) issued as surety for the bid shall be valid for 28 days beyond the validity of the bid.

17.3. Any bid not accompanied by an acceptable bid security and not secured as indicated in Sub Clause 17.1 and 17.2 above shall be rejected by the Employer as non - responsive.

17.4. The Bid Security of the unsuccessful bidders will be returned as promptly as possible but not later than 28 days after the expiration of the period of bid validity.

17.5. The Bid Security of the successful bidder will be returned when the bidder has furnished the required performance security and signed the agreement.

17.6. The Bid Security may be forfeited

a) if the bidder withdraws his bid during the period of bid validity;

b) if the bidder does not accept the correction of his bid price, pursuant to Clause 29

c) in the case of a successful bidder, if the bidder fails within the specified time limit to

(i) furnish the required Performance Security or

(ii) sign the Agreement.

18. Alternative Proposals by Bidders

18.1. Bidders shall submit offers, which comply with the requirements of the bidding documents, including the conditions of contract, basic technical design as indicated in the Drawings and Specifications. Conditional offer or alternative offers will not be considered further in the process of bid evaluation.

19. Pre- Bid Meeting(s)

19.1. The bidder or his official representative is invited to attend a pre-bid meeting, which will take place at _____on _____ at.

19.2. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

19.3. The bidder is requested to submit questions in writing or by cable/fax, to reach the Employer before date of the meeting.

19.4. Minutes of the pre-bid meeting, including the text of the questions raised and the responses given together with any response prepared after the meeting, will be transmitted without delay to all purchasers of the bidding documents. Any modification of the bidding documents listed in Sub Clause 9.1 which may be considered necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to Clause 11 and not through the minutes of the pre-bid meeting.

19.5. Non-attendance at the pre-bid meeting will not be a cause for disqualification of a bidder.

20. Format and Signing of Bid

20.1. The bidder shall prepare only one copy of the documents comprising the bid as described in Clause 13 of these Instructions to Bidders.

20.2. The bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the bidder, pursuant to Sub Clause 5.1 or 5.3, as the case may be.

20.3. The bid shall contain no alterations, omissions or additions, except those to comply with instructions issued by the Employer, or as necessary to correct errors made by the bidder, in which case all such corrections shall be initialed by the person or persons signing the bid.

20.4. All witnesses and sureties shall be persons of status and probity and their full names, occupations and addresses shall be printed below their signatures.

D. Submission of Bids

21. Sealing and Marking of Bids

21.1. The bidder shall submit the Bid in two parts, the Technical Bid and the Financial Bid. Each part of the Bid shall be sealed in separate envelopes and the two sealed envelopes shall be sealed in an outer envelope. The Bid envelopes shall be marked as follows: -

Outer Envelope:

Technical and Financial Bid for the work"_____"

Bid Reference Number:_____

Inner Envelope, Technical Bid:

Technical Bid for the work "_____"

Bid Reference Number:_____

The Inner envelope marked 'Technical Bid' shall contain the following:

i) Bid Security in a separate sealed envelope marked" Bid Security"

ii) Documents listed at (ii) to (iv) of Part-I of Sub Clause 13.1, in a separate sealed envelope.

Both these envelopes shall be kept in one envelope and marked "Technical Bid" and sealed.

Inner Envelope, Financial Bid:

Financial Bid for the work "_____ "

Bid Reference Number :_____

The sealed envelope marked 'Financial Bid' shall contain the following:

i. Documents listed under Part-II of Sub Clause 13.1.

The inner envelopes marked as 'Technical Bid' and Financial Bid' shall be enclosed in an outer envelope and sealed.

21.2. The inner and outer envelopes shall.

a) be addressed to the Employer at the following address: **Office of the Executive Engineer, NH-48 Project Implementation Unit (World Bank), ShiradiGhat Tunnel Construction Division, Sakaleshpur-573134.**

bear the following identification:

Bid for_____

Bid Reference Number: MORTH/_____

TO BE OPENED++

ONLY IN PRESENCE OF THE EVALUATION COMMITTEE

b) indicate the name and address of the bidder.

21.3. If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the bid.

22. Deadline for Submission of Bids

22.1. Bids must be received by the Employer at the address specified above not later than the time and date specified in the IFB.

22.2. The Employer may, at his discretion, extend the deadline for submission of bids by Issuing an amendment in accordance with Clause 11, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

23. Late Bids

23.1. Any bid received by the Employer after the deadline for submission of bids prescribed in Clause 22 will be returned unopened to the bidder.

24. Modification and Withdrawal of Bids

24.1. The bidder may modify or withdraw his bid after bid submission, provided that written notice of the modification or withdrawal is received by the Employer prior to the deadline for submission of bids. Any MODIFICATIONS in respect of TECHNICAL BID and FINANCIAL BID shall be submitted in separate sealed envelope duly marked so.

24.2. The bidder's modification or withdrawal notice shall be prepared, sealed, marked and delivered in accordance with the provisions of Clause 21, with the outer and inner envelopes additionally marked "MODIFICATIONS" or 'WITHDRAWAL" as appropriate.

24.3. No bid shall be modified by the bidder after the deadline for submission of bids.

24.4. Withdrawal of a bid during the interval between the deadline for submission of bids and the expiration of the period of bid validity specified in Clause 16 may result in the forfeiture of the Bid Security pursuant to Clause 17.

E. Bid Opening and Evaluation

25. Opening of Technical Bids

25.1. The Employer will open the outer envelope of all the bids received for the package (except those received late) containing the sealed technical bid and the sealed financial bid and announce the names of (i) bidders, (ii) bidders who have submitted modification of technical/financial bids, and (iii) bidders who have given notice for withdrawal of their bids in the presence of bidders or their representatives who choose to attend on the date and time mentioned in the IFB. In the event of specified date of bid opening being declared as a holiday for the Employer, the Technical Bids will be opened at the appointed time and location on the next working day

25.2. Bids for which acceptable notice of withdrawal has been submitted pursuant to Clause 24 shall not be opened and shall be returned.

25.3. Envelopes marked Technical Bid shall then be opened. Bidder's names, 'Modification of Technical Bid', the presence/or absence of Bid Security, the amount and validity of Bid Security furnished with each bid and such other details, as the Employer may consider appropriate will be announced by the Employer at the opening.

25.4. The bidders or their representatives who are present shall sign attendance sheet evidencing their attendance.

25.5. The sealed envelope containing the Financial Bid shall not be opened at this stage.

25.6. The Employer shall prepare besides the record of bid opening, minutes of the Bid opening, including the information disclosed to those present in accordance with Sub Clause 25.3 hereof.

26. Examination of Technical Bids and Determination of Responsiveness of Technical Bid

26.1. Prior to evaluation of Technical Bids, the Employer will determine whether the bid is accompanied by the required Bid Security.

26.2. If the Bid Security furnished does not conform to the amount and validity period as specified in the Invitation for Bid and has not been furnished in the form specified in Clause 17, the bid shall be rejected by the Employer as non - responsive as per Clause 17 and the Technical Bid and the sealed Financial Bid will be returned to the bidder.

26.3. Subject to confirmation of the Bid Security by the issuing bank, the Technical Bid accompanied with valid Bid Security will be taken up for further evaluation. In case, the Bank does not confirm the Bid I Security, the bid shall be rejected as non-responsive and no further evaluation carried out.

26.4. The Technical Bid will further be examined to determine whether the bid has been properly signed, meets the eligibility and qualification criteria, has the required available bid capacity, is accompanied by the requisite certificates, undertaking and other relevant information specified in the bid documents and is sub-

stantially responsive to the requirement of the bidding documents and provides any clarification for ascertaining the correctness of the information/details that the Employer may require pursuant to Clause 30.

26.5. If the Technical Bid is not substantially responsive, it will be rejected by the Employer and will not subsequently be made responsive by correction or modification or withdrawal of the non-conforming deviation or reservation.

26.6. The Employer shall inform, by fax, the bidders, whose Technical Bid is found to be responsive, the date, time and place of opening of Financial Bid. In the event of the specified date being declared a holiday for the Employer, the Financial Bid will be opened at the appointed time and location on the next working day.

26.7. The Financial Bid of those bidders whose Technical Bid is determined to be non- responsive or not substantially responsive pursuant to this Clause 26 will be returned unopened to the bidders.

27. Opening of Financial Bids

27.1. The Financial bids shall be opened package-wise in the serial order listed in the IFB for evaluation and award.

27.2. Financial Bids of the bidders whose bid capacity has already been exhausted on award of package(s) prior to the package under consideration shall not be opened and returned unopened to the bidder.

27.3. The Employer will open the envelope marked 'Financial Bid' (including 'Modification pursuant to Clause 24) of those bidders whose Technical Bid has been determined to be substantially responsive in accordance with Clause 26, and who have the required available bid capacity, in presence of the bidders or their representatives who choose to attend on the date intimated to such bidders. In the event of specified date of Financial Bid opening being declared a holiday for Employer, the 'Financial Bids' shall be opened at the appointed time and location on the next working day.

27.4. Financial Bids of the bidders whose bid capacity has already been exhausted on account of award of packages prior to this proposal will not be opened *for* further evaluation and will be returned to the bidders.

27.5. The names of the bidders whose Technical Bid is found to be substantially responsive, the bid prices, the total amount of each bid, any discount, 'modifications of Financial Bids' and such other details, as the Employer may consider appropriate will be announced by the Employer at the opening of the Financial Bid. Any bid price, which is not read out and recorded at the bid opening will not be taken into account in Bid Evaluation.

27.6. The bidders or their representatives who are present shall sign attendance sheet evidencing their attendance.

27.7. The Employer shall prepare besides the record of bid opening, minutes of the Financial Bid opening including the information disclosed to those in accordance with Sub-Clause 27.4.

28. Examination of Financial Bids and Determination of Responsiveness of Financial

Bid

28.1. The Employer will determine responsiveness of each Financial Bid with respect to Priced Bill of Quantities, Technical Specifications, Drawings and other relevant requirement of biding documents.

28.2. A substantially responsive Financial Bid is one which conforms to all the terms, conditions and specifications of the bidding documents, without material deviation or reservation. A material deviation or reservation is one (i) which affects in any substantial way the scope, quality or performance of the Works; (ii) which limits in any substantial way, inconsistent with the bidding documents, the Employer's rights or the bidder's obligations under the Contract; or (iii) whose rectification would affect unfairly the competitive position of other bidders presenting substantially responsive financial bids.

28.3. If the Financial Bid is not substantially responsive, it will be rejected by the Employer and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.

29. Correction of Errors

29.1. Financial Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Arithmetic errors will be rectified on the following basis:-

i) where there is a discrepancy between the amount in figures and in words for any rate in the unit rate column, the amount in words will govern and

ii) where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern and the line item total will be corrected.

iii) if there is a discrepancy between the total bid amount and the sum of total costs per item, the sum of the total costs per item shall prevail and the total bid amount will be corrected.

29.2. The amount stated in the Form of Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and shall be considered as binding upon the bidder. If the bidder does not accept the corrected amount of bid, his bid will be rejected, and his Bid Security may be forfeited in accordance with Clause 17.

30. Evaluation and Comparison of Financial Bids

30.1. The Employer will evaluate and compare only those Financial Bids which are determined to be substantially responsive in accordance with Clause 28 and qualified for award of Contract in accordance with Clause 5.

30.2. In evaluating the Financial Bids, the Employer will determine for each Financial Bid the evaluated Bid Price by adjusting the Bid Price as follows: -

a) making any correction for errors pursuant to Clause 29;

b) making appropriate adjustments to reflect any price modifications offered in accordance with Clause 24. "

30.3. The estimated effect of the price adjustment provision under Clause 70 of the Conditions of Particular Application applied during the period of implementation of the Contract, shall not be taken Into account in Bid evaluation.

30.4. If the Bid of the successful Bidder IS seriously unbalanced in relation to the Employer's estimate of the cost of the items of the Works to be performed under the Contract, the Employer may require the bidder to produce detailed price analysis for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed After evaluation of the price analysis, the Employer may require that the amount of the performance security set forth in Clause 37 be increased up to an additional 5 (five) per cent at the expense of the successful bidder to protect the Employer against financial loss in the event of default of the successful bidder under the Contract.

30.5. A bid, which contains several items in the Bill of Quantities which are unrealistically priced low and which could not be substantiated satisfactorily by the bidder, may be rejected as non-responsive.

31. Clarification of Bids

31.1. To assist in the examination, evaluation and comparison of bids, the Employer may, at his discretion, ask any bidder for authentication the correctness of the information/details furnished by him in his bid. Such request by the Employer and the response by bidder shall be in writing or by cable/fax, but no change in the price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of arithmetical errors discovered by the Employer in the evaluation of the bids in accordance with Clause 29.

31.2. Subject to Sub Clause 31.1, no bidders shall contact the Employer on any matter relating to his bid from the time of bid opening to the time contract is awarded.

31.3. Any effort by the bidder to influence the Employer in the Employer's bid evaluation, bid comparison or contract award decisions may result in the rejection of his bid.

32. Process to be Confidential

32.1. Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process until the award to the successful bidder has been announced. Any effort by a bidder to influence the Employer's processing of bids or award decisions may result in the rejection of his bid.

F. Award of Contract

33. Award

33.1. Subject to Clause 34, the Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents and who has offered the lowest Evaluated Bid Price pursuant to Clause 30, provided that. such bidder has been determined to be (i) eligible in accordance with the provisions of Clause 3; and (ii) qualified in accordance with the provisions of Clause 5.

34. Employer's Right to Accept any Bid and Reject any or all Bids

34.1. Notwithstanding Clause 33, the Employer reserves the right to accept or reject any bid and to annul the bidding process and reject all bids, at any time prior to award of Contract, without thereby incurring any liability to the affected bidder or bidders or any obligation to Inform the affected bidder or bidders of the grounds for the Employer's action.

35. Notification of Award

35.1. Prior to expiration of the period of bid validity prescribed by the Employer, the Employer will notify the successful bidder by cable/fax and confirmed by registered letter that his bid has been accepted. This letter (hereinafter and in the Conditions of Contract called "the Letter of Acceptance") shall name the sum which the Employer will pay the Contractor in consideration of the execution, completion and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Conditions of Contract termed "the Contract Price").

35.2. The notification of award will constitute the formation of the Contract.

36. Signing of Agreement

36.1. At the same time that the Employer notifies the successful bidder that his bid has been accepted, the Employer will direct him to submit the Performance Security and attend the Employer's office on a date determined by the Employer for signing the Form of Agreement.

36.2. Within 28 (twenty eight) days of the date of signing the Form of Agreement, the successful bidder shall, if required, have the same engrossed, have the correct amount of stamp duty adjudicated by the Inspector General of Registrations, New Delhi and return the same duly signed and executed on behalf of the successful bidder to the Employer.

36.3. In case of Joint Venture, all partners of the Joint Venture shall sign the Form of Agreement.

37. Performance Security

37.1. Within 28 (twenty eight) days of the date of receipt of the Letter of Acceptance, the successful bidder shall deliver to the Employer, a Performance Security in the form of a Bank Guarantee given in Section VII for an amount equivalent to 10% (ten percent) of the Contract Price plus additional security for unbalanced bids in accordance with Sub Clause 30.4 and relevant Conditions of Contract.

37.2. The Performance Security to be provided by the successful bidder in the

form of a bank guarantee as per format given in Volume 3 Section V", shall be issued from any nationalized Indian/IDBI/ICICI/Foreign bank with counter guarantee from any nationalized Indian Bank/any RBI approved scheduled commercial bank having net worth of more than Rs.500 Crore of Indian Operation and acceptable to Employer.

37.3. In case of Joint Venture (JV), the Bank Guarantee towards Performance Security shall be provided by all partners in proportion to their participation in the project as defined in the JV Agreement. Along with the proof issued by the said bank in this regard. The local partner(s) alone shall NOT be allowed to deposit the Bank Guarantee of foreign partner(s) of the Joint Venture.

37.4. Failure of the successful bidder to comply with the requirements of Clause 36 and 37 shall constitute sufficient grounds for cancellation of the ~ward and forfeiture of the Bid Security including restriction on future participation in Employer's projects for a period as decided by the Employer.

38. Corrupt or Fraudulent Practices

38.1. The Employer will reject a proposal for award if he determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question. The Employer will declare the firm ineligible, either indefinitely or for a stated period of time, to be awarded a contract by Ministry of Road, Transport & Highways if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for the contract, or during execution.

i) "corrupt practice" means behavior on the pan of officials in the public or private sectors by which they improperly and unlawfully enrich themselves and/or those close to them, or induce others to do so, by misusing the position in which they are placed, and it includes the offering, giving, receiving, or soliciting of anything of value to influence the action of any such official in the procurement process or in contract execution; and

ii) "fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Borrower, and includes collusive practice among bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels; and to deprive the Borrower of the benefits of free and open competition.

38.2. Furthermore, bidders shall be aware of the provision stated in Sub Clause 2.2 and Sub Clause 63.5 of the "Conditions of Contract, Pan-II: Conditions of Particular Application".

Section V

A: FORM OF BID

(Clause 13 of Section I)

(The Appendix forms part of the Bid. Bidders are required to fill up all the blanks in the form of Bid)

Name of the contract:

To

Office of the Executive Engineer,
NH-48 Project Implementation Unit (World Bank),
ShiradiGhat Tunnel Construction Division,
Sakaleshpur- 573134

Dear Sir,

1. Having examined the Conditions of Contract, Specifications, Bill of Quantities, Drawings and Addenda No. _____ for the execution of the above named works, we, the undersigned, offer to execute and complete such works and remedy any defects therein in conformity with the Conditions of Contract, Specifications, Bill of Quantities, Drawings and Addenda for the sum of Rs. _____(Rupees _____ _____).
2. We acknowledge that the Appendix to Bid forms part of our Bid.
3. We undertake, if our Bid is accepted, to commence the Works on Site within the period stated in the Appendix to Bid hereto after receipt of an order of the Engineer's notice to commence, and to complete and deliver the sections and the whole of the Works comprised in the Contract within the period stated in the Appendix to Bid hereto.
4. If our Bid is accepted, we will furnish Performance Security (ies) in the form of Bank Guarantee(s) to be jointly and severally bound on us in accordance with the Conditions of Contract.
5. We agree to abide by this Bid for the period of one hundred and twenty (120) days after the date of bid opening, and it shall remain binding upon us and may be accepted at any time before the expiry of that period.
6. Unless and until a formal Agreement is prepared and executed, this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.

7. We understand that you are not bound to accept the lowest or any Bid you may receive.

8. All the partners of our Joint Venture are legally and severally bound by this Bid[1].

Dated this _____day of _____ 2016

Signature_____

in the capacity of _____duly authorized [2] to sign Bid for and on behalf of _____

Address (in block capitals)

_____

_____

_____

Name of Witness _____

Occupation of the Witness _____

Address of Witness

_____

_____

_____

Signature of Witness _____

[1] To be deleted of the bidder is not a Joint Venture

[2] Certified copy of Power of Attorney/Authorization for signature shall be furnished by the Contractor in accordance with Clause 20 of Instruction to Bidders (Section I)

B: APPENDIX TO BID

Sl. No.	Items	Conditions of Contract Clause/Sub Clause	Particular Conditions for this Contract
1.	Amount of Performance Security	10.1	10% of Contract price.
2.	Addresses	11.2	1. The Employer is: Chairman, Ministry of Road, Transport & Highways Address: G 5&6, Sec. 10, Dwarka, New Delhi – 110 075 Name of authorized representative: (will be intimated later) 2. The Engineer is – (will be intimated later)
3.	Language ability of Contractor's Representative	15.2	English
4.	Minimum amount of third party insurance	23.2	Rupees Four million per occurrence, with number of occurrence unlimited.
5.	Time for commencement of works	41.1	30 days
6.	Time of completion	43.1	To be mentioned by Concerned Executive Engineer
7.	Amount of liquidated damages	47.1	1/2000 of contract price per day delay
8.	Limit of liquidated damages	47.1	10% of contract price
9.	Defects Liability Period	49.1	365 days
10.	Limit of Retention Money	60.4	5% of contract price
11.	Mobilization advance	60.6(a)	(i) Payment of interest bearing mobilization advance up to 5% of the contract price at commencement of work. (ii) Payment of additional interest bearing advance up to 5% of the contract price after the contractor has achieved a financial progress of 10% of the contract price. (iii) Rate of interest shall be 10% per annum.
12.	Equipment advance	60.6 (b)	(i) Payment of interest bearing equipment advance up to 5% of the contract price against the new equipment purchased by the contractor on or after the date of issue of letter of acceptance, under its ownership, subject to production of proof of payment. (ii) No equipment advance shall be admissible on any other equipment where no purchase of

			equipment is involved (i.e. equipments already owned by the contractor) or equipments purchased under hire purchase scheme/financing arrangement or on hired equipments, etc. (iii) Rate of Interest shall be 10% per annum.
13.	(a) Mobilization advance	60.6(d)	Twelve months from commencement of work.
	(b) Equipment advance	60.6(d)	Eighteen months from commencement of work.
14.	Rate of interest upon unpaid sums	60.12(b)	10% per annum
15.	Payment after termination	63.3	20%
16.	Number of members of Dispute Review Board	67.1	Three
17.	Member of Dispute Review Board (if not agreed) to be appointed by	67.1	Director General (Road Development and Special Secretary), Ministry of Road Transport & Highways.
18.	Number of Arbitrators	67.3	Three
19.	Place of Arbitrators	67.3	New Delhi
20.	Members of the Arbitral Tribunal (if not agreed) to be appointed by	67.3	Director General (Road Development and Special Secretary), Ministry of Road Transport & Highways.
21.	Language of Arbitration	67.4	English
22.	Notice to Employer and Engineer	68.2	The Engineer is-(will be intimated later) Name of Authorized Representative: (will be intimated later)
23.	Price Adjustment	70.3 (i)	Adjustment of Labour Component: State/place for the average consumer price index to be indicated by concerned Executive Engineer.
		70.3(v)	Adjustment of Bitumen Component: Nearest refinery for supply of bitumen to defined by concerned Executive Engineer.
		70.3(vi)	Adjustment for Fuel and Lubricates: Nearest Petrol Pump for supply of HSD.

SECTION - VII

FORM OF BID SECURITY (BANK GUARANTEE)

WHEREAS, _____*(Name of Bidder)* - (hereinafter called "the bidder") has submitted his bid dated _____ (date) for the construction of [name of contract] (hereinafter called "the Bid").

KNOW ALL MEN by these presents that We, _____(Name of Bank) of _____ (Name of Country) having our registered office at _____ (hereinafter called "the Bank") are bound unto _____(Name of Employer) (hereinafter called "the Employer") in the sum of _____ _____)[1]

for which payment will and truly to be made to the said Employer the Bank binds himself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this _____day of _____ 2016.

THE CONDITIONS of this obligation are:

(1) If the Bidder withdraws his Bid during the period of bid validity specified in the Form of Bid; or

(2) If the Bidder does not accept the correction of arithmetical errors of his Bid Price in accordance with the Instructions to Bidder; or ,-

(3) If the Bidder having been notified of the acceptance of his Bid by the Employer during the period of bid validity,

   a. fails or refuses to execute the Form of Agreement in accordance with the Instructions to Bidders, if required; or

   b. fails or refuses to furnish the Performance Security, in accordance with the Instructions to Bidders,

We undertake to pay the Employer up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or any of the conditions, specifying the occurred condition or conditions.

[1] Amount of Bid Security in figures and works in accordance with Sub Clause 17.1 of Instructions to bidders (Section I Volume I).

This Guarantee will remain in force up to and including the date 148 (one hundred and forty eight) days after the deadline for submission of bids as such deadline is stated in the Instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date.

Notwithstanding anything contained herein before, our liability under this guarantee is restricted to Rs. _____(Rs._____) and the guarantee shall remain valid till . Unless a claim or a demand in writing is made upon us on or before all our liability under this guarantee shall cease.

DATE _____

SIGNATURE OF THE BANK SEAL OF THE BANK _____

SIGNATURE OF THE WITNESS _____

Name and Address of the Witness _____

SECTION - VII

FORM OF PERFORMANCE SECURITY

(BANK GUARANTEE)

(Clause 37 of Section I Volume 1)

Note: Bidders are not required to complete this form at the time of Bid submission.

To

Office of the Executive Engineer,
NH-48 Project Implementation Unit (World Bank),
ShiradiGhat Tunnel Construction Division,
Sakaleshapur - 573134

WHEREAS _____ [Name and address of Contractor [1]] (hereinafter called "the contractor") has undertaken, in pursuance of Contract No. _____dated _____to execute_____ [Name of contract and brief description of works) (hereinafter called the "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;

NOW THEREOF we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor up to a total of _____ [amount of Guarantee [2]] _____in words], such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____amount of Guarantee] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

---

[1] Give names of all partners if the Contractor is a Joint Venture.

[2] An amount is to be inserted by the guarantor, representing the percentage of the Contract Price specified in the Contract an denominated in Indian Rupped.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

The liability of the Bank under this Guarantee shall not be affected by any change in the constitution of the contractor or of the Bank.

Notwithstanding anything contained herein before, our liability under this guarantee is restricted to Rs. _____(Rs._____) and the guarantee shall remain valid till _____Unless a claim or a demand in writing is made upon us on or before _____all our liability under this guarantee shall cease.

This guarantee shall be valid until 365 days after the date of issue of the Defects liability Certificate.

Signature and Seal of the Guarantor _____In presence of

Name and Designation_____ 1._____

(Name, Signature & Occupation)

Name of the Bank_____

Address_____2_____

(Name & Occupation)

Date_____

SECTION - VII

FORM OF ADVANCE PAYMENT SECURITY

(BANK GUARANTEE)

(Sub Clause 60.6 of Section III Volume 1)

To

Office of the Executive Engineer,
NH-48 Project Implementation Unit (World Bank)
ShiradiGhat Tunnel Construction Division,
Sakaleshapur - 573134

_____[Name of Contract]

Sir,

In accordance with the provisions of the Conditions of Particular Application - Part-II, Sub Clause 60.6 ("Mobilization Advance") for the above Contract_____ _____ _[Name and Address of Contractor] (hereinafter called "the Contractor") shall deposit with the Ministry of Road, Transport & Highways, A Bank Guarantee to guarantee his proper and faithful performance under the said Clause of the Contract in an amount of _____[amount of guarantee]_____ [in words].

We, the _____[bank or financial institution], as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligatory and not as Surety merely, the payment to the Ministry of Road, Transport & Highways on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, in the amount not exceeding _____ [amount of Guarantee [1]] [in words].

We further agree that no change or addition to or other modification of the terms of the Contract or of Works to be performed there under or of any of the Contract documents which may be made between the Ministry of Road, Transport & Highways and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until the Ministry of Road, Transport & Highways receives full repayment of the same amount from the Contractor.

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[1] an amount is to be inserted by the bank or financial institution representating the amount of the Advance Payment, and denominated in the currency (ies) of the Advance payment as specified in the Contract.

Yours truly, _____ In presence of Signature _____

Signature and seal Name_____ Name _____

Name and Designation (Printed) _____ Address

_____

Name of Bank/Financial Institution _____ _____

Address_____

Date _____ Date_____

SECTION - VII

FORM OF AGREEMENT

THIS AGREEMENT made the _____ day of _____, 200__ between Office of the Executive Engineer, NH-48 Project Implementation Unit (World Bank), ShiradiGhat Tunnel Construction Division, Sakaleshapur - 573134 (hereinafter called "the Employer") of the one part and M/s_____ _____(hereinafter called "the Contractor") of the other part.

WHEREAS the Employer is desirous that certain works should be executed by the Contractor, viz._____ _____and has accepted the bid by the contractor for the execution and completion of such works and the remedying of any defects therein at a contract price of Rs. _____(Rupees_____ _____).

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz.:
    (a) the Letter of Acceptance;
    (b) the said Bid and Appendix to Bid;
    (c) the Conditions of Particular Application (Part II);
    (d) the General Conditions of Contract (Part I);
    (e) the Technical Specifications; (f) the Drawings;
    (f) the Priced Bill of Quantities; and
    (g) other documents forming part of the contract.
3. In consideration of the payments to be made by the Employer to the Contractor as I hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed the day and year first before written.

Signed, sealed, and delivered by the said Employer and the Contractor in the presence of:

WITNESSES:

On behalf of **Ministry of Road, Transport & Highways**	On behalf of M/s
1. 2.	1. 2.

Binding Signature of the Employer

Binding Signature of the Contractor

SECTION - VIII: SCHEDULE A

HANDING OVER OF SITE

Time schedule	***Section to be handed over***
Within the time specified for commencement of work in the appendix to bid in accordance with Sub Clause 41.1	
After 6 months of commencement	
After 12 months of commencement	

Note: The details of site* to *be handed over are* to *be given by the concerned Executive Engineer.

Section- VIII : Schedule B

DETAILS OF KEY EQUIPMENT AND MACHINERY

MINIMUM PLANT AND EQUIPMENT OWNED/LEASED BY THE CONTRACTOR

Whereas it is entirely the responsibility of the Contractor to deploy sufficient construction plant and equipment to ensure compliance with this obligates under the Contract. This list constitutes the Employer's estimate of the minimum essential basic holding of construction plant and equipment: -

Table 1

S. No.	Type of Equipment	Max. Age (in yrs.)	Capacity	No. of Plant and Equipment					
				Package	Package	Package			
1	Excavators	5	1.25 mm						
2	Motor Grader	5	Engine output above 150 KW						
3	Stone crusher cum screening unit (cone/impact type)	5	175-200 T/hour						
4	WMM Mixing Plant	5	200 T/hour						
5	Hot Mix plant (Batch type) with electronic controls and vibratory screens	5	Minimum 120 TPH						
6	Paver finisher with electronic sensor and telescopic tractor frame	5	Capable of paving upto 10m width and upto 250mm lift of Granular/bituminous materials						
7	Slip form paver with electronic sensor device and telescopic tractor frame	5	To accommodate a range of widening from 5.5m to 9.0 m on tracks						
8	Concrete batching and mixing plant with facilities of – - weighing multi-compartment computerized integrated system	5	40 cum/hour						
9	Truck mounted concrete boom pump/transit mixer and concrete pumps	5	Maximum vertical reach not less than 25m pumping 30 cum/hour						
10	Pneumatic Tyred Roiler	5	Operating weight not less than 8 tonne; minimum 8 tyred with self inflating system						

11.	Vibratory Roller	5	Minimum 10 tonne operating weight						
12.	Tandem Vibratory Roller	5	Minimum 8 tonne						
13.	Tandem Vibratory Roller for compaction of edges (self propelling)	5	Minimum operating weight 1 tonne						
14	Cranes	5	Minimum 80 tonne						
15	Pilling Equipment	5	-						

T=Tonnes T/Hr.= Tonnes per hour

- ~~Any total system for crushing stone aggregate and feeding aggregate fractions in their required proportions into the plant to achieve the desired mix, if such is utilized by the contractor, must be capable of meeting all the requirements of the specifications under stringent quality control.~~
- ~~Equipment required for construction of foundation and substructure of major bridges and any other equipment required for completion of the project to be indicated by concerned Executive Engineer.~~

Section – VIII: Schedule C

Key Personnel

Essential key personnel required for the project by bidders

S. No.	Key Personnel	Qualifying	Experience
1.	Project Manager	B.E. Civil	15 Years (min. 5 years as Project Manager)
	Name of Prime Candidate		
	Name of Alternate Candidate		
2.	Highway Engineer	B.E. Civil	10 Years (5 years on Road Construction)
	Name of Prime Candidate		
	Name of Alternate Candidate		
3.	Bridge Engineer	B.E. Civil	10 Years (5 Years in Bridge Construction)
	Name of Prime Candidate		
	Name of Alternate Candidate		
4.	Material Engineer	B.E. Civil	10 Years
	Name of Prime Candidate		
	Name of Alternate Candidate		

SECTION - IX

Sample Form for updating - qualification information

1. General Information.
2. Evidence of access to a revolving line of credit specific to the proposal (minimum 10%).
3. Undertaking for making available the required key equipment (minimum requirement as per Section-VIII, Schedule B).
4. Undertaking for making available the required key personnel at site organization for the administration and execution of the contract (minimum requirement as per Section-VIII, Schedule C).
5. Annual Turnover duly audited.
6. Current Contract Commitments/works in progress.
7. Financial Data
8. Additional information regarding litigation, debarment, arbitration etc.
9. Joint Venture Agreement in case the bidder is Joint Venture.
10. Work Programme
11. Affidavit.

Section IX : Form I

General Information

All individual firms and each partner of a Joint Venture must complete the information in this form. Nationality information shall be provided for all owner(s) applicant (s) that are partnership or individually owned firms.

1.	Name of Firm	
2.	Head Office Address …….. ……..	
3.	Local Office Address (if any) …….. ……..	
4.	Telephone	Contact
5.	Facsimile	E-mail
6.	Place of incorporation/registration	Year of incorporation/registration
7.	Main lines of business 1. ……... ……... 2. ……... ……... 3. ……... ……... 4. ……... ……...	 Since: ……. Since: ……. Since: ……. Since: …….

SECTION - IX : FORM II

BANK'S LETTER OF GUARANTEE CONFIRMING THE BANK'S UNDERTAKING FOR OPENING A REVOLVING LINE OF CREDIT IN FAVOUR OF THE CONTRACTOR

To

Office of the Executive Engineer,
NH-48 Project Implementation Unit (World Bank),
ShiradiGhat Tunnel Construction Division
Sakaleshapur - 573134

Sub.: Letter of Guarantee confirming Bank's undertaking to opening a revolving line of credit in favour of M/s. _____ (Name and Address of the Bidder) _____ in the event of the award to them of Contract Package No. [1] _____.

Dear Sir,

I/WE, the authorised representative(s) of_____ _____(Name and Address of the Bank) _____hereby agree and undertake for and on behalf of the bank that if M/s_____ (Name and Address of the Bidder)_____ are awarded the Contract No(s) _____, they will be provided by us with a revolving line of credit for an amount not less than Rs. * _____ _____ for the purpose of the execution of the above mentioned contract(s). This revolving line of credit will be maintained until the whole of the completed works are taken over by the Ministry of Road, Transport & Highways. The above credit facility proposed to be extended to the bidder shall be subject to due diligence and approvals from our sanctioning authorities.

IN WITNESS WHEREOF the authorised representative of the bank has hereunto signed and sealed this letter of Guarantee.

Signature _____ *Signature* _____

Date _____ _____ *Date* _____

Name and Address _____ *Name and Designation*_____

_____ _____

Witness *Seal Guarantor*

_____

[1] Insert the name of the contract package or packages for which this guarantee will be applicable

* Minimum amount 10% of value of works(s)/package(s)

Section – IX: Form III

Equipment Proposed for the Project

Undertaking to be submitted for making available the required key personnel as per Section-VIII, Schedule B

Section – IX: Form IV

Undertaking to be submitted for making available the required key personnel as per Section-VIII, Schedule C.

Section – IX: Form V

Annual Turnover duly audited (Civil Works Construction only)

Name of Bidder or partner of a Joint Venture

All individual firms and partners of a Joint Venture must complete the information in this form. The information supplied shall be the annual turnover of the Bidder (each member of a Joint Venture) in term of the amount billed to clients for each year for work in progress or completed.

Use a separate sheet for ach partner of a Joint Venture

Annual turnover (civil works construction only) for the last five years	
Year	**Turnover (in Rs.)**

Note: Exchange rate for conversion shall be specified and shall be as prevailing at the end of the period reported.

Section – IX: Form VI

Summary of Current Contract Commitments/Works in Progress

Name of Bidder or Partner of a Joint Venture

Bidders and each partner of a Joint Venture shall provide information on their current commitments on all civil contracts that have been awarded or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified full completion certificate has yet to be issued.

Name of Employer	Name of the contract location and nature of their work*	Name of consulting Engineer of agency responsible for supervision	Contract amount in Indian Rupees and date of contract	Percentage of participation of company in the project	Value of work completed and certified in Indian Rupees	Value of outstanding work (in Indian rupees)	Actual date of start	Estimated completion date
1	2	3	4	5	6	7	8	9

* If the work has been carried out under Joint Venture, indicate the status of the Joint Venture

Note: Exchange rate for conversion shall be specified and shall be as prevailing at the end of the period reported

Section-IX: Form VII

Financial Data

Name of Bidder or Partner of a Joint Venture

Bidders includes each partner of a Joint Venture shall provide financial information to demonstrate that they continue to meet the requirements for pre-qualification. Each Bidder or partner of a Joint Venture must fill in this form. If necessary, use separate sheets to provide complete information. A copy of the audited balance sheet for each of the last five years shall be attached.

Summarize actual assets and liabilities in Indian Rupees for the previous five years.

Financial information in Indian Rupees		Previous Five Years				
1.	Total Assets					
2.	Current Assets					
3.	Total liabilities					
4.	Current Liabilities					
5.	Profit Before Taxes					
6.	Profit After Taxes					

Note: Exchange rate for conversion shall be specified and shall be as prevailing at the end of the period reported

SECTION - IX : FORM VIII

Additional Information

Name of Bidder or partner of a Joint Venture

1. Describe Company's history of litigation or arbitration on contracts completed in the last five years or currently under execution. Indicate for each case the year, name of employer, cause of litigation, matter in dispute, disputed amount, and whether the award was for or against the company.
2. Indicate if the bidder or any of its constituent partners have been debarred! expelled by any Agency during the last five years. Details of each of the cases with reasons shall be furnished.
3. Indicate if the bidder or any of its constituent partners have abandoned any contract during the last five years. Details of each of the cases with reasons shall be furnished.
4. Indicate if the bidder or any of its constituent partners have been declared bankrupt during the last five years. Details including the present status shall be furnished.

Section-IX: Form IX

Joint Venture Agreement

A copy of Joint Venture agreement to be submitted taking into consideration all the requirements as mentioned under Clause 5.3 of I.T.B.

Section-IX: Form X

Work Programme

Bidders shall submit work programme taking into consideration the work methods, backed with equipment planning and cash flow requirements etc. in sufficient details for assessing the bidder's capability to complete the work in accordance with the specification and time for completion.

Section III

Conditions of Particular Application – Part III

Ministry of Road Transport and Highways (MoRTH)

SECTION III

CONDITIONS OF PARTICULAR APPLICATION : PART II

The Clause numbers mentioned hereinafter refer to the corresponding Clauses of the General Conditions of contract – Part I (Section II) to which a Condition of Particular Application relates:

Sub-Clause 1.1 **Definitions**	(a) (i) The 'Employer' is the Chairman, Ministry of Road, Transport & Highways or his successors in office and assigns. (a) (iv) The 'Engineer' is the Supervision Consultant or any other competent person appointed by the Employer, and notified to the Contractor, to act in replacement of the Engineer. Add the following words at the end of sub-para (b) (v): The word "Tender" is synonymous with "Bid" and the words "Appendix to Tender" with "Appendix to Bid" and the words "Tender Documents" with "Bid Documents" or "Bidding Documents. Substitute the words "Sub-Clause 60.2 (a)" at the end of sub para (e) (ii) by the words "Sub-Clause 60.4". Substitute the words "Sub-Clause 60.8" at the end of sub para (e) (iv) by the words "Sub-Clause 60.11" :
Sub-Clause 2.1 **Engineer's Duties and Authority**	Delete from Sub-Clause 2.1(b) the last sentence "Provided further that any requisite approval shall be deemed to have been given by the employer for any such authority exercised by the Engineer" With reference to Sub-Clause 2.1 (b), the following provisions shall also apply: The Engineer shall obtain prior permission from and specific approval of the Employer before taking any of the following actions specified in Part I:

	consenting to the subcontracting of any part of the Works under Clause 4; certifying additional cost determined under Clause 12; ordering suspension of work under Clause 40. issuing the Notice to commence the work under Clause 41. determining an extension of time under Clause 44; issuing a variation under Clause 51 except if such variation would be within the limits as indicated below. <u>Variation in individual BOO Items</u>: The 'Engineer' is authorized to issue variation order upto 25% of the value of individual item or 1 % of contract value whichever is less. New items (Non-BOO items): Before issuing orders to execute new items of work (no n BOO items), 'Engineer' shall obtain technical approval from Employer. Subject to provision under (I) & (ii) above, the 'Engineer' is authorised to issue cumulative variations upto a limit of 10% of the original contract value (less negative variations/savings). The overall limit shall apply collectively on all BOO items as well as non-BOO items and shall include all the variations issued till that point of time including those approved otherwise than by the Engineer. The overall limit shall be exclusive of escalation. Any variation beyond above limits (individual items and overall variations) shall be approved by the Employer. fixing new rates or prices under Clause 52. notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibilities under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer, The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer".
Sub-Clause 4.1 **Sub-contracting**	In line 1, the words "the whole" shall be substituted by the word "more than 33% of the contract amount including where otherwise provided by the Contract" and in line 3, the words "prior consent" shall be substituted with the word "prior written permission".

	Add the following at the end of the words "servants or workmen" The Engineer should satisfy whether (a) the circumstances brought out warrant such sub-contracting; and (b) the Sub-contractors so proposed for the work possess the necessary experience, qualifications and equipment for the job proposed to be entrusted to them in proportion to the quantum of work to be sub-contracted.
Sub-Clause 5.1 **Language and Law**	(a) The Contract Documents shall be drawn up in English language and all correspondence, drawings and documents and any written matter relating to the contract shall be in English only. (b) This Contract shall be governed and construed in accordance with the law in force in India.
Sub-Clause 5.2 **Priority of contract Documents**	Delete the documents listed as (1) to (6) and substitute as below: The several documents forming the Contract are to be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies the same shall be explained and adjusted by the Engineer who shall thereupon issue to the Contractor instructions thereon and in such event, unless otherwise provided in the Contract, the priority of the documents forming the Contract shall be as follows: 1. the Contract Agreement; 2. the Letter of Acceptance; 3. the Tender; 4. the Conditions of Particular Application; 5. the General Conditions of Contract; 6. the Technical Specifications; 7. the Drawings; 8. the priced Bill of quantities 9. any other document forming part of the Contract.
Sub-Clause 6.6 **Drawings**	Add the following as Sub-Clause 6.6: Working Drawings for culverts based on the typical drawings provided in the Contract and design calculations and fabrication drawings for temporary works (such as form work, staging, centering, scaffolding, specialized construction, handling and launching facilities and the like), material list for structural fabrication as well as detailed drawings for anchorage and temporary support details for pre- stressing cables as well as bar bending and cutting schedules for reinforcement etc. shall be prepared by the Contractor at his own cost and forwarded in triplicate to the Engineer at least four weeks in advance of actual constructional requirements. The Engineer will scrutinize and return one copy of the same for the Contrac-

	tor's use with amendments, if any, noted in red ink within two weeks of submission. Such approval shall not relieve the Contractor of any of his responsibilities in connection with temporary works. The Contractor will supply four copies of the approved drawings for the Engineer's use. The cost of preparing all such items of work shall be deemed to have been included in the respective rates/prices quoted by the Contractor in the Bill of Quantities.
Sub-Clause 6.7 **As built Drawings**	Add the following as Sub-Clause 6.7: On the completion of works, the Contractor shall arrange to furnish to the Employer two (2) bound sets of all "As Built" drawings for every component of the Works at his own cost, all such copies being on Polyester film of quality to be approved by the Engineer or his Representative. The Taking-Over Certificate of the Works, as per the provisions of Clause 48 hereof, shall not be issued by the Engineer in the event of the Contractor's failure to furnish the aforesaid "As Built" drawings for the entire Works.
Sub-Clause 10.1 **Performance Security**	Substitute Sub-Clause 10.1 with the following: "The Contractor shall provide performance security for his proper performance of the Contract to the Employer within 28 days of the receipt of the Letter of Acceptance for the amount provided in Appendix to Bid. The performance security shall be in the form of a bank guarantee as per the given format and shall be issued from any national Indian/IDBI/ICICI or Foreign bank with counter guarantee fro many National Indian bank/any RBI approved scheduled commercial bank having net worth of more than Rs.500 crore of Indian operation and acceptable to the Employer. Without limitation to the provisions of the preceding paragraph, whenever the Engineer determines an addition to the Contract Price as a result of a change in cost and/or legislation or as a result of a variation amounting to more than 25 percent of the Contract Price, the Contractor, at the Engineer's written request, shall promptly increase the value of the performance security by an equal percentage. In case of Joint Venture (JV), the bank guarantee towards performance security shall be provided by all partners in proportion to their participation in the project as defined in the JV agreement, along with the proof issued by the said bank in this regard. The local partner(s} alone shall NOT be allowed to deposit the Bank Guarantee of foreign partner(s} of the Joint Venture.
Sub-Clause 10.2 **Validity of the Perfor-**	Substitute Sub-Clause 10.2 with the following: "The performance security shall be valid until a date 365 days after the expiry of the defects liability period. The performance security

mance Security	shall be returned to the Contractor within 28 days of expiry of validity period of performance security or final payment by the employer pursuant to Sub-Clause 60.12, whichever is earlier. The cost of complying with the requirements of this Clause shall be borne by the Contractor,"
Sub-Clause 10.3 **Claims under Performance Security**	Delete Sub Clause 10.3
Sub-Clause 11.2 **Access to Data**	Add the following as Sub-Clause 11.2: "Data made available by the Employer in accordance with Sub-Clause 11.1 shall be deemed to include data listed elsewhere in the Contract as open for inspection at the address stipulated in the Appendix to Bid.
Sub-Clause 14.1 **Program to be Submitted**	Substitute Sub-Clause 14.1 by the following: The Contractor shall within 28 (twenty eight) days of the date of receipt of the Letter of Acceptance, submit to the Engineer for his consent six copies of a programme, for the execution of the work. The programme shall conform and satisfy the requirement of Clause 114 of Technical Specifications. Unless otherwise agreed, the programme shall generally be based on the programme submitted with the Bid and shall include: (i) A detailed method statement defining the Contractor's methodology for construction backed with his proposals for construction equipment planning and deployment duly supported with broad output calculations and details of the quality control procedures proposed to be adopted, justifying his capability of achieving the completion of work in accordance with the stipulated period of completion. The method statement shall conform and satisfy the requirement of Clause 115 of Technical Specifications. (ii) A bar chart showing the quantities of principal work items to be performed each month together with the mechanical equipment, materials and labour which shall be deployed on such activities. The programme shall not be unbalanced and shall be based on the achievement outputs calculated and demonstrated in the method statement submitted vide sub-para (i) above. An 'S' curve illustrating anticipated cumulative turnover and the anticipated cumulative progress shall be superimposed upon the bar chart. (iii) A CPM/PERT analysis of all major activities from commencement of works to completion. (iv) A separate time based monthly programme indicating the Contractor's proposals for the purchase, long term lease, or hire of

	equipment throughout the duration of the Contract. (v) A quality assurance plan (QAP) covering all aspects of the work to be adopted for this work to ensure the desired quality. The procedure shall conform to and satisfy the requirement of Clause 105 of Technical Specifications. QAP shall be submitted to the Engineer for his consent. If the work programme submitted by the Contractor is deemed in any way incomplete or unacceptable by the Engineer/Employer, the Contractor shall be given 15 days to revise and resubmit it to the Engineer's satisfaction.
Sub-Clause 14.3 **Cash Flow Estimate to be Submitted**	"The time within which the detailed cash flow estimate shall be submitted shall be 28 days."
Sub-Clause 15.2 **Language Ability of contractor's Representative**	Add the following as Sub-Clause 15.2: "If the Contractor's authorized representative is not, in the opinion of the Engineer, fluent in the language specified in the Appendix to Bid, the Contractor shall have available on Site at all times a competent interpreter to ensure the proper transmission of instructions and information."
Sub-Clause 15.3 **Review Meetings and Contractor's Representative**	Add the following as Sub-Clause 15.3: "The Contractor shall ensure that his Project Manageror Senior Site Representative attends all the periodic review meetings notified by the Engineer/Employer /Employer's representative".
Sub-Clause 16.3 **Language Ability of Superintendence Staff**	Add the following as Sub-Clause 16.3: "A reasonable proportion of the Contractor's superintendence staff including his authorized representative shall have a working knowledge of English or the Contractor shall have available on Site at all times a sufficient number of competent interpreters to ensure the proper transmission of instructions and information."
Sub-Clause 16.4 **Employment of Local Personnel**	Add the following as Sub-Clause 16.4: " The Contractor is encouraged to employ staff and labour with appropriate qualifications and experience from sources within India."
Sub-Clause 17.2 **Notice to Engineer**	Add the following as Sub-Clause 17.2: "The Contractor shall give to the Engineer not less than 48 (forty eight) hours notice of his intention to set out or give levels for any part of the Works so that timely arrangement may be made for checking or issuing instructions. He shall indicate therein by which date the information, if any is required by him."

Sub-Clause 18.1 **Boreholes & Exploratory Excavations**	Substitute Sub-Clause 18.1 by the following: "If, at any time during the execution of the Works, the Engineer requires the Contractor to make boreholes or to carry out exploratory excavations in excess of the requirements specified elsewhere in the contract then such requirement shall be the subject of an instruction in accordance with Clause 51, unless an item or a provisional sum in respect of such work is included in the Bill of Quantities.
Sub-Clause 19.1 **Safety, Security and Protection of Environment**	Add the following as sub-paras (d), (e) and (f) to Sub-Clause 19.1. (d) Ensure that all lights provided by the Contractor shall be screened so as not to interfere with any signal light on the railways or with any traffic or signal lights of any local or other authority. (e) Ensure that during continuance of the contract, the Contractor and his Sub-contractors shall abide at all times by all existing enactments on environmental protection and rules made thereunder, regulations, notifications and bye-18Ws of the State or Central Government, or local authorities and any other law, bye-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority. He shall ensure that air emissions, surface discharges and effluents from the Site shall not exceed the values, if any, indicated in the Technical Specifications and shall in no case exceed the values prescribed by Applicable Law. Salient features of some of the major laws that are applicable are given below: The Water Prevention and Control of Pollution Act 1974 This provides for the prevention and control of water pollution and the maintaining and restoring of wholesomeness of water. Pollution means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms. The Air Prevention and Control of Pollution Act 1981 This provides for prevention, control and abatement of air pollution. 'Air Pollution' means the presence in the atmosphere of any 'air pollutant', which means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment. The Environment (Protection) Act, 1986. This provides for the pro-

	tection and improvement of environment and for matters connected therewith, and the prevention of hazards to human beings, other living creatures, plants and property. 'Environment' includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro- organism and property. The Public Liability Insurance Act 1991. This provides for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling hazardous substances and for matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under the Environment (Protection) Act 1986, and exceeding such quantity as may be specified by notification by the Central Government. (f) Take all reasonable steps to implement the environ mental mitigation measures provided for in the 'Environ mental Management Plan [Part 1 (b) of Contract Agreement] in accordance with objective, procedures, and other provisions set forth therein and shall not take any action which would prevent or interfere with such implementation. Further, he shall adhere to all environmental requirements of the contract.
Sub-Clause 20.4 **Employer's Risks.**	Amend Sub-Clause 20.4 to read as follows: The Employer's risks are (a) insofar as they directly affect the execution of the works in the country where the Permanent Works are to be executed: (i) war and hostilities (whether war be declared or not), invasion, act of foreign enemies; (ii) rebellion, revolution, insurrection, or military or usurped power, or civil war; (iii) ionizing radiations, or contamination by radioactivity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof; (iv) pressure waves caused by aircraft or other aerial devices traveling at sonic or supersonic speeds; (v) riot, commotion or disorder, unless solely restricted to the employees of the contractor or of his sub contractors and arising from the conduct of the works; (b) loss or damage due to the use or occupation by the Employer of any Section or part of the Permanent Works, except as may be provided for in the Contract.

	(c) loss or damage to the extent that it is due to the design of the Works, other than any part of the design provided by the Contractor or for which the Contractor is responsible; and (d) any operation of the forces of nature (insofar as it occurs on the Site) which an experienced contractor: (i) could not have reasonably foreseen, or (ii) could reasonably have foreseen, but against which he could not reasonably have taken at least one of the following measures: (A) prevent loss or damage to physical property from occurring by taking appropriate measures, or (B) insure against such loss or damage.
Sub-Clause 21.1 **Insurance of Works and Contractor's Equipment**	Add the following as sub para (d) to Sub-Clause 21.1: (d) The insurance shall be issued by an insurance company which has been determined by the Contractor to be acceptable to the Employer.
Sub-Clause 21.2 **Scope of Cover**	Amend sub para (a) of Sub-Clause 21.2 by substituting the words "from the start of work at the Site" by the words "from the first working day after the Commencement Date". Add the following as sub-para (c) to Sub-Clause 21.2 (c) It shall be the responsibility of the Contractor to notify the insurance company of any change in the nature and extent of the Works and to ensure the adequacy of the insurance coverage at all times during the period of the Contract.
Sub-Clause 21.4 **Exclusions**	Amend the text of Sub-Clause 21.4 to read as follows: There shall be no obligation for the insurances in Sub-Clause 21.1 to include loss or damage caused by the risks listed under Sub-Clause 20.4 sub-para (a) (i) to (iv),
Sub-Clause 21.5 **War Risk Insurance**	Add the following as Sub-Clause 21.5: If the Contractor receives instructions from the Employer to insure against War Risk, such insurance, if available, shall be effected, at the cost of the Employer, with an insurance company acceptable to the Employer and shall be in the joint names of the Contractor and the Employer.
Sub-Clause 25.1 **Evidence and Terms of Insurances**	Amend Sub-Clause 25.1 by inserting the words "as soon as practicable after the respective insurances have been taken out but in any case" before the words "prior to the start of work at the Site".
Sub-Clause 25.5	Add the following as Sub-Clause 25.5:

Source of Insurance	"The Contractor shall be entitled to place all insurance relating to the Contract (including, but not limited to, the insurance referred to in Clause 21, 23 and 24) with insurers from India, which have been determined to be acceptable to the Employer.
Sub-Clause 26.2 **Inspections and Audit by Employer**	Add the following as Sub-Clause 26.2: The Contractor shall permit Employer or its representative to inspect the Contractor's accounts and records relating to the performance of the Contract and to have them audited by auditors appointed by Employer.
Sub-Clause 29.1 **Interference with Traffic and Adjoining Properties**	In sub-para (b) of Sub-Clause 29.1 add the words "railway and any other right of way" after the words "private roads". Add the following as sub-paras (c), (d) and (e) after sub-para (b) of I Sub-Clause 29.1: (c) "If any equipment (floating or otherwise) belonging to or hired by the Contractor or any Sub-contractor or any person employed by the Contractor or by any Sub-contractor or any materials or things therein or therefrom sink from any cause whatsoever, it shall immediately be reported by the Contractor to the competent authorities and the Engineer or his Representative, and Contractor shall forthwith, at his cost raise and remove any such equipment, materials or things or otherwise deal with the same as the Engineer may direct. The fact that such sunken equipment, materials or things are insured or have been declared a total loss or do not represent any further value shall not absolve the Contractor from his obligations under this Clause to raise and remove the same. Until such sunken equipment or materials or things have been raised and removed, the Contractor shall set such buoys and display at night such lights and do all such things for the safety as may be required by the competent authorities or by the Engineers Representative. In the event of the Contractor not carrying out the obligations imposed on him by this Clause, the Employer may cause to set buoys and display at night, lights on such equipment and raise and remove the same without prejudice to the right of the Employer to hold the Contractor liable and all expenses and consequences thereon and incidental thereto shall be borne by the Contractor and shall be recoverable from him as a debt by the Employer or may be deducted by the Employer from any moneys due or which may become due to the Contractor." (d) "In case, any operation connected with traffic necessitated diversion, obstruction or closure of any road, railway or any other Right of Way, the approval of the Engineer or the Engineer's Representative and the concerned authorities shall be obtained well in

	advance by the Contractor," (e) The Contractor shall so conduct his operations as to have under construction no greater length or amount of work than he can carry out efficiently with due regard to the convenience of the public. The Contractor shall maintain the existing road in its normal condition suitable for the season of the year, from the time he commences the work on Site until the completion of the works. Within 56 days of the date of receipt of the Letter of Acceptance, the Contractor shall submit a programme for the approval of the Engineer describing in detail how he intends to pass traffic through the Works in general, and at bridge Sites in particular.
Sub-Clause 30.2 **Transport of Contractor's Equipment or Temporary Works**	Add the following paragraph at the end of Sub-Clause 30.2: "If it is found necessary for the Contractor to move one or more loads of heavy constructional plant and equipment, materials or pre-constructed units or parts of units of work over roads, highways, bridges on which such oversized and overweight items a re not normally allowed to be moved, the Contractor shall obtain prior permission from the concerned authorities. Payments for complying with the requirements, if any, for protection of or strengthening of the roads, highways or bridges shall be made by the Contractor and such expenses shall be deemed to be included in his Contract Price".
Sub-Clause 34.2 **Compliance with Labour Regulations**	Add the following as Sub-Clause 34.2 "During continuance of the contract, the Contractor and his Sub-contractors shall abide at all times by all existing labour enactments and rules made thereunder, regulations, notifications and bye laws of State or Central Government or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority Salient features of some of the major labour laws that are applicable to construction industry are given below. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made thereunder, regulations or notifications including amendments. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications / bye-laws / acts / rules / regulations including amendments, if any, on the part of the Contractor, the Employer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer. The employees of the Contractor and the Sub-contractor shall in no

	case shall be treated as the employees of the Employer at any point of time. Salient features of some major Labour Laws applicable to establishments engaged in Construction of Civil Works are given in Annexure A-1 for reference purpose. The contractor and sub contractor shall comply with the safety and welfare provisions as detailed in Annexure A-II.
Sub-Clause 35.1 **Returns of Labour and Contractors Equipment**	Add the following at the end of Sub-Clause 35.1. For Contractors Labour Regulations refer to Sub-Clause 34.2.
Sub-Clause 36.6 **Methodology**	Add the following as Sub-Clause 36.6 At least 14 days in advance of his programmed commencement of each item of work, the Contractor shall furnish for the Engineer's consent and under intimation to the Employer, the methodology he intends to adopt for executing the item, providing full details of the method of working, equipment to be deployed and measures to be adopted for ensuring quality of construction and safety.
Sub-Clause 37.4 **Rejection**	Add the following after Sub-Clause 37.4: "If the contractor persistently causes testing referred to in this Clause to be repeated, it will be considered to be a failure on behalf of the contractor to comply with a notice issued pursuant to this clause by the Engineer."
Sub-Clause 41.1 **Commencement of Work.**	Substitute Sub-Clause 41.1 by the following: "The Contractor shall commence the Works on Site within the period stated in the Appendix to Bid after receipt by him of a Notice to this effect from the Engineer/Employer, to be issued within 90 days after singing of the agreement. Thereafter, the Contractor shall proceed with the Works with due expedition and without delay. The requirement to 'commence the works at Site' shall be fulfilled if :- a) a programme has been submitted in accordance with Sub-Clause 14.1 Conditions of Particular Application; b) the Contractor's authorised Representative vide Sub-Clause 15.1 with full supporting staff are in position at Site; c) Equipment, Plant, material and labour for the work programmed for execution in the first two months, have been mobilised at the Site."
Sub-Clause 45.1	Delete Sub-Clause 45.1 and substitute:

Restriction on Working Hours	"Subject to any provision to the contrary contained in the Contract, the Contractor shall have the option to work continuously by day and by night and on locally recognized holidays, days of rest, provided that the contractors makes suitable arrangements for the same and inform the Engineer well in advance. Provided further that the rates and prices entered by the contractors in the Priced Bill of Quantities shall include all costs and charges whatsoever involved in working out side normal hours or holidays and on rest days.
Sub-Clause 48.5 **Prevention from Testing**	Add the following as Sub-Clause 48.5 : If the Contractor is prevented from carrying out the Tests on Completion by a cause for which the Employer or the Engineer or other Contractors employed by the Employer are responsible, the Employer shall be deemed to have taken over the Works on the date when the Tests on Completion would have been completed but for such prevention. The Engineer shall issue a Taking-Over Certificate accordingly. Provided always that the Works shall not be deemed to have been taken over if they are not substantially completed in accordance with the Contract. If the Works are taken over under this Sub-Clause, the Contractor shall nevertheless carry out the Tests on Completion during the Defects Liability Period. The Engineer shall require the Tests to be carried out by giving 14 days' notice. Any additional costs to which the Contractor may be put, in making the Tests on Completion during the Defects Liability Period, shall be added to the Contract Price.
Sub-Clause 49.5 **Extension of Defects Liability Period**	Add the following as Sub-Clause 49.5 : The Employer shall be entitled subject to Sub-Clause 2.5 (Employer's Claims) to an extension of the Defects Liability Period for the Works or a Section if and to the extent that the Works, Section or a major item of Plant (as the case may be, and after taking over) cannot be used for the purposes for which they are intended by reason of a defect or damage. However, a Defects Liability Period shall not be extended by more than twelve months.
Sub-Clause 51.2 **Instructions for Variations**	Delete the following sentence from Sub Clause 51.2 "Provided that no instruction shall be required for increase or decrease in the quantity of any work where such increase or decrease is not the result pf an instruction given under this Clause, but is the result of the quantities exceeding or being less than those stated in the Bill of Quantities".
Sub-Clause 52.1 **Valuation of Variation**	Substitute the words "if, in the opinion of the Engineer, the same shall be applicable" in the fourth and fifth line by the following: "subject to provisions of Sub Clause 52.2".

Sub-Clause 52.2 **Power of Engineer to Fix Rates**	Add the following paragraphs at the end of Sub-Clause 52.2: Provided further that no change in the rate or price for any item contained in the BOQ shall be considered unless the actual quantity of work executed under the item exceeds due to any reason the quantity set out in the BOQ by more than 25% and if the cost of additional quantity at the BOQ rate exceeds by 1 per cent of initial Contract Price, the Engineer shall fix the new rate to allow for the change in the quantity subject to restrictions under Sub- Clause 2.1. The new rate fixed by the Engineer shall be applicable only to the quantity exceeding 1.25 times the BOQ quantity. Provided further that no change in the rate for any item contained in the BOQ shall be considered in case of any decrease in the actual quantity of work executed.
Sub-Clause 53.3 **Substantiation of Claims**	"Add after first line: "but not exceeding sixty (60) days".
Sub-Clause 54.5 **Conditions of Hire** **of Contractor's Equipment**	Delete Sub-Clause 54.5
Sub-Clause 54.6 **Cost for the purpose of Clause 63**	Delete Sub-Clause 54.6
Sub Clause 54.7 **Incorporation of Clause in Subcontracts**	Delete Sub-Clause 54.7
Sub-Clause 54.9 **Contractor request for material & equipment.**	Add the following as Sub-Clause 54.9: No material, plant or equipment would be supplied by Employer. The Contractor would be fully responsible for all materials, plants and equipment required for the construction.
Sub-Clause 55.2 **Omissions of Quantities**	Add the following as Sub-Clause 55.2: Items of the Works provided in the Bill of Quantities for which no rate or price has been entered in the Contract shall be considered as included in other rates and prices in the Contract and will not be paid for separately by the Employer.
Sub-Clause 57.1 **Method of Measurement of Works**	Add the following paragraph at the end of Sub-Clause 57.1: "The Engineer/Engineer's Representative shall be responsible for ensuring that all measurements are taken as per specifications and drawings for the Works and are recorded in the measurement book

	of the Employer. The Engineer/Engineer's Representative (Team Leader) should ensure that he has verified the measurements of not less than 10% of value in each bill and countersign the measurement books accordingly."
Clause 60 **Certificates and Payment**	Delete Sub-Clauses 60.1 to 60.10 and substitute by the following Sub-Clauses 60.1 to 60.13:
Sub-Clause 60.1 **Monthly Statements**	"The Contractor shall submit a statement in 3 copies to the Engineer by the 7'h day of ea.ch month, signed by the authorized representative of the Contractor, for the work executed up to the end of the previous month in a tabulated form, approved by the Engineer, showing the amounts to which the Contractor considers himself to be entitled. The statement shall include the following items, as applicable, which shall be taken into account in the sequence listed: (a) the estimated value of temporary and permanent Works executed up to the end of the month in question determined in accordance with Sub-Clause 56.1, at base unit rates and prices; (b) the actual value certified for payment for the temporary and permanent Works executed up to the end of the previous month, at base unit rates and prices; (c) the estimated value at base unit rates and prices of the temporary and permanent Works for the month in question, obtained by deducting (b) from (a); (d) the value of any variations executed upto the end of the month in question, less the amount certified in the previous Interim Payment Certificate, pursuant to Clause 52 and 2.1; (e) any credit or debit for the month in question in respect of materials and Plant for the temporary and permanent Works under the conditions set forth in Sub-Clause 60.3; (f) amounts reflecting changes in cost and legislation, pursuant to Clause 70; (g) any amount to be withheld under the retention provisions of Sub-Clause 60.4; (h) any amount to be deducted as repayment of the Advance under the provisions of Sub-Clause 60.6; (i) amounts to be deducted for all taxes in accordance with Clause 73 thereof.
Sub-Clause 60.2 **Monthly Payments**	Within 5 days of receipt of the monthly statement from the Contractor in pursuant to Sub-Clause 60.1, the Engineer shall broadly determine the amount due to the Contractor and shall, accordingly, recommend to the Employer for release to the Contractor up to a

	maximum of 75% of net payment as part payment against the monthly statement, pending certificate of IPC by the Engineer. Within 2 days of the receipt of recommendation of the Engineer, the Employer shall make payment to the Contractor. The said statement shall be approved or amended by the Engineer in such a way that, in his opinion, it reflects the amount due to the Contractor in accordance with the Contract, after deduction,. other than pursuant to Clause 47, of any sums which may have become due and payable by the Contractor to the Employer. In cases where there is a difference of opinion as to the value of any item, the Engineer's view shall prevail. Within 21 days' of the receipt of the monthly statement referred to in Sub-Clause 60.1, the Engineer shall determine the amount due to the Contractor and shall deliver to the Employer and the Contractor, an Interim Payment Certificate, certifying the amounts due to the Contractor after adjusting the payment already released to the Contractor against the said statement. Notwithstanding the terms of this Sub-Clause or any other clause of the Contract, no amount will be certified by the Engineer for payment until the performance security has been provided by the Contractor and approved by the Employer.
Sub-Clause 60.3 **Materials and Plant for the Permanent Work**	"With respect to materials brought by the Contractor to the Site for incorporation in the Permanent Works, the Contractor shall (i) receive a credit in the month in which these materials are brought to the Site and (ii) be charged a debit in the month in which they are incorporated in to the Permanent Works, both such credit and debit to be determined by the Engineer in accordance with the following provisions; (a) no credit shall be given unless the following conditions shall have been met to the Engineer's satisfaction; (i) the materials and Plant are in accordance with the specifications for the Works. (ii) the materials and Plant have been delivered to the Site and are properly stored (bulk materials are to be stored in measurable stocks) and: protected against loss, damage or deterioration. (iii) the Contractor's records of the requirements, orders, receipts and use of materials and Plant are kept in a form approved by the Engineer, and such records are available for inspection by the Engineer. (iv) only the materials and Plant for which payment has been made by the Contractor shall be considered for advance. Where the materials are supplied from the Contractor's captive source, the reasonableness of the valuation of such materials shall be furnished by the

	Contractor. The materials and Plant brought on credit to the Site shall not be considered for advance. (v) the Contractor has submitted a statement of his cost of acquiring and delivering the materials and Plant to the Site together with paid vouchers and other such documents as may be required for the purpose of evidencing such cost. (vi) the material and plant shall be incorporated or used within 90 days period. (b) the amount to be credited to the Contractor shall be the equivalent of 75 per cent of the Contractor's reasonable cost of the materials delivered to the Site, after review of the documents listed in sub paragraph (a) (v) above, as determined by the Engineer Provided further, the advance shall not exceed 75 per cent of the corresponding value of materials determined on the basis of the 800 rates (c) the amount to be debited to the Contractor for any materials and Plant incorporated into the Permanent Works shall be equivalent to the credit previously granted to the Contractor for such materials and Plant pursuant to sub-para (b) above, as determined by the Engineer
Sub-Clause 60.4 **Retention Money**	A retention amounting to 6 (six) per cent of the amount due, determined in accordance with the procedure set out in Sub-Clause 60.1 shall be made by the Engineer in the first and following Interim Payment Certificates, until the amount so retained reaches a limit of retention money as stated in the Appendix to Bid. The Contractor may, at his option, replace the retention amount with an unconditional bank guarantee from the bank acceptable to the Employer at the following stages: (a) After the amount reaches half the value of the limit of Retention Money as stated in the appendix to bid. (b) After the amount reaches the maximum limit of the retention money as stated in the appendix to bid.
Sub-Clause 60.5 **Payment of Retention Money**	Upon the issue of the Taking-Over Certificate with respect to the whole of the Works, one half of the Retention Money (or Bank Guarantee, which replaced Retention Money) or upon the issue of a Taking-Over Certificate with respect to a Section or part of the Permanent Works, only such proportion thereof as the Engineer determines having regard to the relative value of such Section or part of the Permanent Works shall be certified by the Engineer for payment (or release of Bank Guarantee) to the Contractor. The Contractor may substitute the remaining retention money with an on-demand bank guarantee in a form and from a source, acceptable to the Employer.

	Upon expiration of 365 days after the Defects Liability Period of the Works or final payment by the employer pursuant to Sub-Clause 60.12, whichever is earlier, the other half of the Retention Money (or Bank Guarantee which replaced Retention Money) shall be certified by the Engineer for payment or release of bank guarantee to the Contractor. Provided that, in the event of different Defects Liability Periods being applicable to the different Sections or parts of the Permanent Works pursuant to Clause 48, the expression "expiration of the Defects Liability Period" shall, for the purpose of this Sub-Clause, be deemed to mean the expiration of the latest of such periods.
Sub-Clause 60.6 **Advance Payment**	(a) The Employer will make an interest bearing advance payment (rate of interest given in Appendix to Bid) to the Contractor exclusively for the costs of mobilization in respect of the Works upto an amount equivalent to 10 (Ten) percent of the Contract Price named in the Letter of Acceptance in two stages as provided in Appendix to Bid. Payment of such advance amount will be due under separate certification by the Engineer after (i) execution of the Form of Agreement by the parties hereto; (ii) submission by the Contractor of the performance security in accordance with Sub-Clause 10.1; and (iii) submission by the Contractor of an unconditional bank guarantee in a form and by a bank acceptable to the Employer in amount equal to the advance payment. The Bank guarantee may be split into not more than four separate Bank Guarantees and each having minimum value of 2.5% of the Contract Price. Such Bank Guarantee shall remain effective till date of completion of work, until the advance payment has been repaid pursuant to sub para (c) below, but the amount thereof shall be progressively reduced in accordance with the value of bank guarantees furnished by the Contractor and the amount repaid by him as indicated in Interim Payment Certificates issued in accordance with this Clause. (b) In addition to the advance mentioned in sub-para (a) above, the Employer will pay another interest bearing advance as provided in Appendix to Bid against key construction equipment required for the Works as per agreed construction programme and brought to Site, if so requested by the Contractor subject to the same terms and conditions specified in paragraph (a) above. The maximum of such advance shall be five percent of the Contract Price. This advance shall be further subject to the condition that (i) such equipment are considered by the Engineer to be necessary for the Works and (ii) these equipment have been verified to have been brought to site. (c) The advance payment under sub para (a) and (b) above shall be repaid through percentage deductions from the interim payments certified by the Engineer in accordance with this Clause. Deductions shall commence in the next Interim Payment Certificate either following that in which the total of all interim payments certified to the Contractor has reach ed 20 (Twenty) percent of the Contract Price less Provisional Sums or after 12 months from the date of com-

	mencement whichever period concludes earlier and shall be made at the rate of 25 Twenty Five) percent of the amount of all Interim Payment Certificates until such time as the advance payment including interest has been repaid; always provided that the advance payment including interest shall be completely repaid prior to the time when 80 percent of the Contract Price has been certified for payment. Provided further that repayment of advance can be made prior to the above schedule at the option of the Contractor. (d) The advance shall be used by the Contractor exclusively for mobilization expenditures, including the acquisition of new Construction equipments, in connection with the Works. All withdrawls under Mobilization advance and equipment advance should be effected before the period stipulated in this regard in the Appendix to Bid. Should the Contractor misappropriate any portion of the advance, it shall become due and payable immediately, and no further advance will be made to the Contractor thereafter. The term "misappropriate" in the above context would mean include, renewal of or transfer of any of the mobilization advance so drawn for investment outside the project account. The contractor will submit a utilization certificate specifying the usage of the sums so drawn have been put to supported by complete documentary evidence within 6 months from the date of release of such advances.
Sub-Clause 60.7 **Correction of Certificates**	The Engineer may by any Interim Payment Certificate make any correction or modification in any previous Interim Payment Certificate, which has been issued by him. Further, he shall have authority, if any work is not being carried out to his satisfaction, to omit or reduce the value of such work in any Interim Payment Certificate.
Sub-Clause 60.8 **Statement at Completion**	Not later than 84 days after the issue of the Taking- Over Certificate in respect of the whole of the Works, the Contractor shall submi1 to the Engineer six copies of a Statement at Completion with supporting documents showing in detail, in the form approved by the Engineer:- (a) the final value of all work done in accordance with the Contract up to the date stated in such Taking-Over Certificate; (b) any further sums which the Contractor considers to be due to him; and (c) an estimate of amounts which the Contractor considers will become due to him under the Contract. Estimated amounts shall be shown separately in such Statement at Completion. The Engineer shall certify payment in accordance with Sub-Clause 60.2.
Sub-Clause 60.9	Not later than 56 days after the issue of the Defects Liability Certificate pursuant to Sub-Clause 621, the Contractor shall submit to the Engineer for consideration six copies of a Draft Final Statement with

Final Statement	supporting documents showing in detail, in the form approved by the Engineer, (a) the value of all work done in accordance with the Contract; and (b) any further sums which the Contractor considers to be due to him under the Contract or otherwise. If the Engineer disagrees with or cannot verify any part of the Draft Final Statement, the Contractor shall submit such further information as the Engineer may reasonably require and shall make such changes in the Draft Final Statement as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed (for the purposes of these Conditions referred to as the "Final Statement"). If following the discussions between the Engineer and the Contractor and any changes to the Draft Final Statement which may be agreed between them, it becomes evident that a dispute exists, the Engineer shall deliver to the Employer an Interim Payment Certificate for those parts of the Draft Final Statement, if any, which are not in dispute. The dispute shall then be settled in accordance with Clause 67. The Final Statement shall be the agreed upon settlement of the dispute.
Sub-Clause 60.10 **Discharge**	Upon submission of the Final Statement, the Contractor shall give to the Employer with a copy to the Engineer, a written discharge confirming that the total of the Final Statement represents full and final settlement of all monies due to the Contractor arising out of or in respect of the Contract. Provided that such discharge shall become effective only after payment due under the Final Payment Certificate issued pursuant to Sub-Clause 60.11 has been made and the performance security referred to in Sub-Clause 10.1 has been returned to the Contractor.
Sub-Clause 60.11 **Final Payment Certificate**	Within 28 days after receipt of the Final Statement, and the written discharge, the Engineer shall deliver to the Employer (with a copy to the Contractor) a Final Payment Certificate stating: (a) the amount which, in the opinion of the Engineer, is finally due under the Contract or otherwise, and (b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled, other than under Clause 47, the balance, if any, due from the Employer to the Contractor or from the Contractor to the Employer as the case may be.
Sub-Clause 60.12 **Time of Payment and In-**	(a) The amount due to the Contractor under any Interim Payment Time of Payment Certificate issued by the Engineer pursuant to this

terest	Clause, or to and Interest any other term of the Contract, shall, subject to Clause 47, be paid by the Employer to the, Contractor as follows: (i) in the case of Interim Payment Certificates, within 42 days after the Contractor's monthly statement has been submitted to the Engineer for certification, pursuant to Sub-Clause 60.1. Provided that if the Engineer's Interim Payment Certificate has not yet been issued within said 42 days, the Employer shall pay the amount shown in the Contractor's monthly statement and that any discrepancy shall be added to, or deducted from, the next payment to the Contractor; (ii) in the case of the Final Payment Certificate pursuant to Sub- . Clause 60.11, within 84 days after the Final Statement and written discharge have been submitted to the Engineer for certification; (b) In the event of the failure of the Employer to make payment within the time stated, the Employer shall pay to the Contractor interest at the rate stated in the Appendix to Bid upon all sums unpaid from the date by which the same should have been paid. The provisions of this Sub-Clause are without prejudice to the Contractor's entitlement under Clause 69 or otherwise.
Sub-Clause 60.13 **Cessation of Employer's Liability**	The Employer shall not be liable to the Contractor for any matter or Cessation of thing arising out of or in connection with the Contract or execution of Employer's Liability the Works, unless the Contractor shall have included a claim in respect thereof in his Final Statement and (except in respect of matters or things arising after the issue of the Taking-Over Certificate in respect of the whole of the Works) in the Statement at Completion referred to in Sub-Clause 60.8.
Sub-Clause 62.1 **Defects Liability Certificate**	Delete the following sentence from Sub-Clause 62.1 Provided that the issue of the Defects Liability Certificate shall not be a condition precedent to payment to the contractor of the second portion of the Retention Money in accordance with the conditions set out in Sub-Clause 60.3.
Sub-Clause 63.1 **Default of Contractor**	Delete Sub-Clause 63.1 and substitute by the following:- The Employer shall be entitled to terminate the contract If the contractor: (a) fails to carry out any obligation under the contract. (b) without reasonable excuse fails (i) to commence the works in accordance with Sub-Clause 41.1 or (ii) to proceed with the works, or any section thereof, within

	28 days after received notice pursuant to Sub-Clause 46.1. (c) has failed to comply with a notice issued pursuant to Sub-Clause 37.4 or an instruction issued pursuant to Sub-Clause 39.1 within 28 days after having received. (d) abandons the works or otherwise plainly demonstrates the intention not to continue performance of his obligation under the contract. (e) sub-contracts the works or assigns the contract without the specific prior written permission of the Engineer. (f) despite previous warning from the Engineer, in writing, is otherwise persistently or fragrantly neglecting to comply with any of his obligations under the contract, (g) has failed to comply with the requirements applicable to joint venture as per the contract. (h) has failed to furnish the required securities or extension thereof in terms of the contract. (i) becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under receiver, trustee or manager for the benefit of his creditors, or if any act IS done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events, In any of these events or circumstances, the Employer may, upon giving 14 days notice to the contractor, terminate the contract and expel the contractor from the site. However, in the case of sub-paragraphs (i), the Employer may by notice terminate the contract immediately. The Employer's election to terminate the contract shall not prejudice any other rights of the Employer, under the contract or otherwise. The contractor shall then leave the site and deliver any required goods, all contractor's documents, and other design documents made by or for him, to the Engineer. However, the contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice (i) for the assignment of any sub-contract, and (ii) for the protection of life or property or for the safety of the works. After termination, the Employer may complete the Works and/or arrange for any other entities to do so. The Employer and these entities may then use any goods, contractor's documents and other design documents made by or on behalf of the contractor. The Employer shall then give notice that the contractor's equipment

	and temporary works will be released to the contractor at or near the site. The contractor shall promptly arrange their removal at the risk and cost of the contractor. However, if by this time the contractor has failed to make a payment due to the Employer, these items may be sold by the Employer in order to recover this payment. Any balance of the proceeds shall then be paid to the contractor.
Sub-Clause 63.3 **Payment after Termination**	Substitute Sub-Clause 63.3 with the following: If the Employer terminates the Contractor's employment under this Clause, he shall not be liable to pay to the Contractor any further amount in respect of the Contract until the Engineer shall determine the value of the work done up to the date of termination of contract, less payments received, less other recoveries due in terms of the Contract, less payment due, if any, under Clause 47, less taxes due to be deducted at source as per applicable laws, less the percentage indicated in the Appendix to Bid to apply to the value work not completed at BOQ rates plus the variations already approved by the Engineer and less cost of remedying of any defects in the works executed by the Contractor. If the Engineer determines that a sum is payable to the Contractor, he will then be entitled to receive such sum from the Employer. If the Engineer determines that a sum is due from the Contractor and payable to the Employer, it shall be deemed a debt due by the Contractor to the Employer and shall be recoverable accordingly.
Sub-Clause 63.5 **Invocation of the Bank Guarantee**	Add the following as Sub-Clause 63.5 Without prejudice to the generality of the provisions of the Agreements, if the contractor unsuccessfully challenges any action of the Employer before a Court of Law regarding invocation of the Bank Guarantee furnished under the Agreement or termination of the Agreement and any interim directions are obtained against the Employer, which are subsequently vacated by the Court, then the contractor shall be liable to pay: (a) in case of a Bank Guarantee interest @ 12% of the Bank Guarantee amount; or (b) in case of termination of the Agreement an amount equivalent to 1/2000 per day of the contract value. for the intervening period starting from the date of the interim directions till the final disposal of the case by the Court. Both the parties agree that the damages in Clause (b) is a genuine pre-estimate of the loss suffered by the Employer.
Sub-Clause 63.6 **Corrupt or Fraudulent Practices**	Add the following as Sub-Clause 63.6 : If in the judgment of the Employer, the Contractor has engaged in corrupt or fraudulent practices, in competing for or in executing the

	Contract, then the Employer may, after having given 14 days notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site, and the provisions of Clause 63 shall apply as if such termination had been made under Sub-Clause 63.1. For the purpose of this Sub-Clause: "corrupt practice" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the procurement process or in contract execution. "fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Employer, and includes collusive practice among bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.
Sub-Clause 65.2 **Special Risks**	Substitute Sub-Clause 65.2 with the following: The Special Risks are the risks defined under para (a), sub paras (i) to (iv) of Sub-Clause 20.4.
Sub-Clause 67.1 **Disputes Review Board**	Substitute Clause 67.1 by the following: If any dispute arises between the Employer and the Contractor in connection with, or arising out of, the Contract or the execution of the Works, whether during the execution of the Works or after their completion and whether before or after the repudiation or other termination of Contract, including any disagreement by either party with any action, inaction, opinion, instruction, determination, certificate or valuation of the Engineer, the matter in dispute shall, in the first place, be referred to the Disputes Review Board ("the Board"). The Board shall be established when each of the three Board Members has signed a Board Member's Declaration of Acceptance as required by the ORB's rules and procedures (which, along with the declaration of acceptance form, are attached as Annex "'A-III' to these Conditions of Particular Applications - Part II). The Board shall comprise three Members experienced with the type of construction involved in the Works and with the interpretation of contractual documents. One Member shall be selected by each of the Employer and the Contractor and approved by the other. If either of these Members is not so selected and approved within 28 days of the date of the Letter of Acceptance, then upon the request of either or both parties such Member shall be selected as soon as practicable by the Appointing Authority specified in the Appendix to Bid. The third Member shall be selected by the other two and approved by the parties. If the two Members selected by or on behalf of the parties

	fail to select the third Member within 14 days after the later of their selections or if within 14 days after the selection of the third Member, the parties fail to approve that Member, then upon the request of either or both parties such third Member shall be selected promptly by the same Appointing Authority specified in the Appendix to Bid who shall seek the approval of the proposed third Member by the parties before selection but, failing such approval, nevertheless shall select the third Member. The third Member shall serve as Chairman of the Board. In the event of death, disability, or resignation of any Member, such Member shall be replaced in the same manner as the Member being replaced was selected. If for whatever other reason a Member shall fail or be unable to serve, the Chairman (or failing the action of the Chairman then either of the other Members) shall inform the parties and such non- serving Member shall be replaced in the same manner as the Member being replaced was selected. Any replacement made by the parties shall be completed within 28 days after the event giving rise to the vacancy on the Board, failing which the replacement shall be made by the Appointing Authority in the same manner as described above. Replacement shall be considered completed when the new Member signs the Board Member's Declaration of Acceptance. Throughout any replacement process the Members not being replaced shall continue to serve and the Board shall continue to function and its activities shall have the same force and effect as if the vacancy had not occurred,. provided, however, that the Board shall not conduct a hearing nor issue a Recommendation until the replacement is completed. The recommendation of the Board shall be binding on both parties, who shall promptly give effect to it unless and until the same shall be revised, as herein after provided, in an arbitral award. Unless the Contract has already been repudiated or terminated, the Contractor shall, in every case, continue to proceed with the Works in accordance with the contract. If either the Employer or the Contractor is dissatisfied with any Recommendation of the Board, or if the Board fails to issue its Recommendation within 56 days after receipt by the Chairman of the Board of the written Request for Recommendation or any extension mutually agreed upon by the Employer and the Contractor, then either the Employer or the Contractor may, within 28 days after his receipt of the Recommendation, or within 28 days after the expiry of the said period, as the case may be, give notice to the other party, with a copy for information to the Engineer, of his intention to commence arbitration, as hereinafter provided, as to the matter in dispute. Such notice shall establish the entitlement of the party giving the same to commence arbitration, as hereinafter provided, as to such dispute and, subject to Sub-Clause 67.4 no arbitration in respect thereof may be commenced unless such notice is given.

	If the Board has issued a Recommendation to the Employer and the Contractor within the said 56 days or any extension mutually agreed upon by the Employer and the Contractor and no notice of intention to commence arbitration as to such dispute has been given by either the Employer or the Contractor within 28 days after the parties received such Recommendation from the Board, the Recommendation shall become final and binding upon the Employer and the Contractor. Whether or not it has become final and binding upon the Employer and the Contractor, a Recommendation shall be admissible as evidence in any subsequent dispute resolution procedure, including any arbitration or litigation having any relation to the dispute to which the Recommendation relates. All Recommendations which have become final and binding shall be implemented by the parties forthwith, such implementation to include any relevant action of the Engineer. If during the contract period, the Employer and the Contractor are of the opinion that the Disputes Review Board is not performing its functions properly, the Employer and the Contractor may together disband the Disputes Review Board and reconstitute it. A new board shall then be selected in accordance with the provisions applying to the selection of the original Board as specified above, except that words "within 28 days after the Letter of Acceptance" shall be replaced by the words "within 28 days after the date on which the notice disbanding the original Board became effective". The Employer and the Contractor shall jointly sign a notice specifying that the Board shall stand disbanded with effect from the date specified in the notice. The notice shall be posted by a registered letter with AD or delivered personally to each Member of the Board. A Member shall be deemed to have received the delivery of the letter even if he refuses to do so.
Sub-Clause 67.2 **Amicable Settlement**	Delete Sub-Clause 67.2
Sub-Clause 67.3 **Arbitration**	Substitute Sub-Clause 67.3 with the following : Any dispute in respect of which the Recommendation(s), if any, of the Board has not become final and binding pursuant to Sub-Clause 67.1 shall be finally settled by arbitration as set forth below. The arbitral tribunal shall have full power to open up, review and revise any decision, opinion, instruction, determination, certificate or valuation of the Engineer and any Recommendation(s) of the Board related to the dispute. (i) A dispute with an Indian Contractor shall be finally settled by arbitration in accordance with the Arbitration & Conciliation Act, 1996,

	or any statutory amendment thereof. The arbitral tribunal shall consist of 3 (three) Arbitrators, one each to be appointed by the Employer and the Contractor. The third Arbitrator shall be chosen by the two Arbitrators so appointed by the Parties and shall act as Presiding Arbitrator. In case of failure of the two Arbitrators, appointed by the parties to reach upon a consensus within a period of 30 days fro m the appointment of the arbitrator appointed subsequently, the Presiding arbitrator shall be appointed by the Appointing Authority as specified in the Appendix to Bid. For the purposes of this Sub-Clause, the term "Indian Contractor" means a Contractor who is registered in India and is a juridical person created under Indian law as well as a joint venture between such a Contractor and a Foreign Contractor. (ii) In the case of a dispute with a Foreign Contractor, the dispute shall be finally settled in accordance with the provisions of UNCITRAL Arbitration Rules. If agreed to by both the parties, the disputes shall be settled in accordance with the Arbitration and Reconciliation Act, 1996. The arbitral tribunal shall consist of three Arbitrators, one each to be appointed by the Employer and the Contractor. The third Arbitrator shall be chosen by the two Arbitrators so appointed by the parties, and shall act as Presiding Arbitrator. In case of failure of the two Arbitrators appointed by the parties to reach upon a consensus within a period of 30 days from the appointment of the Arbitrator appointed subsequently, the Presiding Arbitrator shall be appointed by the Authority specified in the Appendix to Bid. For the purposes of this Sub-Clause, the term "Foreign Contractor" means a Contractor who is not registered in India and is not a juridical person created under Indian Law. (iii) Neither party shall be limited in the proceedings before such tribunal to the evidence or arguments before the Board for the purpose of obtaining its Recommendation(s) pursuant to Sub- Clause 67.1. No Recommendation shall disqualify any Board Member from being called as a witness and giving evidence before the Arbitrator(s) on any matter whatsoever relevant to the dispute (iv) Arbitration may be commenced prior to or after completion of the Works, provided that the obligations of the Employer, the Engineer, the Contractor and the Board shall not be altered by reason of the arbitration being conducted during the progress of the Works. (v) If one of the parties fail to appoint its arbitrator in pursuance of Sub-paras (i) and (ii) above, within 30 days after receipt of the notice of the appointment of its Arbitrator by the other party, then the Appointing Authority specified in the Appendix to Bid shall appoint the Arbitrator. (vi) Arbitration proceedings shall be held at Delhi or at the place near to the project site. The language of the arbitration proceedings and that of all documents and communications between the parties

	shall be English. (vii) The decision of the majority of Arbitrators shall be fin al and binding upon both parties. The cost and expenses of Arbitration proceedings will be paid as determined by the arbitral tribunal. However, the expenses incurred by each party in connection with the preparation, presentation, etc., of its proceedings as also the fees and expenses paid to the Arbitrator appointed by such party or on its behalf shall be borne by each party itself.
Sub-Clause 67.4 **Failure to Comply with Recommendation**	Substitute Sub-Clause 67.4 with the following: Where neither the Employer nor the Contractor has given notice of intention to commence arbitration of a dispute within the period stated in Sub-Clause 67.1 and the related Recommendation has become final and binding, either party may, if the other party fails to comply with such Recommendation and without prejudice to any other right it may have, refer the failure to arbitration in accordance with Sub-Clause 67.3. The provisions of Sub-Clause 67.1 shall not apply to any such reference.
Sub-Clause 68.2 **Notice to Employer and Engineer**	For the purposes of this Sub-Clause, the addresses are those specified in the Appendix to Bid.
Clause 69 **Default of Employer**	In Sub-Clause 69.1,69.4, and 69.5, substitute "Sub-Clause 60.10" for "Sub-Clause 60.12.
Clause 69.1 **Default of Employer**	In Sub-Clause 69.1 (a), substitute the words "28 days" with "56 days". In the last para, substitute the words "14 days" with "28 days".
Sub-Clause 69.2 **Removal of contractor's Equipments**	In Sub-Clause 69.2, substitute the words "14 days" with "28 days".
Sub-Clause 69.3 **Payment on Termination**	In Sub-Clause 69.3, delete the text from, "but in addition to the payments specified……." to the end of the Sub-Clause.
Clause 70 **Changes in cost and Legislation**	Delete Sub-Clauses 70.1 and 70.2 and substitute with the following:
Sub-Clause 70.1 **Price Adjustment**	The amounts payable to the Contractor and valued at base rates and prices in the Interim Payment Certificates issued by the Engineer, pursuant to Sub-Clause 60.1, shall be adjusted in respect of the rise or fall in the index cost for labour, Contractor's Equipment, Plant, materials, and other inputs to the Works, by the addition or subtraction of the amounts determined by the formulae prescribed

	in this Clause.
Sub-Clause 70.2 **Other Changes in Cost**	To the extent that full compensation for any rise or fall in costs to the Contractor is not covered by the provisions of this or other Clauses in the Contract, the unit rates and prices included in the Contract shall be deemed to include amounts to cover the contingency of such other rise or fall of costs.
Sub-Clause 70.3 **Adjustment Formulae**	Contract Price shall be adjusted for increase or Price decrease in rates and price of labour, materials, fuels and lubricants in accordance with the following principles and procedures as per formula given below. The amount certified in each payment certificate is adjusted by applying the respective price adjustment factor to the payment amounts due: (a) Price adjustment shall apply only for work carried out within the stipulated time or extensions granted by the Employer and shall not apply to work carried out beyond the stipulated time; price adjustment for extensions for reasons attributable to the Contractor, shall be paid in accordance with Sub-Clause 70.5; Price adjustment shall be calculated as per the formula given below: (b) Following expressions and meanings are assigned to the value of the work done during each month: R = Total value of work done during the month. It would include the value of materials on which secured advance has been granted, if any during the month less the value of materials in respect of which the secured advance has been recovered, if any during the month. This will exclude cost of work on items for which rates were fixed under variations Clause 51 and 52 for which the escalation will be regulated as mutually agreed at the time of fixation of rate.
	(i) Adjustment for Labour Component Price adjustment for increase or decrease in the cost due to labour shall be paid in accordance with the following formula: $V_L = 0.85 \times P_l/100 \times Rx (L_i - L_o)/L_o$ V_L = Increase or decrease in the cost of work during the month under consideration due to changes in rates for local labour. Lo = the average consumer price index for industrial workers for the place as defined in the Appendix to Bid, in the previous month prior to the closing date of submission of bids as published by Labour Bureau, Ministry of Labour*, Government of India. L_I = The average consumer price index for industrial workers for the place as defined in the Appendix to Bid, in the previous month prior to the last day of the period to which a particular Interim Payment Certificate is related as published by Labour Bureau, Ministry of

	Labour*, Government of India. P_l = Percentage of labour component of the work. Note: For the application of this Clause, index of Industrial Workers has been chosen to represent the labour component. ii) Adjustment for Cement Component Price adjustment for increase or decrease in the cost of cement procured by the Contractor shall be paid in accordance with the following formula. $V_c = 0.85 \times P_c/100 \times Rx (C_i - C_o)/C_o$ V_c =Increase or decrease in the cost of work during the month under consideration due to changes in the rates for cement C_o = The all India average Wholesale price index for cement in the previous month prior to the closing date of submission of bids as published by the Ministry of Commerce & Industry, Government of India. C_l = The all India average wholesale price index for cement in the previous month prior to the last day of the period to which a particular Interim Payment Certificate is related, as published by Ministry of Commerce & Industry, Government of India. P_c = Percentage of cement component of the work (iii) Adjustment for steel component Price adjustment for increase or decrease in the cost of steel procured by the Contractor shall be paid in accordance with the following formula: $V_s = 0.85 \times P_s/100 \times Rx (S_i - S_o)/S_o$ V_s = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for steel. S_o = The all India average wholesale price Index for steel (Bars and Rods) in the previous month prior to the closing date of submission of bids as published by the Ministry of Commerce & Industry, Government of India. S_i = The all India average wholesale price index for steel (Bars and Rods) in the previous month prior to the last day of the period to which a particular Interim Payment Certificate is related as published by the Ministry of Commerce & Industry, Government of India. P_s = Percentage of steel component of the work Note: For the application of this Clause, index of Bars and Rods has

	been chosen to represent steel component. (iv) Adjustment for Plant and machinery and spares component Price adjustment for increase or decrease in the cost of Plant and. machinery spares procured by the Contractor shall be paid in accordance with the following formula: $V_p = 0.85 \times P_p/100 \times Rx (P_i - P_o)/P_o$ V_p = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for Plant and machinery spares P_o = The all India average wholesale price index for heavy machinery and parts in the previous month prior to the closing date of submission of bids as published by the Ministry of Commerce & Industry, Government of India. P_i = The all India average wholesale price index for heavy machinery and parts in the previous month prior to the last day of the period to which a particular Interim Payment Certificate is related as published by the Ministry of Commerce & Industry, Government of India. P_p = Percentage of Plant and machinery spares component of the work Note: For the application of this Clause, index of heavy machinery and parts has been chosen to represent the Plant and Machinery spares component. (v) Adjustment for Bitumen Component. Price adjustment for increase or decrease in the cost of bitumen shall be paid in accordance with the following formula: $V_b = 0.85 \times P_b/100 \times Rx (B_i - B_o)/B_o$ V_b = increase or decrease in the cost of work during the month under consideration due to changes in the rates for bitumen: B_o = the average official retail price of bitumen at the nearest refinery for the place as defined in Appendix to Bid, in the previous month prior to the date of submission of Bids. B_i= the average official retail price of bitumen at nearest refinery for the place as defined in Appendix to Bid, in the previous month prior to the last day of the period to which a particular Interim Payment Certificate is related. P_b = Percentage of bitumen component of the work.

	(vi) Adjustment for Fuel and lubricants (POL) Price adjustment for increase or decrease in the cost of POL (fuel and lubricant) shall be paid in accordance with the following formula: $V_f = 0.85 \times P_f/100 \times Rx (F_i - F_o)/F_o$ V_f = Increase or decrease in the cost of work during the month under consideration due to changes in rates for fuel and lubricants. F_o = The average official retail price of High Speed Diesel (HSD) oil at the existing consumer pumps of IOC for the place defined in the Appendix to Bid in the previous month prior to date of submission of bids. F_j = The average official retail price of HSD at the existing consumer pumps of IOC for the place defined in the Appendix to Bid in the previous month prior to the last day of the period to which a particular Interim Payment Certificate is related P_f = Percentage of fuel and lubricants component of the work. Note: For the application of this clause, the price of High Speed Diesel oil at the IOC pumps has been chosen to represent fuel and lubricants component. * Based price index for Industrial Workers to be published by Labour Bureau, Ministry of Labour, Govt. of India be checked. (vii) Adjustment for Other local Materials Price adjustment for increase or decrease in cost of local materials other than cement, steel, bitumen, plant spares and POL procured by the Contractor shall be paid in accordance with the following formula $V_m = 0.85 \times P_m/100 \times Rx (M_i - M_o)/M_o$ V_m = Increase or decrease in the cost of work during the month under consideration due to changes in rates for local materials other than cement, steel, bitumen, plant spares and POL. M_o = The all India average wholesale price index (all commodities) in the previous month prior to date of submission of bids, as published by the Ministry of Commerce & Industry, Government of India. M_i = The all India average wholesale price index (all commodities) in the previous month prior to the last day of the period to which a particular Interim Payment Certificate is related as published by the Ministry of Commerce & Industry, Government of India. P_m = Percentage of local material component (other than cement,

	steel, bitumen, plant spares and POL) of the work. (viii) The following percentages will govern the price adjustment of the contract: 1. Labour- P_l - 20% 2. Plant and Machinery and Spares - P_p - 20% 3. POL – P_f - 10% 4. Bitumen - P_b - x% 5. Cement - P_c - Y% 6. Steel - P_s - z% 7. Other materials - P_m - 50-(x+y+z)% Total - 100% (Note: x, y, z are the actual percentage of material of bitumen, cement and steel respectively used for execution of work as per the Interim Payment Certificate for the month.)
Sub-Clause 70.4 **Base, Current and Provisional Indices**	The base cost indices or prices shall be those prevailing in the previous month prior to the closing date for submission of bids, Current indices or prices shall be those prevailing in the previous month to which a particular Interim Payment Certificate is related. If at any time the current indices are not available, provisional indices as determined by the Engineer will be used, subject to subsequent correction of the amounts paid to the Contractor when the applicable indices become available.
Sub-Clause 70.5 **Limit of Price Adjustment**	Provided that, in determining all such price adjustment in accordance with the aforesaid Sub-Clauses: (a) No account will be taken of any amount by which any cost incurred by the Contractor has been increased by default or negligence of the contractor. (b) If the contractor fails to complete the work within time for completion prescribed under Clause 43.1, the adjustment of prices thereafter until the completion of the works shall be made using either the indices or prices relating to prescribed time for completion, or the current indices or prices, whichever is more favourable to the Employer, provided that if an extension of time is granted pursuant to Sub-Clause 44.1, the above position shall apply to the adjustments made after expiry of such extension of time.
Sub-Clause 70.6 **Subsequent Legislation**	If, after the date 28 days prior to the latest date for submission of tenders for the Contract, there occur changes to any National or State Statute, Ordinance, Decree or other Law or any regulation or

	bye-law of any local or other duly constituted authority, or the introduction of any such State Statute, Ordinance, Decree. Law, regulation or bye-law which causes additional or reduced cost to the Contractor, other than under the preceding Sub-Clauses of this Clause, in the execution of the Contract, such additional or reduced cost shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be added to or deducted from the Contract Price and the Engineer shall notify the Contractor accordingly, with a copy to the Employer. Notwithstanding the foregoing, such additional or reduced cost, shall not be separately paid or credited if the same shall a1ready have taken into account in the indexing of any inputs to the Price Adjustment Formulae in accordance with the provisions of Sub-Clause (1) to (5) of 'this Clause.
Sub-Clause 71.1 **Currency Restrictions**	Delete Sub-Clause 71.1
Sub-Clause 72.1 **Rates of Exchange**	Delete Sub-Clause 72.1
Sub-Clause 72.2 **Currency Proportions**	Delete Sub-Clause 72.2
Sub-Clause 72.3 **Currencies of Payment for Provisional Sums**	Delete Sub-Clause 72.3

Additional Clauses

Sub-Clause 73.1 Foreign Taxation

The prices bid by the Contractor shall include all taxes, duties, and other charges imposed outside the Employer's country on the production, manufacture, sale, and transport of the Contractor's Equipment, Plant, materials, and supplies to be used on or furnished under the Contract, and on the services performed under the Contract.

Sub-Clause 73.2 Taxation

The prices bid by the Contractor shall include all **Local** customs duties, import duties, business taxes, and income and other taxes local/state govt., octroi, royalty etc., that may be levied in accordance with the laws and regulations being in force on the date 28 days prior to the latest date for submission of bids in the Employer's country on the Contractor's Equipment, Plant, materials, and supplies (permanent, temporary, and consumable) acquired for the purpose of the Contract and on the services performed under the Contract. Nothing in the Contract shall relieve the Contractor from his responsibility to pay any tax that may be levied in the Employer's country on profits made by him in respect of the Contract. All taxes shall be deducted from Contractor's payment as per relevant legislation.

Sub-Clause 73.3 Personal Income Tax

The Contractor's staff and labour will be liable to pay personal income tax in the Employer's country in respect of such of their salaries and wages as are chargeable under the laws and regulations for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such laws and regulations.

Sub-Clause 73.4 Advance Deduction of Taxes

Advance deduction of taxes shall be made from each Interim Payment Certificate in accordance with the relevant provisions of all prevailing Acts and Regulations.

Sub-Clause 73.5 Customs and Security Requirements

The Contractor shall comply with all regulations for the time being imposed by the Customs and Port Security Authorities in respect of the passage of plant, vehicles, materials, and personnel through Customs barriers.

Sub-Clause 74 Joint Venture

If a contractor is a joint venture, consortium or other unincorporated group of two or more persons then such joint venture, consortium or other unincorporated group shall be treated as a separate entity distinct from its constituents and competent to enter into contract in its own name and its constituents shall be jointly and severally liable to the Employer for the performance of the Contract and shall comply with the following requirements:-

(a) There shall be a Joint Venture Agreement between the constituent firms specific for the contract packages. The JV Agree-

ment shall include among other things, the joint venture's objectives, the proposed management structure, the proposed distribution of responsibilities both financial as well as technical for execution of the work, the contribution of each partner to the joint venture operation, the commitment of the partners to joint and several liability for due performance, recourse/sanctions within the Joint Venture in the event of default or withdrawal of any partner and arrangements for providing the required indemnities.

(b) The most experienced partner will be the Lead Partner and nominated as the partner-in-charge; and this authorization shall be evidenced by submitting a power of attorney signed by the legally authorized signatories of all the partners. The most experienced partner (lead partner) will be the one defined as such in the communication approving the prequalification.

(c) The most experienced partner (Lead Partner) of the joint venture will provide suitable experienced personnel for at least 3(three) positions at site for the purpose of general planning, site management and plant operations, during the whole period of contract execution and a statement to this effect should be included in the Joint Venture Agreement.

(d) The Form of Agreement shall be signed and/or executed in such a manner as may be required for making it legally binding on all partners (including operative parts of the ensuing Contract in respect of Arbitration Agreement etc.)

(e) The partner-in-charge shall be authorized to incur liabilities and to receive instructions for and on: behalf of all partners of the Joint Venture and the entire execution of the contract including payment shall be carried out exclusively through the partner-in-charge. A statement to this effect should be included in the Joint Venture agreement.

(f) All partners of the Joint Venture shall be liable jointly and severally for the execution of the contract in accordance with the contract terms, and a statement to this effect shall be included in the Joint Venture Agreement.

(g) Performance Security, as required, will be furnished by all partners(s), out of their accounts, in proportion to their participation in joint venture.

(h) Joint Venture Agreement shall contain a clause to the effect that there shall be separate JV Bank Account (distinct from the Bank Accounts of the individual partners) to which the individual partner shall contribute their share capital and/or working capital.

(i) Joint Venture Agreement shall also contain a clause to the

effect that the financial obligations of the Joint Venture shall be discharged through the said JB Bank Account only and also all the payments received by the Joint Venture from the Employer shall be through that account alone.

(j) In the event of default by the most experienced partner (Lead Partner), it shall be construed as default of the Contractor; and Employer will take action under Clause 63 of the Conditions of Contract.

(k) In the event of any other partner leaving the joint venture, it shall be Intimated to the Employer within 30 days by the other partner(s).

Failure to do so shall be construed as default of the contractor and the Employer may take action under Clause 63 of the Conditions of Contract, Part-II.

(I) In case the Joint Venture Agreement is not acceptable to the Employer, the joint venture will modify the agreement so as to be acceptable to the Employer.

(m) The contractor shall not alter its composition or legal status without the prior written permission of the Employer. Failure to do so shall be construed as default of the contractor and the Employer may take action under Clause 63 of the Conditions of Contract, Part-II.

Sub-Clause 75.1 Termination of Contract for Employer's Convenience

The Employer shall be entitled to terminate this Contract at any time for the Employer's convenience after giving 56 days' prior notice to the Contractor, with a copy to the Engineer. In the event of such termination, the Contractor

(a) shall proceed as provided in Sub-Clause 65.7; a{1d

(b) shall be paid by the Employer as provided in Sub-Clause 65.8.

Sub-Clause 76.1 Details to be Confidential

The Contractor shall treat the details of the Contract as private and confidential, save insofar as may be necessary for the purposes thereof, and shall not publish or disclose the same or any particulars thereof in any trade or technical paper or elsewhere without the previous consent in writing of the Employer. If any dispute arises as to the necessity of any publication or disclosure for the purpose of the Contract, the same shall be referred to the Employer whose determination shall be final.

Sub-Clause 77.1 Contractor's Temporary Moorings

Should the Contractor for the purpose of the Contract desire to provide temporary mooring for his craft and floating plant, he will be allowed to do so in positions and manners approved by the Engineer. The Contractor shall not lay such moorings so as to interfere with traffic in the waterways and such moorings shall be removed if and when required by the Engineer and/or the

	Employer.
Sub-Clause 78.1 Life-saving Appliances and First-aid equipment	The Contractor shall provide and maintain upon the Works and the Site, sufficient, proper and efficient life-saving appliances and first-aid equipment to the approval of the Engineer. The appliances and equipment shall be available for use at all times during the Contract Period.
Sub-Clause 79.1 Drawings and Photographs of the Works	The Contractor shall not disclose details of drawings furnished to him without the prior approval of the Engineer in writing. No photograph of the Works or any part thereof or equipment employed thereon shall be taken or permitted by the Contractor to be taken by any of his employees or any employees of his Sub-contractors without the prior approval of the Engineer in writing and no such photographs shall be published or otherwise circulated without the approval of the Engineer in writing.
Sub-Clause 80.1 The Apprentices Act, 1961	The Contractor shall duly comply with the provisions of the Apprentices Act, 1961, the rules made thereunder and the orders that may be issued from time to time under the said Act and the said Rules and on his failure or neglect to do so, he shall be subject to all liabilities and penalties provided by the said Act and the said Rules.
Sub-Clause 81.1 Inspection of work and Review of progress by Employer	The Employer or his representative may inspect and review the progress of works and may issue appropriate directions to the Engineer for taking necessary action. The Employer or his representative may also test check the quality and quantity of the materials brought to the site for incorporating in the. permanent works and may also test check the quantity, quality and workmanship of the Work executed in the presence of the representatives of the Engineer and the Contractor.
Sub-Clause 81.2 Performance Appraisal	The Employer or his representative shall carry out the performance appraisal of the Contractor through the Engineer in the format prescribed by the Employer.
Sub-Clause 82.1 Use of explosives	The Contractor shall not use explosives unless the use of explosives is so provided or ordered or authorized. The Contractor shall comply with the requirements of the following Sub-Clauses besides the law of the land as applicable.
Sub-Clause 82.2 Precautions for the use of explosives	The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and shall, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer.
Sub-Clause 82.3 Permission for	The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties

use of explosives	whatsoever concerned or affected or likely to be concerned or affected by blasting operations.
Sub-Clause 82.4 Storage of explosives	The Contractor shall pay all license fees and charges, which may be, required for storage of explosives or in respect of any other matter whatsoever.
Sub-Clause 83.1 Noise and Disturbance	All Works shall be carried out without unreasonable noise and disturbance. The Contractor shall indemnify and keep indemnified the Employer from and against any liability for damages on account of noise or other disturbance created while or in carrying out the Works and from and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in regard or in relation to such liability. The precautions for safeguarding the Environment shall be the responsibility of the Contractor and to be complied in accordance with Clause 111 of Technical Specifications.
Sub-Clause 84.1 Pollution	Subject and without prejudice to any other provision of the Contract and the law of the land and its obligations as applicable, the Contractor shall take all reasonable precautions a) in connection with rivers, streams, waterways, drains, watercourses, lakes, reservoirs and the like to prevent: i) Silting; . ii) Erosion of their beds or banks; and iii) Pollution of the water so as to affect adversely the quality or appearance thereof or cause injury or death to animal and plant life. b) in connection with underground water resources including percolating water to prevent. i) any interference with the supply to or obstruction from such sources; and ii) pollution of the water so as to affect adversely the quality thereof.
Sub-Clause 85.1 Maintenance of Right of Way	Throughout the period of the Contract, the Contractor shall at all times maintain public vehicular access along the right-of-way and from the right-of-way to all public and private access and land, as exists immediately prior to his commencement of the Works. The Contractor may on written request to the Engineer, (including a drawing, programme and specification), be given approval to operate. a) a road diversion suitable for the road traffic of suitable width,

or

b) traffic on a one way system using manual co-ordinated direction control or automatic traffic lights having a secure source of power.

Applications for approval shall show every detail of the proposals including road construction (cross section including pavement and surfacing, and profile and drainage), road signing, communication between the ends of the controlled section lighting and proposed period of operation.

One way systems shall be provided with adequate sign posting and the Contractor shall limit delays to any traffic to the minimum and with the approval of the Engineer. The traveling public shall be notified by signs, of exceptional delay well in advance of the site of delay, as required by the Engineer.

Annexure-AI

Salient features of some major Labour Laws applicable to establishments engaged in Construction of Civil Works

(i) Workmen Compensation Act, 1923

The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

(ii) Payment of Gratuity Act, 1972 s

Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death at the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

(iii) Emplovees' PF and Miscellaneous Provisions Act. 1952

The Act provides for monthly contributions by the employer plus workers @10 % or 8.33 %. The benefits payable under the Act are:

(a) Pension or family pension on retirement or death as the case may be.

(b) Deposit linked insurance on the death in harness of the worker.

(c) Payment of PF accumulation on retirement/death etc.

(iv) Maternity Benefit Act. 1951

The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

(v) Contract Labour (Regulation and Abolition) Act. 1970

The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided by the Principal Employer by Law. The principal employer is required to take Certificate of Registration and the Contractor is required to take a License from the designated Officer. The Act is applicable to the establishments or Contractor of principal employer if they employ 20 or more contract labour.

(vi) Minimum Wages Act. 1948

The employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, roads, Runways are scheduled employment.

(vii) Payment of Wages Act. 1936

It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

(viii) Equal Remuneration Act. 1979

The Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees in the matters of transfers training and promotions etc. .

(ix) Payment of Bonus Act. 1965

The Act is applicable to all establishments employing 20 or more workmen. The Act provides f()r payments of annual bonus subject to a minimum of 8.33 % of wages and maximum of 20 % ()f wages to employees drawing Rs. 3.500/- per month or less. The bonus to be paid to employees getting Rs. 2.500/- per month or above up to Rs.3.500/- per month shall be worked out by taking wages as Rs.2,500/- per month only. The Act does not apply to certain establishments. The newly set up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of the Act.

(x) Industrial Disputes Act, 1947

The Act lays down the machinery and procedure for resolution of industrial disputes. in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

(xi) Industrial Employment (Standing Orders) Act. 1946 i

It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the employer on matters provided in the Act and get the same certified by the designated Authority.

(xii) Trade Unions Act. 1926

The Act lays .down the procedure for registration of trade unions of workmen and employees. The trade unions registered under the Act have been given certain Immunities from civil and criminal liabilities.

(xiii) Child Labour (Prohibition and Regulation) Act. 1986

The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry.

(xiv) Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979

The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The inter-state migrant workmen, in an establishment to which this Act becomes applicable. are required to be provided certain facilities such as housing, medical aid, travelling expenses from home upto the establishment and back. etc

(xv) Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act. 1996 and the Cess Act of 1996

All the establishments who carry on any building or other construction work and employs 10 0 r more workers are covered under this Act. All such establishments are required to pay Cess at rate

not exceeding 2% of the cost of construction as may be notified by the Government. The employer of the establishment is required to provide safety measures at the Building 0 r Construction work and other welfare measures, such as Canteens, First-aid facilities, Ambulance, Housing accommodation for Workers near the workplace etc. The employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

(xvi) The Factories Act. 1948

The Act lays down the procedure for approval of plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

Annexure-A II

1.1.1.1.1.1.1. Safety & Welfare Provisions for labour to be employed by the Contractor

All necessary personal safety equipment as considered adequate by the Engineer shall be available for use of persons employed on the Site and maintained in a condition suitable for immediate use; and the Contractor shall take adequate steps to ensure proper use of such equipment by those concerned.

1. Safety Provisions:

The Contractor shall comply with all the precautions as required for the safety of the workmen.

(i) All workmen at site shall be provided with safety helmets and yellow/orange jackets. Workmen required on site during night hours shall be provided with fluorescent yellow jackets with reflective lopes.

(ii) Workers employed on mixing asphaltic materials, cement, lime mortars, concrete etc. shall be provided with protective footwear, protective goggles.

(iii) Those engaged in handling any material, which is injurious to the eyes, shall be provided with protective goggles. '

(iv) Those engaged in welding works shall be provided with welder's protective eye-shield.

(v) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

(vi) Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from solid construction except for such short period work as can be done safely from ladders. When a ladder is used, an extra labourer shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable foot-holds and hand-holds shall be provided on the ladder, which shall be given an inclination not steeper than 1/4 to 1.

(vii) Scaffolding or staging more than 3.25 metres above the ground or floor, swung or suspended from an overhead support or erected with stationary support, shall have a guard rail properly attached, bolted, braced and otherwise secured at least 1 metre high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the support or structure.

(viii) Working platforms, gangways, and stairways shall be so constructed that they do not sag unduly or unequally, and if the height of any platform or gangway or stairway is more than 3.25 metres above ground level or floor level it shall have closely spaced boards, have adequate width and be suitably provided with guard rails as described in (ii) above.

(ix) Every opening in the floor of a structure or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of one metre.

(x) Safe means of access and egress shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 metres in length. The width between side rails in a rung ladder shall in no case be less than 30 cm for ladders up to and including 3 metres in length. For longer ladders the width shall be increased at least 6mm for each additional 30 cm of length. Spacing of steps shall be uniform and shall not exceed 30 cm.

(xi) Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Contractor shall provide all necessary fencing and lights to protect the public from accidents and shall be bound to bear the expenses of defending every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the Contractor be paid to compromise any claim by any such person.

(xii) Excavation and Trenching: All trenches, 1.5 metres or more in depth, shall at all times be supplied with at least one ladder for each 20 metres in length or fraction thereof. Ladders shall be extended from the bottom of the trench to at least 1 metres or more in depth shall be stepped back to provide a suitable slope, or be securely held by timber bracing so as to avoid the danger of side collapse trench or half the depth of the trench, whichever is more. Excavation shall be made from the top to the bottom. Under no circumstances shall undermining or undercutting be done.

(xiii) When workers are employed in sewers and manholes, which are in use, the Contractor shall ensure that manhole are open and manholes are ventilated at least for an hour before workers are allowed to go into them. Manholes so open shall be cordoned off with suitable railing and provide warning signals or boards to prevent accidents to the public.

(xiv) Demolition: Before any demolition work is commenced and also during the process of the work.

a) All roads and open areas adjacent to the work site shall either be closed or suitably protected.

b) No electric cable or apparatus, which is liable to be a source of danger other than a cable or apparatus used by operators, shall remain electrically charged.

c) All practical steps shall be taken to prevent danger to persons employed by the Employer, from risk of fire or explosion, or flooding. No floor, roof or other part of a building shall be so overloaded with debris or materials as to render it unsafe.

(xv) When work is performed near any place where there is risk of drowning all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

(xvi) Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:

(a) These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good working order be regularly inspected and properly maintained.

(b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from defects.

(c) For every hoisting machine and every chain hook, shackle, swivel and pulley block used in hoisting, lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine or a variable safe working load, each safe working load and conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to in the paragraph above shall be loaded beyond safe working load except for the purpose of testing

(xvii) Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards; hoisting appliances shall be provided with such means as will reduce the risk of accident during descent of load to the minimum. Adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energised, insulating mats, working apparel such as gloves, sleeves and boots, as may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys or other material which are good conductors of electricity.

(xviii) AII scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work.

(xix) These safety provisions shall be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work location. Persons responsible for ensuring compliance with the Safety Code shall be named therein by the Contractor.

(xx) To ensure effective enforcement of the rules and regulations relating to safe1y precautions, arrangements made by the Contractor shall be open to inspection by the Engineer or his Representative.

(xxi) Notwithstanding anything contained in condition (i) to (xv) above, the Contractor shall remain liable to comply with the provisions of all acts, rules, regulations and bylaws for the time being in force in India and applicable in this matter.

The Contractor shall be responsible for observance, by his sub-contractors, of th e foregoing provisions.

2. Labour Welfare Provisions:

(i) First Aid:

At every workplace, there shall be maintained in a readily accessible place I first aid appliances including an adequate supply of sterilised dressings and sterilised cotton wool as prescribed in the Factory Rules of the State in which the work is carried on. The appliances shall be kept in good order and, in large work places, they shall be placed under the charge of a responsible person who shall be readily available during working hours.

(ii) Accommodation for Labour:

The Contractor shall during the progress of the work provide, erect and maintain necessary temporary living accommodation and ancillary facilities for labour at his own expense to standards and scales approved by the Engineer.

(iii) Drinking Water:

In every workplace, there shall be provided and maintained at suitable places easily accessible to labour, a sufficient supply of cold water fit for drinking.

Where drinking water is obtained from an intermittent public water supply each workplace shall be provided with storage tanks where drinking water shall be stored.

Every water supply storage shall be at a distance of not less than 15 metres from any latrine, drain or other source of pollution. Where water has to be drawn from an existing well, which is within such proximity of any latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with a trap door, which shall be dust proof and waterproof.

A reliable pump shall be fitted to each covered well. The trap door shall be kept locked and opened only for cleaning or inspection, which shall be done at least once a month.

(iv) Washing and Bathing Places:

Adequate washing and bathing places shall be provided separately for men and women. Such places shall be kept in clean and drained condition.

(v) Scale of Accommodation in Latrines and Urinals:

There shall be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, shall not be less than at the following scale:

No. of Seats

(a) Where number of persons does not exceed 50 2

(b) Where number of persons exceed 50 but does

not exceed 100 3

(c) For additional persons per 100 or part thereof 3

In particu1ar cases, the Engineer shall have the power to increase the requirement, wherever necessary.

(vi) Latrines and Urinals:

Except in workplaces provided with water-flushed latrines connected with a water borne sewage system, all latrines shall be provided with dry-earth system (receptacles) which shall be cleaned at least four times daily and at least twice during working hours and kept in a strictly sanitary condition. Receptacles shall be tarred inside and outside at least once a year.

If women are employed, separate latrines and urinals, screened from those for men and marked in the vernacular in conspicuous letters "For women only", shall be provided. Those for men shall be similarly marked "For men only". A poster showing the figure of a man and a woman shall also be exhibited at the entrance to latrines for each sex. There shall be adequate supply of water, close to latrines and urinals.

(vii) Construction of Latrines:

Inside walls shall be constructed of masonry or other non-absorbent material and shall be cement-washed inside and outside at least once a year. The dates of cement washing shall be noted in a register maintained for the purpose and kept available for inspection. Latrines shall have at least a thatched roof.

(viii) Disposal of Excreta:

Unless otherwise arranged for by the local sanitary authority, arrangement for proper disposal of excreta by incineration at the workplace shall be made by means of a suitable incinerator approved by the local medical health and municipal or cantonment authorities. Alternatively, excreta may be disposed of by putting a layer of night soils at the bottom of a pucca tank prepared for the purpose and covering it with a 15 cm layer of waste or refuse and then covering it with a layer of earth for a fortnight (when it will turn into manure).

The Contractor shall, at his own expense, carry out all instructions issued to him by the Engineer to effect proper disposal of soil and other conservancy work in respect of Contractor's work-purpose or employees on the site. The Contractor shall be responsible for payment of any charges, which may be levied by municipal or cantonment authority for execution of such work on his behalf.

(ix) Provisions of shelters during rest:

At every workplace, there shall be provided, free of cost, four suitable sheds, two for meals and two others for rest, separately for use of men and women labour. The height of each shelter shall not be less than 3 metres from floor level to lowest part of roof. Sheds shall be kept clean and the space provided shall be on the basis of at least 0.5 sq.m. per head.

(x) Creches:

At a place where women are ordinarily employed, there shall be provided at least one hut for use of children under the age ,of 6 years belonging to such women. Huts shall not be constructed to a standard lower than that of thatched roof, mud floor and wall with wooden planks spread over mud floor and covered with matting.

Huts shall be provided with suitable and sufficient openings, for light and ventilation. There shall be adequate provision of sweepers to keep the places clean. There shall be a maidservant in attendance. Sanitary utensils shall be provided to the satisfaction of local medical, health a municipal or

cantonment authorities. Use of huts shall be restricted to children, their attendants and mothers of children.

(xi) Canteen:

A cooked food canteen on a moderate scale sha11 be provided for the benefit of workers wherever it is considered necessary.

(xii) Planning, siting and erection of the above mentioned structures shall be approved by the Engineer or his Representative and the whole of such temporary accommodation shall at all times during the progress of the Works be kept tidy and in a clean and sanitary condition to the satisfaction of the Engineer or his Representative and at the Contractor's expense. The Contractor shall conform generally to sanitary requirements of local medical, health and municipal or cantonment authorities and at all times adopt such precautions as may be necessary to prevent soil pollution of the Site,

On completion of the Works, the whole of such temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer

(xiii) Anti-malarial precautions:

The Contractor shall, at his own expense, conform to all anti malarial instructions given to him by the Engineer, including filling up any borrow pi1s which may have been dug by him.

(xiv) Awareness and Education of HIV/AIDS

The contractor shall provide/carryout HIV/AIDS awareness and training programme 'to its labour and management, at least twice per year during the construction period.

(xv) Child labour Prohibition

The contractor shall not employ Child labour for any works or in any manner under the Contract at any time. In the event that the Contractor uses child labour, the Employer shall terminate the Contract.

(xvi) Amendments:

The Employer may, from time to time, add tor or amend these Rules and issue such directions as it may be considered necessary for the proper implementation of these Rules or for the purpose of removing any difficulty, which may arise in the administration thereof.

Annexure-A III

1.1.1.1.1.1.2. Disputes Review Board's Rules and Procedures

(see Clause 67 of the Conditions of Particular Application)

1. Except for providing the services required hereunder, the Board Members shall not give any advice to either party or to the Engineer concerning conduct of the Works. The Board Members:

(a) shall have no financial interest in any party to the Contract, or the Engineer, or a financial interest in the Contract, except for payment for services on the Board;

(b) shall have had no previous employment by, or financial ties to, any party to the Contract, or the Engineer, except for fee-based consulting services on other projects, and/or be Retired Government officers (not connected in whole or part with the project), all of which must be disclosed in writing to both parties prior to appointment to the Board;

(c) shall have disclosed in writing to both parties prior to appointment to the Board any and all recent or close professional or personal relationships with any director, officer, or employee of any party to the Contract, or the Engineer, and any and all prior involvement in the project to which the Contract relates;

(d) shall not, while a Board Member, be employed whether as a consultant or otherwise by either party to the Contract, or the Engineer, except as a Board Member, without the prior consent of the parties and the other Board Members;

(e) shall not, while a Board Member, engage in discussion or make any agreement with any party to the Contract, or with the Engineer, regarding employment whether as a consultant or otherwise either after the Contract is completed or after service as a Board Member is completed;

(f) shall be and remain impartial and independent of. the parties and shall disclose in writing to the Employer, the Contractor, the Engineer, and one another any fact or circumstance which might be such as to cause either the Employer or the Contractor to question the continued existence of the impartiality and independence required of Board Members; and

(g) shall be fluent in the language of the Contract. ,

2. Except for its participation in the Board's activities as provided in the Contract and in this Agreement none of the Employer, the Contractor, and or the Engineer shall solicit advicp or consultation from the Board or the Board Members on matters dealing with the conduct of the Works.

3. The Contractor shall:

(a) Furnish to each Board Member one copy of all documents which the Board may reques1 including Contract Documents, progress reports, variation orders, and other documents pertinent to the performance of the Contract.

(b) In cooperation with the Employer, coordinate the Site visits of the Board, including conference facilities, and secretarial and copying services.

4. The Board shall begin its activities following the signing of a Board Member's Declaration of Acceptance by all three Board Members, and it shall terminate these activities as set forth below:

(a) The Board shall terminate its regular activities when either (i) the Defects Liability Period referred to in Sub-Clause 49.1 (or, if there are more than one, the Defects Liability Period expiring

last) has expired, or (ii) the Employer has terminated the contract pursuant to Sub-Clause 63.1, and when, in either case, the Board has communicated to the parties and the Engineer its Recommendations on all disputes previously referred to it.

(b) Once the Board has terminated its regular activities as provided by the previous paragraph, the Board shall remain available to process any dispute referred to it by either party. In case of such a referral, Board Members shall receive payments as provided in paragraphs 7(a)(ii), (iii) and (iv).

5. Board Members shall not assign or subcontract any of their work under these Rules an d Procedures.

6. The Board Members are independent Contractors and not employees or agents of either the Employer or the Contractor.

7. Payments to the Board Members for their services shall be governed by the following provisions:

(a) Each Board Member will receive payments as follows:

(i) A retainer fee per calendar month equivalent to three times the daily fee established from time to time for arbitrators: under the Administrative and Financial Regulations of the International Centre for Settlement of Investment Disputes (the ICSID Arbitrator's Daily Fee), or such other retainer as the Employer and Contractor may agree in writing. This retainer shall be considered as payment in full for:

(A) Being available, on 7 days' notice.. for all hearings; Site Visits, and other meetings of the Board.

(B) Being conversant with all project developments and maintaining relevant files.

(C) All office and overhead expenses such as secretarial services, photocopying and office supplies (but not including telephone calls, faxes and telexes) incurred in connection with the duties as a Board Member.

(D) All services performed hereunder except those performed during the days referred to in paragraph (ii) below.

(ii) A daily fee equivalent to the ICSID Arbitrator's Daily Fee, or such other daily fee as the Employer and Contractor may agree in writing. This daily fee shall only be payable in respect of the following days, and shall be considered as payment in full for:

(A) Each day up to a maximum of two days of travel time in each direction for the journey between the Board Member's home and the Site or other location of a Board meeting.

(B) Each day on Site or other locations of a Board meeting.

(iii) Expenses. In addition to the above, all reasonable and necessary travel expenses (including less than first class air fare, subsistence, and other direct travel expenses) as well as the cost of telephone calls, faxes and telexes incurred in connection with the duties as Board Member shall be reimbursed against invoices. Receipts for all expenses in excess of Rs.1000/- (Rupees One Thousand only) shall be provided.

(iv) Reimbursement of any taxes that may be levied in the country of the Site on payments made to the Board Member (other than a national or permanent resident of the country of the Site) pursuant to this paragraph 7.

(b) Escalation. The retainer and fees shall remain fixed for the period of each Board Member's term.

(c) Phasing out of monthly retainer fee. Beginning with the next month after the Taking- Over Certificate referred to in Clause 48 (or, if there are more than one, the one issued last) has been issued, the Board Members shall receive only one-third of the monthly retainer fee. Beginning with the next month after the Board has terminated its regular activities pursuant to paragraph 4(a) above, the Board members shall no longer receive any monthly retainer fee.

(d) Payments to the Board Members shall be shared equally by the Employer and the Contractor. The Contractor shall pay Members' invoices within 30 calendar days after receipt of such invoices and shall invoice the Employer (through the monthly statements to be submitted in accordance with Sub-Clause 60.1 of the General Conditions) for one- half of the amounts of such invoices. The Employer shall pay such Contractor's invoices within the time period specified in the Construction Contract for other payments to the Contractor by the Employer.

(e) Failure of either the Employer or the Contractor to make payment in accordance with this Agreement shall constitute an event of default under the Contract, entitling the non- defaulting party to take the measures set forth, respectively, in Clause 63 or Clause 69.

(f) Notwithstanding such event of default, and without waiver of rights there from, in the event that either the Employer or the Contractor fails to make payment in accordance with these Rules and Procedures, the other party may pay whatever amount may be required to finance the operation of the Board. The party making such payments, in addition to all other rights arising from such default, shall be entitled to reimbursement of all sums paid in excess of one-half of the amount required to maintain operation of the Board, plus all costs of obtaining such sums.

8. Board Site Visits:

(a) The Board shall visit the Site and meet with representatives of the Employer and the Contractor and the Engineer at regular intervals, at times of critical construction events at the written request of either party, and in any case not less than 3 times in any period of 12 months. The timing of Site visits shall be as agreed among the Employer, the Contractor and the Board, but failing agreement shall be fixed by the Board.

(b) Site visits shall include an informal discussion of the status of the construction of the Works, an inspection of the Works, and the review of any Requests for Recommendation made in accordance with paragraph 10 below. Site visits shall be attended by personnel from the Employer, the Contractor and the Engineer.

(c) At the conclusion of each Site visit, the Board shall prepare a report covering its activities during the visit and shall send copies to the parties and to the Engineer.

9. Procedure for Dispute Referral to the Board:

(a) If either party objects to any action or inaction of the other party or the Engineer, the objecting party may file a written Notice of Dispute to the other party with a copy to the Engineer stating that it is given pursuant to Clause 67 and stating clearly and in detail the basis of the dispute.

(b) The party receiving the Notice of Dispute will consider it and respond in writing within 14 days after receipt.

(c) This response shall be final and conclusive on the subject, unless a written appeal to the response is filed with the responding party within 7 days after receiving the response. Both parties are encouraged to pursue the matter further to attempt to settle the dispute.

(d) When it appears that the dispute cannot be resolved without the assistance of the Board, or if the party receiving the Notice of Dispute fails to provide a written response within 14 days after receipt of such Notice, either party may refer the dispute to the Board by written Request for Recommendation to the Board. The Request shall be addressed to the Chairman of the Board, with copies to the other Board Members, the other party, and the Engineer, and it shall state that it is made pursuant to Clause 67.

(e) The Request for Recommendation shall state clearly and in full detail the specific issues of the dispute to be considered by the Board.

(f) When a dispute is referred to the Board, and the Board is satisfied that the dispute requires the Board's assistance, the Board shall decide when to conduct a hearing on the dispute. The Board may request that written documentation and arguments from both parties be submitted to each Board Member before the hearing begins. The parties shall submit insofar as possible agreed statements of the relevant facts.

(g) During the hearing, the Contractor, the Employer, and the Engineer shall each have ample opportunity to be heard and to offer evidence. The Board's Recommendations for resolution of the dispute will be given in writing to the Employer, the Contractor and the Engineer as soon as possible, and in any event not more than 56 days or any mutually extended period between the Employer and the Contractor.

10. Conduct of Hearings:

(a) Normally hearings will be conducted at the Site, but any location that would be more convenient and still provide all required facilities and access to necessary documentation may be utilized by the Board. Private sessions of the Board may be held at any cost effective location convenient to the Board.

(b) The Employer, the Engineer and the Contractor shall be given the opportunity to have representatives at all hearings.

(c) During the hearings, no Board Member shall express any opinion concerning the merit of the respective arguments of the parties.

(d) After the hearings are concluded, the Board shall meet privately to formulate its Recommendations. All Board deliberations shall be conducted in private, with all Members' individual views kept strictly confidential. The Board's Recommendations, together with an explanation of its reasoning shall be submitted in writing to both parties and to the Engineer The Recommendations shall be based on the pertinent Contract provisions, applicable laws and regulations, and the facts and circumstances involved in the dispute.

(e) The Board shall make every effort to reach a unanimous Recommendation. If this proves impossible, the majority shall decide, and the dissenting Member may prepare a written minority report for submission to both parties and to the Engineer.

11. In all procedural matters, including the furnishing of written documents and arguments relating to disputes, Site visits, and conduct of hearings, the Board shall have full and final authority. If a unanimous decision on any such matter proves impossible, the majority shall prevail.

12. After having been selected and, where necessary, approved, each Board Member shall sign two copies of the following declaration and make one copy available each to the Employer and to the Contractor.

"BOARD MEMBER'S DECLARATION OF ACCEPTANCE

WHEREAS

(a) a Construction Contract (the Contract) for the _____project [fill in the name of project] has been signed on _____[fill in date] between _____[name of Employer] (the Employer) and _____[name of Contractor] (the Contractor).;

(b) Clause 67 of the Conditions of Particular Application of the Construction Contract and Annex A to said Conditions provide for the establishment and operation of a Disputes Review Board (the Board);

(c) the undersigned has been selected (and where required, approved) to serve as a Board Member on said Board;

NOW THEREFORE, the undersigned Board Member hereby declares as follows:

1. I accept the selection as a Board Member and agree to serve on the Board and to be bound by the provisions of Clause 67 of the Conditions of Particular Application of the Contract and Annex A to said Conditions.

2. With respect to paragraph 1 of said Annex A, I declare

(a) that I have no financial interest of the kind referred to in subparagraph (a);

(b) that I have had no previous employment nor financial ties of the kind referred to in subparagraph (b); and

(c) that I have made to both parties any disclosures that may be required by sub- paragraphs (b) and (c).

BOARD MEMBER

_____

_____[insert name of Board Member]

Date:_____ "

--------End of Main Document----------

Prepared for:

सड़क परिवहन और राजमार्ग मंत्रालय
MINISTRY OF ROAD TRANSPORT & HIGHWAYS

Karnataka
Public Works, Ports & Inland Water Transport Department

Project:

Consultancy Services for "Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.000 to 261.450 on NH-48 in the State of Karnataka"

Subject:

KD-6 - Draft Detailed Project Report for Final Approved Alignment for Bypass

Volume - XI: Project Clearances

Prepared by:

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Revision History

Rev.	Date	Long Description

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INTRODUCTION

This report is prepared under Contract Agreement clause 2.8; "Key Date No: KD 6: Draft De tailed Project Report for Final Approved Alignment for Bypass (DDPR)" after incorporation of Client's observations on earlier submitted "KD5: Kucha Draft Detailed Project Report (KDDPR)" vide letter no. NH/PIU-Tunnel/NH-48/KD-3/2015-16/383-386 dated 14.12.2015.

The present submission (10 Hard Bound Sets and 5 Soft Copies of each) is as detailed below:

(i) Volume-I, Main Report:

- *Executive summary*
- *Project Description*
- *Socio Economic Profile*
- *Materials Surveys and Investigation*
- *Traffic Surveys and Analysis*
- *Design Standards and Specifications*
- *Alignment Proposals*
- *Summary of EIA/IEE and Action Plan*
- *Summary of Resettlement Plan*
- *Preliminary Cost Estimates*
- *Preliminary Economic Analysis*
- *Preliminary Financial Analysis*
- *Suggested Methods of procurement and packaging*
- *Conclusions and Recommendations*
- *Acknowledgement*
- *Compliance of the Observations*

The basic data obtained from the field studies and investigations and input data used for the detailed engineering design (if any) shall be submitted in a separate volume as an Appendix to Main Report.

(ii) Volume – II : Design Report

Part- I Traffic Study, Analysis and Forecast :

- *Description of Existing Road in Ghat Section*
- *Road and Bridge Inventory*
- *Traffic Surveys, analysis and forecast*
- *Proposed Pavement Design*

Part-II Design of Tunnels :

- *Proposed Tunnel Design, Standards*
- *Structural Analysis- Primary Lining*

Part-III Design of Bridges and Cross-Drainage Structures :

- *Proposed Bridges and Structures Design Basis and*
- *Bridges Dimensioning*

Part-IV Geological Design and Geotechnical Report :

- *Geological Survey and Analysis*
- *Geotechnical Investigations Report*

(iii) Volume-III Materials Report :

(iv) Volume - IV(a) Environmental Assessment Report including Environmental Management Plan (EMP) &

(v) Volume - IV(b) Resettlement Action Plan (RAP) :

(vi) Volume - V Technical Specifications :

(vii) Volume - VI Rate Analysis :

(viii) Volume - VII Cost Estimates :

(ix) Volume - VIII Bill of Quantities :

(x) Volume - IX Drawings (A3 Size) :

a. *Location map*
b. *Layout plans*
c. *General Drawings*
d. *Plan and Profile of Refined Alignment "A"*
e. *Typical Cross Sections showing Pavement details of Cut & Fill Section*
f. *Typical Cross Sections of Tunnel*
g. *Typical Cross Sections of Bridges*
h. *Tunnels- General Arrangement Plan and L-Sections (L&R)*
i. *Viaducts – General Arrangement Plan and L-Section*
j. *Cut & Fill and Viaducts – General Arrangement Plan and L-Section*
k. *GAD for proposed RoB at Railway km 54+650*
l. *Standard Drawings*
m. *Miscellaneous Drawings*
n. *Indicative Land Acquisition Plans*
o. *Detailed Cross Sections @ 100m interval*

(xi) Volume - X Civil Work Contract Agreement :

(xii) Volume - XI Project Clearances :

Volume – XI: Project Clearances

1 GENERAL

This Volume -XI: Project Clearance, a part of KD6: Draft Detailed Project Report for Final Approved Alignment for Bypass (DDPR) is submitted in accordance with the Contract Agreement for Preparation of “Feasibility-Cum-Geo Technical Study for the bypass to Shiradi Ghat from Km 238.00 to 261.45 on NH-48 in the State of Karnataka”.

2 PROJECT BACKGROUND

The section of National Highway – 48 Bangalore – Mangalore road between Maranahally (km 238.00) and Gundya (km 261.450) runs in deep mountain and valleys are called Shiradi Ghat. The average rain fall is of 6000 mm to 7000 mm per year. The topography changes up to approximately 700 mtrs over a length of 26.00 km. The Shiradi Ghat of NH-48 is very steep and comprised of many hairpin bends. The road is being closed every year during monsoon for certain period due to earth slips. Due to rugged terrain and difficult Geomorphology the widening of the road is not easy. The tremendous in VPD has been causing strenuous for smooth plying of vehicles and maintenance of the road. Further, Shiradi Ghat is a highly eco-conscious forest reservation are. This stretch of road may be got reduced by constructing 4-lane new Bypass [two tubes of 2+1(emergency lane) tunnels, 4-lane bridges, number of lane and lane width have been designed considering the current traffic intensity and projected traffic volume for 20 years] comprising of four lane road. High rise pier Bridges with long arch span to negotiate deep valleys and Tunnel road to cross mountain ranges. The total length of road between Maranahally and Gundya could be reduced to 23.6km as against 26.0km. It is proposed to link this stretch of 4-lane Bypass to entire Bangalore – Mangalore expressway which is proposed to be widen as 4-lane road throughout.

3 EXISTING CHARACTERISTICS OF THE PROJECT ROAD

The terrain on this Ghat section of 23km can be termed as hilly and mountainous. The abutting land use pattern varies from residential to agricultural and forest area. Sparingly industrial land also is observed along with barren lands. Almost throughout the ghat section of the Project Highway, very few human settlements were observed along the road. They were as semi built-up and completely built-up areas. The settlements are mainly residential, commercial, religious places viz temple, masjid/mosque, church and petrol stations. The river Kempu hole runs almost parallel to the road on left side along the entire Ghat section. Important crops grown are coffee, Black Pepper, Potato, Paddy and Sugarcane. Three mini hydel power station is located at the Ghat section to the left of the highway.

Important places and villages are Heggade, Maranhally, Kempuhole, Gundiya, and Adda hole along the Project stretch. The existing road is having two lane undivided carriageway width of 7.0 m of flexible & newly laid rigid pavement and predominantly gravel/earthen shoulder of 1.0m to 2.0m width.

The existing road is having two lane undivided carriageway width of 7.0 m of flexible pavement with predominantly earthen shoulder and paved shoulder at few locations of width varying from 1.0m to 1.5m. The horizontal geometry of the Project road doesn't meet IRC standards with respect of design speed, pavement surface condition, riding quality etc. It has many sharp and substandard curves; the stretches passing through ghat sections have sharp curves with design speed of less than 30kmph. All major utility providers have cables running throughout the project road on both sides.

The State PWD had successfully completed the improvement and reconstruction work of the badly damaged bituminous pavement by providing cement concrete pavement from km 238 to km 250 in 2015; and taking up balance section from km 228 to km 238 and km 250 to km 263 shortly.

4 LAND TOPOGRAPHY

Karnataka has representatives of all types of variations in topography - high mountains, plateaus, residual hills and coastal plains. The State is enclosed by chains of mountains to its west, east and south. It consists mainly of plateau which has higher elevation of 600 to 900 metres above mean sea level. The entire landscape is undulating, broken up by mountains and deep ravines. Plain land of elevation less than 300 metres above mean sea level is to be found only in the narrow coastal belt, facing the Arabian Sea. There are quite a few high peaks both in Western and Eastern Ghat systems with altitudes more than 1,500 metres. A series of cross-sections drawn from west to east across the Western Ghat generally exhibit, a narrow coastal plain followed to the east by small and short plateaus at different altitudes, then suddenly rising up-to great heights.

Then follows the gentle east and east-north-west sloping plateau. Among the tallest peaks of Karnataka are the Mullayyana Giri (1,925 m), Bababudangiri (Chandradrona Parvata 1,894 m) and the Kudremukh (1,895 m) all in Chikmagalur Dt. and the Pushpagiri (1,908 m) in Kodagu Dt. There are a dozen peaks which rise above the height of 1,500 metres.

5 THE PROJECT AREA

The project road passes to Dakshin Kannada and Hassan District. In this project road, Heggade, Maranhally, Aluvalli, Yadekumari, Kagenari State forest and Gundya village are coming along the proposed road and Tunnel.

6 PROPOSED ALIGNMENT

The project road takes off at Heggade, km 236.400 towards left side of the road after crossing the existing Kempu hole river and traverses through reserve forest areas near to existing railway track alignment. There are six (6) tunnels (twin tubes), six (6) major bridges, two (2) RoB, one long viaduct and ten (10) cut & fill sections. Details of project clearances and utilities for the project road are described follows:

6.1 Right of Way (ROW)

The proposed alignment is a green alignment passing almost through barren and forest land except at entry & exit of NH-48 road. There is no existing ROW, hence total corridor of about 100m land width along the centre line of total alignment will be required during construction period. After construction of tunnels, high level bridges & viaducts and cut & fill sections, permanent land acquisition for proposed Right of Way will be required in cut & fill sections. Initially land details for required ROW was initially collected on enquiry from the local PWD and officers, Revenue department and the same are presented herewith. Subsequently, the village maps from the revenue authorities have been collected and the proposed ROW will be marked accordingly on the LA plans. The details of proposed ROW is also given in Table 1.

Table: 1: Details of Proposed Right of Way and Land Acquisition

Sl	Design Chainage (Km)		Length (km)	Distance of PROW (m) wrt proposed centre line of alignment		Total PRoW (m) (1+2)	Area (Ha)	Remarks
	From	To		LHS (1)	RHS (2)			
1	0	23+561	12.600	50	50	100		Tunnel Sections
2			6.840	50	50	100		Bridges and Viaduct
3			4.100	30	30	60		Cut & Fill Sections

6.2 Districts, Taluk and Villages

The project road passes through Hassan and Dakshin Kannada (Mangalore) Districts. Detatails of Taluk, Villages lying in the project area are given in Table 2 as below:

Table: 2: Details of District, Taluk and Villages

Sl	District	Taluk	Hddi	Village
1	Hassan	Sakleshpur		Aluvalli
2	Hassan	Sakleshpur	Hanbal	Maranhally
3	Hassan	Sakleshpur	Hanbal	Heggade
4	Hassan	Sakleshpur	Hetthur	Yadakumari
5	Hassan	Sakleshpur		Kadagarvalli
6	Mangalore	Puttur	Subramaya	Gundya
7	Mangalore	Puttur	Subramaya	Arebatta
8	Mangalore	Puttur	Subramaya	Addahole
9	Mangalore	Puttur	Subramaya	Shiribagilu

6.3 Land Acquisition

Effort has been made to align the road and plan alignment proposal to minimized land acquisition. As per MoRTH guidelines the land acquisition for cut & fill sections is kept as 60m to minimize the impact. In all other section the proposed ROW is 100m. However, additional land is required in the following situations:

- At the taking off existing NH-48 section, km 236.400 and merging point near Adda Hole; km 263.400 km for exit & entry junctions development with NH- 48.
- At Bus Bays connectivity to Railway Stations Kadagarvalli and Yadakumari.
- Sight Seeing Points and Rest Areas (if any) near Yadakumari Railway Station
- At Toll-Plaza Location (if any) is proposed as per Government policies.

6.4 Land Acquisition Plans

There is a requirement of forest land up to 95% of total land acquisition. Land Acquisition Report and Strip Plan will be prepared and submitted for the project road section. The report will include schedules about acquisition of land holdings as per revenue records and their locations in a strip plan and costs as per district authorities. The LA documents will be prepared in consultation with the concerned affected persons, non-government agencies; government agencies and MoRTH, NH-KPWD and Authority officials. The details will be submitted in Kannad and English both languages as per MoRTH guidelines. Land acquisition process will be started now as alignment option A has been approved on 12.11.2015. LA Plans will be submitted as per schedule after joint verification with concerned officials. The LA Plan and Form 3'a'; 3"A", & Draft 3"D" will be submitted to Authority shortly.

6.5 Relocation of Utilities

The inventory as well as topographic survey will be carried out to find out existence of the following types of utilities within proposed ROW on both sides of centre line alignment. Suitable location /area will be proposed for relocation of different utilities.

- Electric Line (EL)
- Light Poles
- Electric Transformer
- High Tension Line (HTL)
- Telephone Lines (TL)
- Optical Fibre Cable (OFC)
- Water Supply Pipe Line
- Hand Pump

The effected Utilities will be submitted to Authority along with Draft Detailed Project Report. The individual utilities have been submitted with this report for onwards submission to respected department for finalization of cost estimation.

6.5.1 Electric Line (EP)

Electric Lines doesn't exist on both side of proposed centre line of the alignment and proposed right of way.

6.5.2 Electric Transformer & Junction Box (TF & EPB)

There is no Electric Transformers and junction box located and/or affected within the proposed corridor. The effected transformers and Junction box (if any) found in due course up to Final DPR submission will be shifted to Utility corridor of proposed road.

6.5.3 Telephone Line & Post (TP)

There is no Telephone Lines and Post exists along the proposed road alignment and Right of Way. The affected telephone lines will be listed (if any) found in due course up to Final DPR submission. These will be relocated at Utility corridor of proposed Road.

6.5.4 High Tension Line (HT)

The proposed project road is not crossing any High tension line from km 0 to km 23.6. The Proposed alignment and Right of Way are not affecting High Tension Line and Pylon.

6.5.5 Optical Fiber Cable (OFC)

Optical fiber cables don't exist along the proposed road alignment. The proposed road alignment will not affect the Optical Fiber Cable line. The effected OFC line will be listed which need to be relocated at Utility Corridor if required.

6.5.6 Hand Pump

Hand pump are not found along the proposed road alignment. If anyone found out then these hand pump need to be relocated for the purpose of proposed bypass alignment. The effected hand pumps will be listed and to be relocated outside the road corridor.

6.5.7 Water Pipe Line and Water Tap (WT)

Water distribution line has been observed at Heggade, Maranhally, Yadakumari, Shiradi, Gundya and Addhole villages. The water distribution line is close to the existing road (NH-48) along with water tap. The existing water pipe line and Tap is NOT falling with the proposed road corridor and which doesn't need to be relocated in the Utility corridor of proposed road.

6.6 Tree Cutting and Forest Clearances

The affected Tree lying within Proposed Right of Way (PROW) to be fallen down will be submitted in Tree Cutting Plan Drawings with this Draft DPR.

The letters will be written to concerned District Forest Officer (DFO) Hassan, and Mangalore for joint verification and numbering of trees, estimate of tree cutting etc.

The details of forest land are as below:

Table: 3: Forest Area

Sl. No.	Name and Type of Forest	Existing Road (km)		Length (km)
		From	To	
1	Reserved Forest (Shiradi Ghat ,Hassan District)	236.400	255.000	19.600
2	Reserved Forest (Shiradi Ghat, Mangalore Distric)	255.000	263.400	13.400
Total				**23.000**

6.7 GAD's Approval of ROB

There is a proposed ROB at Railway Km 54+650. The GAD of proposed ROB will be submitted on-line to the concerned Authority shortly subsequently GAD will be reviewed by Railway officials. The Final GAD will be submitted after incorporating observation from Railway authority.

6.8 Interaction with Affected Agencies

The Consultant will submit Draft letters to Authority for onwards submission to concerned agencies for getting estimate for shifting/ relocation of affected utilities. The Utility Relocation Plan of all affected on surface and underground utilities with Draft DPR.

However, individual utilities plan and lists are being submitted herewith for further action to individual department for project clearances.

7 TABLE OF ANNEXURES

Sr. No.	Topic	Pages