

AFRICAN DEVELOPMENT BANK
GOVERNMENT OF MAURITIUS

CONTRACT
FOR
CONSTRUCTION
OF
BEAU BASSIN - PORT LOUIS LINK ROAD

VOLUME B

TECHNICAL SPECIFICATIONS

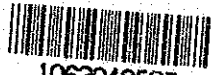
SEPTEMBER 1980

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國際協力事業団	
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TECHNICAL SPECIFICATIONS

These Technical Specifications are intended to amplify the requirements of the Contract and nothing therein contained shall be in derogation of anything contained in the General Conditions of Contract, nor relieves the Contractors of any of their obligations under the said Conditions.

The General Conditions of Contract and the Drawings shall be read in conjunction with these Specifications, and matter referred to, shown or described in any of the former are not necessarily repeated in the latter.

Notwithstanding the Sub-division of these Specifications under different headings, every part of it shall be deemed supplementary to and complementary of every other part, and shall be read with it, or into it, so far as it may be.

These Specifications have been drawn up with all possible care and are intended to cover the supply of all complete the works. In case there are more details of construction or materials which have not been referred to in these Specification on the Bill of Quantities and Drawings but the necessity of which may be reasonably implied or inferred from the Contract documents or which are usual or essential to the completion of all trade, the same shall be deemed to be included in the rates and prices named by the Contractor in the priced bill of quantities.

TECHNICAL SPECIFICATIONS

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- PART 2 DEMOLITION AND CLEARANCE WORKS
- PART 3 EARTHWORKS
- PART 4 STRUCTURAL CONCRETE AND CONCRETE ANCILLARIES WORKS
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- PART 6 STORM DRAINAGE WORKS
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PART 1

GENERAL ITEMS

PART 1 GENERAL ITEMS

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PART 1 GENERAL ITEM

101 LOCATION OF SITE

The Site of Works is located as following on the Island of Mauritius:

Origin of project: Beau Bassin

End of project : Port Louis

102 WORKS TO BE EXECUTED

The Works to be executed under the Contract comprise the construction of:

- (a) 7.6 km of Beau Bassin - Port Louis Link Road (trunk road), of which 0.9 km is 2-lane and 6.7 km is 4-lane,
- (b) 1.8 km of the 2-lane access road.
- (c) 1.0 km of re-alignment of existing motorway at the interchange,
- (d) 10 box culverts,
- (e) 4 roundabouts,
- (f) 2 interchanges,
- (g) 4 Link Road (trunk road) bridges,
- (h) 4 rampway bridges,
- (i) 7 motorway junction bridges,
- (j) 5 overbridges,
- (k) 2 pedestrian bridges,
- (l) 2 aquaduct bridges, and
- (m) all drains, pavements, road markings, traffic signs, lighting and other ancillary works.

103 EXTENT OF CONTRACT

The work specified shall include all general preparatory work on all matters, things, requisites and work of any kind necessary for the due and satisfactory construction, completion and maintenance of the Works to the true intent and meaning of the Drawings and these Specifications and further drawings and orders that may be issued by the Engineer from time to time; compliance by the Contractor with all Conditions of Contract whether specifically mentioned or not in the clauses of these Specifications; all materials, apparatus, plant machinery, tools, fuel, water, temporary works and roads, strutting, timbering moulds and trackles of every description; transport offices, stores, workshops, staff and labour; the provision of proper and sufficient protective works, temporary fencing, lighting and watching required for the safety of the public and protection of the Works and adjoining lands and waterways; all measures necessary to ensure the safety of shipping and shipping operations general; first-aid equipment, mess and sanitary accommodation for staff and workmen; the effecting and maintenance of all insurances, the payment of all wages, salaries, fees, royalties, duties or other charges arising out of the execution of the Works; the regular clearance of rubbish, and reinstatement of and clearing up and leaving perfect the site after completion.

104 CONTRACT DRAWINGS AND TECHNICAL DOCUMENTS

The Drawings and Technical Documents referred to in the Conditions of Contract are enumerated hereunder. These Drawings are subject to modifications and additions as described in the General Conditions of Contract.

The Contract Drawings shall also include any other drawings which the Engineer may issue from time to time during the currency of the Contract, and where, under various clauses of this Specification or on the order of the Engineer or his Representative, the Contractor is required to

furnish drawings for the Engineer's use or approval, all such drawings shall be of a standard size including 3 cm on the left-hand edge for binding.

No examination or approval by the Engineer of any drawing or other document submitted by the Contractor shall relieve the Contractor of any of his responsibilities or liabilities under the Contract and the Contractor shall be and remain entirely responsible for the proper execution, completion and maintenance of the Works in accordance with the terms of the Contract Documents.

The Contract Price shall be deemed to include the cost of the supply and delivery of all drawings, prints and tracings which the Contractor is required to provide if in accordance with the various clauses of these Specifications.

LIST OF DRAWINGS

VOLUME C

TECHNICAL DOCUMENTS

I. ROAD

LOCATION PLAN

ABBREVIATION

PLAN

Main Road

ditto (Phased Construction)

Access Road

PROFILE

Main Road

Coromandel Interchange A - H Ramp

Motorway Junction A - I Ramp and M₁ - M₂ Road

Access Road

TYPICAL CROSS SECTION

HORIZONTAL ALIGNMENT OF INTERCHANGE

ACQUISITIONS

II. ROAD

LOCATION PLAN

ABBREVIATION

HYDRAULIC AND MICELLANEOUS STRUCTURES

BOX CULVERTS

STA 9 + 37.2	Main Road
STA 13 + 95	ditto
STA 15 + 13.4	ditto
STA 15 + 66	ditto
STA 27 + 82	ditto
STA 30 + 73.2	ditto
STA 38 + 20	ditto
STA 68 + 88	ditto
STA 2 + 65	Access Road
STA 8 + 00	ditto

BRIDGE OF FRONTAGE ROAD AND OTHER STRUCTURES

DETAILED PLAN OF ROUNDABOUT AND INTERSECTIONS

St. Martin Junction
Barkly Junction
Beau Bassin Roundabout
Cheble Branch Roundabout
Lichelieu Approach Junction
Coromandel Interchange
S. Hill Junction
Motorway Junction
ditto (Phased Construction)

TEMPORARY ROAD OF A₁ ROAD

STONE MASONRY AND CONCRETE RETAINING WALL

ROAD MARKING AND SIGNS

ILLUMINATION

GEOLOGY

MASS HAUL DIAGRAM

III. BRIDGE

GENERAL

GENERAL NOTES (1)

GENERAL NOTES (2) AND ABBREVIATIONS

SPECIAL LOADING TEST ON THE BRIDGE DECK 1/2

ditto 2/2

STRUCTURES

LINK ROAD BRIDGES

G.R.N.W. A-Le. Br. GENERAL VIEW 1/2

ditto ditto 2/2

ditto BRIDGE ALIGNMENT 1/2

ditto ditto 2/2

ditto PC T-GIRDER

ditto ditto

ditto ABUTMENTS

ditto ditto

ditto PIERS

ditto ditto

ditto SCOUR PROTECTION

G.R.N.W. B-Le. Br. GENERAL VIEW 1/2

ditto ditto 2/2

ditto BRIDGE ALIGNMENT 1/2

ditto ditto 2/2

ditto ABUTMENTS

ditto A₁

ditto	A ₂
ditto	A ₂ WING WALL
ditto	PIERS
ditto	ditto
ST.L.Ri A-Le. Br.	GENERAL VIEW
ditto	BRIDGE ALIGNMENT
ditto	ABUTMENTS
ditto	A ₁
ditto	A ₂
ST.L.Ri. B-Le. Br.	GENERAL VIEW
ditto	BRIDGE ALIGNMENT
ditto	ABUTMENTS
ditto	A ₁ A ₂
ditto	A ₁ WING WALL
ditto	A ₂ WING WALL

RAMP WAY BRIDGES

KEY PLAN

Mwy. Jun. B-Rp. Br.	GENERAL VIEW
ditto	BRIDGE ALIGNMENT
ditto	VOIDED SLAB
ditto	ditto
ditto	ditto
ditto	SIDE SPAN SOLID SLAB
ditto	ABUTMENTS
ditto	ditto

ditto	P ₁
ditto	P ₂
ditto	P ₃
Mwy. Jun. G-Rp. Br.	GENERAL VIEW
ditto	BRIDGE ALIGNMENT
ditto	VOIDED SLAB
ditto	ditto
ditto	ditto
ditto	SIDE SPAN SOLID SLAB
ditto	A ₂
ditto	A ₂
ditto	A ₂ WING WALL
ditto	P ₁
ditto	P ₂
Cor. Int. E-Rp. Br.	GENERAL VIEW
ditto	BRIDGE ALIGNMENT
ditto	VOIDED SLAB
ditto	ditto
ditto	ditto
ditto	SIDE SPAN SOLID SLAB
ditto	ABUTMENTS
ditto	P ₁
ditto	P ₃
Cor. Int. F-Rp. Br.	GENERAL VIEW
ditto	BRIDGE ALIGNMENT
ditto	VOIDED SLAB
ditto	ditto
ditto	SIDE SPAN SOLID SLAB

OVER BRIDGE

PAILLES Ov. Br.	GENERAL VIEW
ditto	PC T-GIRDER
ditto	ditto
ditto	SIDE SPAN SOLID SLAB
ditto	ABUTMENTS
ditto	P ₁ P ₃
ditto	P ₂
AI-ROAD Ov. Br.	GENERAL VIEW
ditto	PC T-GIRDER
ditto	ditto
ditto	SIDE SPAN SOLID SLAB
ditto	ABUTMENTS
ditto	PIERS
ditto	P ₁ P ₃
ditto	P ₂
COROMANDEL Ov. Br.	GENERAL VIEW
ditto	PC T-GIRDER
ditto	ditto
ditto	SIDE SPAN SOLID SLAB
ditto	ABUTMENTS
ditto	P ₁ P ₃
ditto	P ₂
Cor. Int. H-Rp Ov. Br.	GENERAL VIEW
ditto	PC T-GIRDER

ditto	ditto
ditto	ABUTMENTS
STA.22 Ov. Br.	GENERAL VIEW
ditto	VOIDED SLAB
ditto	SIDE SPAN SOLID SLAB
ditto	ABUTMENTS
ditto	P ₁ P ₃
ditto	P ₂

PEDESTRIAN BRIDGES

Hin. TEMPLE Ped. Br.	GENERAL VIEW
ditto	VOIDED BEAM
ditto	ditto
ditto	SUBSTRUCTURES
ditto	A ₁ P ₁
ditto	A ₂ RW-U
B.B. Ped. Br.	GENERAL VIEW
ditto	VOIDED BEAM
ditto	ABUTMENTS
ditto	A ₁ RW-U
ditto	A ₂

AQUEDUCTS

STA.22 AQUEDUCT	GENERAL VIEW
ditto	PC U-GIRDER
STA.57 AQUEDUCT	GENERAL VIEW
ditto	PC U-GIRDER
ditto	SUBSTRUCTURE

MOTORWAY JUNCTION BRIDGES

KEY PLAN

Mwy. Jun. Brs.

GENERAL VIEW

ditto	ditto
Mwy. Jun. A-Le. 1 Br.	ditto
Mwy. Jun. B-Le. 1 Br.	ditto
Mwy. Jun. A-Le. 2 Br.	ditto
Mwy. Jun. B-Le. 2 Br.	ditto
Mwy. Jun. A-Le. 1 Br.	BRIDGE ALIGNMENT
Mwy. Jun. B-Le. 1 Br.	ditto
Mwy. Jun. A-Le. 2 Br.	ditto
Mwy. Jun. B-Le. 2 Br.	ditto
Mwy. Jun. A, B-Le. 1.2 Brs.	SPAN 33.2 m PC T-GIRDER
ditto	ditto
ditto	SPAN 29.2 m PC T-GIRDER
ditto	ditto
ditto	SPAN 26.8 m PC T-GIRDER
ditto	ditto
ditto	SPAN 20.2 m PC T-GIRDER
ditto	ditto
ditto	ABUTMENTS
ditto	WING WALLS
ditto	A-Le. 1 Br. A ₁

ditto	A-Le. 1 Br. A ₁ WING WALL
ditto	A-Le. 1 Br. A ₂
ditto	A-Le. 1 Br. A ₂ WING WALL
ditto	B-Le. 1 Br. A ₁
ditto	B-Le. 1 Br. A ₁ WING WALL
ditto	B-Le. 1 Br. A ₂
ditto	B-Le. 1 Br. A ₂ WING WALL
ditto	A-Le. 2 Br. A ₁
	B-Le. 2 Br. A ₁ A ₂
ditto	ditto
ditto	A-Le. 2 Br. A ₁ WING WALL
ditto	B-Le. 2 Br. A ₁ WING WALL
ditto	B-Le. 2 Br. A ₂ WING WALL
ditto	A-Le. 2 Br. A ₂
ditto	A-Le. 2 Br. A ₂ WING WALL
ditto	PIERS
ditto	ditto
Mwy. Jun. A-Le. 3 Br.	GENERAL VIEW
ditto	BRIDGE ALIGNMENT
ditto	VOIDED SLAB
ditto	A ₁
ditto	ditto
ditto	ditto
ditto	A ₂
ditto	ditto
ditto	ditto
ditto	A ₁ A ₂ WING WALL
Mwy. Jun. B-Le. 3 Br.	GENERAL VIEW
ditto	BRIDGE ALIGNMENT
ditto	VOIDED SLAB
ditto	ABUTMENTS
ditto	A ₁

ditto	A ₂
ditto	A ₁ A ₂ WING WALL
Mwy. Jun. E-Rp. Br.	GENERAL VIEW
ditto	BRIDGE ALIGNMENT
ditto	SPAN 33.2 m PC T-GIRDER
ditto	ditto
ditto	SPAN 29.2 m PC T-GIRDER
ditto	ditto
ditto	SPAN 20.2 m PC T-GIRDER
ditto	ditto
ditto	ABUTMENTS
ditto	A ₁
ditto	A ₂
ditto	A ₂ WING WALL
ditto	PIERS
ditto	ditto
Mwy. Jun. Brs.	RW ₁ RW ₂
ditto	RW ₁
ditto	RW ₂
ditto	RW ₃ RW ₄
ditto	RW ₃
ditto	RW ₄
ditto	RW ₅ RW ₆
ditto	RW ₅
ditto	RW ₆

MISCELLANEOUS WORKS AND FURNISHINGS

MISCELLANEOUS WORKS

APPROACH SLAB DETAILS

VEHICLE PARAPET DETAILS

ditto

ditto

BEARING DETAILS

DRAINAGES

ditto

ditto

EXPANSION JOINTS

NEWEL POST

105 STANDARDS OF WORKMANSHIP AND MATERIALS

All materials, plant, labour and workmanship connected with the execution of work shall be to a standard not less than that specified in the British Standard specifications and the British Code of Practice or their equivalent. Where reference is made to other specifications such as ASTM or AASHO, the latest edition shall be used.

106 NATURE OF GROUND AND CONDITIONS OF WORK

The Contractor must satisfy himself as to the general circumstances at the site of the Works and the construction thereon; the form of river beds and banks, the river flows, the surface of the ground and nature of the materials to be excavated, the possibility of subsidence due to soft ground, bad or broken materials and falling rock, in or around the Works, and the possibility of floods and landslides. The rates and prices in the Bills of Quantities will be held to cover all such contingencies.

107 RESPONSIBILITY OF CONTRACTOR

Where the approval and/or instruction of the Engineer is required under these Specifications such approval and/or instruction shall not relieve the Contractor of his duties or responsibilities under the Contract.

108 COST BREAKDOWN

The Engineer may require the Contractor to submit in a form acceptable to the Engineer a schedule showing the breakdown of his contract rates or prices of the pay item or items, to be made a basis for checking or computing monthly estimates.

109 OFFICE AND ATTENDANCE FOR THE ENGINEER

109.01 Field Office for the Engineer

The Contractor shall provide, erect and maintain during the period of the Contract and remove on completion a furnished office on Site for the Engineer's Representative and his staff and shall provide attendance for cleaning and sanitary duties. One attendant for general duties shall also be provided for the sole use of the Engineer's Representative for the period of the Contract. The office shall be separate from the Contractor's office and shall be situated in a place approved by the Engineer. Hardstanding shall be provided for 4 cars adjacent to the office, with a suitable canopy. This parking facility shall be for the sole use of the Engineer's Representative and his staff. The office shall have a floor space of at least 100 (one hundred) square meters and shall be divided into five rooms, with a connecting passageway. The height from floor to ceiling shall be not less than 2.8 meters and the offices shall be fully air-conditioned. Walls and ceilings shall be fully lined with approved insulating board or plastered and the whole shall be painted. The walls and roof shall give adequate protection from heat and weather and shall be maintained completely watertight with glass louvre windows, ventilators and doors fitted with locks. Floors shall be properly finished in concrete and 30 cm off the ground. Three rooms shall be fitted with a 3 m x 1 m x 1 m drawing table. Running water and basin shall be provided in one of the rooms.

A strong cupboard complete with locks shall be built into one of the rooms for storage of survey equipment. This cupboard shall be at least 1.8 m high and shall be fitted with shelves over one-half of the plan area.

The Contractor shall provide the following loose furniture and apparatus to the Engineer's approval:

Office desk with 6 drawers	1 nr
Office desks with 3 drawers	3 nr
Office tables with 2 drawers	2 nr
Office chairs	8 nr
Steel filing cabinet with 4 drawers	1 nr
Plan chest with 5 drawers	2 nr
Book racks	3 nr
Bench stools	2 nr
Filing trays	10 nr
Waste paper baskets	3 nr
A2 size drawing boards with tee squares	2 nr
250 mm set squares 45°	2 nr
250 mm set squares 60°	2 nr
Protractor for tache plotting with interchangeable scales	1 nr
Fully divided scales (1/100, 1/2500, 1/500, 1/1250, 1/2000, 1/50, 1/250, 1/1500)	3 nr each
Drawing instruments	2 sets
Adjustable planimeter	2 nr
Electronic calculating machine of approved manufacture: 10 digits with floating decimal point	4 nr
Typewriter 450 mm carriage	1 nr
Typewriter normal size	1 nr
Stapler	2 nr
First aid kits	2 nr

Paper punches	2 nr
Fire extinguishers	2 nr
Engineer's automatic level (wild NA2 or similar)	2 nr
Engineer's tilting level with tripod	1 nr
Theodolite reading to 20" arc and tripod (wild TIA or similar)	1 nr
Survey umbrellas	3 nr
5 m levelling staves	4 nr
2.5 m ranging rods	12 nr
Steel tapes 30 m	2 nr
Steel band 100 m	2 nr
Steel tape refills 30 m	2 nr

Particular Requirements

The contractor shall provide the following specified apparatus and equipment to the Engineer for his exclusive use, which will, on a completion of the project, revert to the Employer's property.

Walkie Talkie of high quality covering 15 km of response distance	4 nr
Plate-bearing Test apparatus in complete set as specified below or equivalent subject to the Engineer's approval:	1 nr

Specifications

10 t Jack with a pressure gauge (triple readings)	1
Spherical plate	1
Loading palte (made of steel with a hold): 30 cm	1
Dial indicator: 20mm, 1/100mm graduation	1
Dial indicator fixture	2 sets

Rod (40cm connection system)	6
Rod height adjustment stand (adjustment range: 14cm)	2 sets
Rod connecting spanner	2
Housing box	1-2
Handy Seismic Instrument in complete set (Ripper Meter) as specified below or equivalent subject to the Engineer's approval	1 nr

Specifications

Amplifier

Channels	12
Gain	80 dB
Frequency	5-300Hz (LPF 100 Hz)

Oscillograph

Channels	14
Paper drive speed	30,60,100cm/Sec
Power supply	12V (below 4.5V)

A chemical closet with washing facilities consisting of a wash basin with running water shall be provided in a separate building to be situated at some distance away from the main offices. Attendance shall include provision of clean hand towels.

The Contractor shall within two weeks of the award of the Contract, submit to the Engineer in the form of drawings, schedules, layout construction proposals and list of furniture and equipment for the Engineer's office. The Engineer shall then either approve or require modifications to be made to the Contractor's proposals. After the Engineer's approval the Contractor will be instructed to proceed with

the erection of and to provide furnishings and equipment for the Engineer's office. The Contractor shall provide the Engineer's office and those furnishings and equipment items as required within 8 weeks of the date on which the Engineer instructs the Contractor to proceed.

The Contractor shall bear all expenses incurred by the Engineer due to the failure of the Contractor to complete and hand over to the Engineer the office and any of their fittings, furniture and equipment as requested within the stipulated 8 week period. Should the Contractor fail to submit his layout and construction proposals within the stipulated two weeks, then any period outside these two weeks shall be deducted from the 8 week specified construction period.

The Contractor will be paid 60 % of the Lump Sum when the buildings are accepted by the Resident Engineer fully furnished and equipped and 20 % of the Lump Sum will be paid in equal instalments over the contract period. This payment shall be deemed to cover maintenance of building, furniture, equipment and services and the Engineer may withhold or reduce any instalments if the Contractor fails in his maintenance obligations. The remaining 20 % will be paid when the buildings have been removed and the site cleared at the end of the contract. All payments are subject to deduction of retention money.

109.02 Telephone for the Engineer

A telephone shall be installed and maintained at the Site Office. The Contractor shall pay for the installation and rental of the telephone but payment for all calls will be made by the Employer.

109.03 Junior Staff for the Engineer

The Contractor may be instructed from time to time by the Engineer for his exclusive use to employ and pay such junior staff as the Resident

Engineer may direct. Such staff will be in any or all of the following categories: Laboratory Technicians, Typists, Clerks, Levellers, Chainmen, Common Labourers, Watchmen and other junior staff the Engineer may require.

Payment for such staff will be made at the appropriate rate entered in the Bill of Quantities and the Contractor shall make allowances in his rates for his overheads, etc. and any variations in wages for a particular category of junior staff.

109.04 Transport for the Engineer

The Contractor shall provide and maintain in good condition for the exclusive use of the Engineer throughout the period of the Contract two units of vehicles "Station Wagon". The vehicles shall be provided with two experienced and licensed drivers. When the vehicles are off the road for servicing or repair, suitable alternative vehicles shall be provided by the Contractor. The vehicles and drivers shall be available at all times during normal working hours and when specifically required by the Engineer outside these hours. Insurance shall be comprehensive and cover passengers. The vehicles shall revert to the property of the Contractor on the completion of the Contract.

Payment for the vehicles shall be per vehicle month for the first 2,000 km travelled by those two vehicles during each month. Separate payment will be made per mile travelled by those two vehicles in excess of each month. The rates tendered by the Contractor shall include the provision of the vehicle and its driver, including any overtime, all licensing, insurance, fuel, lubricants, maintenance and repairs, and replacement of the vehicles should it be considered necessary by the Engineer.

110 FIELD TESTING LABORATORY

The Contractor shall provide, erect, maintain and remove on completion of the Works a laboratory for soil, aggregates, concrete and other materials or structures to be tested or examined in this Contract for the use of the Engineer. The laboratory shall be duly equipped and the laboratory equipment shall be of approved makes to the satisfaction of the Engineer as specified in Clause 1002 of these Specifications.

111 CONTRACTOR'S ADMINISTRATIVE AND TEMPORARY FACILITIES

The Contractor shall provide and maintain on the Site suitable offices, stores, workshops and other temporary facilities suitably equipped for carrying out the Works. Suitable and sufficient messing and sanitary accommodation shall be provided together with shelters near the working points. The Contractor shall clear and tidy the site on completion of the Contract to the satisfaction of the Engineer.

The Contractor shall allow in his rates for all charges for power supplies for the offices and workshops.

The Contractor is to make his own arrangements with the Employer, landowners or other Contractors working in or around the Site which he wishes to use as access or for all his temporary works and all costs in this connection shall be borne by the Contractor. All temporary buildings shall be located only on approved sites.

The Contractor shall supply the Engineer with drawings for approval showing the layout and general arrangement of all Temporary Works he proposes to construct for the purpose of the Contract including, but not limited to:

- (a) Camps, including accommodation for the Contractor's staff and labourers,
- (b) Offices,
- (c) Workshops,
- (d) Stores,
- (e) Aggregate crushing plants, and
- (f) Central concreting plants, etc.

A separate item has been included in the General Items of the Bill of Quantities for the supply, erection, maintenance and removal of Temporary Works.

The sum inserted and payment made against this item in the Bill of Quantities will be limited to 2.5 % of the sum named in Paragraph 1 of the Form of Tender. No payment will be certified under this item until the Contractors programme and drawings of his Temporary Works have been approved.

Payment for Temporary Works will be certified by the Engineer at his discretion and according to the progress made by the Contractor in their construction. Full payment will not be certified unless and until, in the opinion of the Engineer, the Temporary Works are completed and sufficient for their purpose under the Contract and in accordance with the drawings submitted by the Contractor and approved by the Engineer.

112 ADVERTISING

The Contractor shall not erect advertisement in any form within the Site or on adjoining ground, but shall provide a board at the main entrances to the Site bearing suitable inscription including the name of the Contractor in accordance with details provided by the Engineer.

113 WORK PROGRAMME TO BE FURNISHED

Within 21 (twenty-one) days after the signature of the Contract, the Contractor shall submit to the Engineer for his approval:-

- (a) A detailed programme showing the order of procedure, planned rate of progress and sequences, and details of temporary works and methods to be employed.
- (b) The organisation, staff, labour, equipment and plant proposed for the execution of the Contract.

The Engineer after examining and if necessary discussing with the Contractor such document shall give his final approval before the commencement of the Works.

114 TEMPORARY WORKS

114.01 General

The Contractor shall provide, maintain and remove on completion of the Works all temporary roadways, bridges, cofferdams, cribs, stagings, and other necessary temporary works, over roads, streams or unstable ground and the Contractor shall make them safe and suitable in every respect to carry all plants required for the Works or for providing access or for maintaining diverted through traffic or for any other purpose. The roadways, bridges, cofferdams, cribs, staging, and other necessary temporary works shall be constructed and maintained to the satisfaction of the Engineer. The Contractor shall submit to the Engineer for his approval a detailed programme showing the structure order of procedure and methods of construction to be employed for such temporary works when required by the Engineer, but the Contractor shall solely be responsible for damage done or caused by such temporary works.

114.02 Design of Temporary Bridge

Temporary bridge structures, where required on any site, shall be designed by the Contractor to carry the specified live load, and details of design shall be submitted to the Engineer for approval. Live loading shall be equivalent to 50 % or more of the standard loading for highway bridges, adopted by the Government of Mauritius, so that the Contractor may ensure that vehicles of any deviation from the public traffic (if any) or vehicles for constructional use are to be able to pass.

Carriage widths on temporary bridges may be 3.5 meters single lane where approved arrangements are made for the proper direction and control of traffic at all times, otherwise the carriageway width shall be 6.7 meters double lane.

114.03 Cofferdam or Crib

Cofferdams or cribs for foundation construction, in general, shall be carried well below the bottom of the footings and shall be well braced and as watertight as practicable. In general, the interior dimension of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit pumping outside of the forms. Cofferdams or cribs which are tilted or moved during the process of sinking, shall be righted or enlarged so as to provide the necessary clearance at the Contractor's expense.

114.04 Temporary Stagings

Temporary stagings or any false works shall be provided by the Contractor to enable the constructional operations to be performed in the required sequence. Such stagings shall be properly designed and constructed for the loads which it will be required to support and complete details of the arrangement proposed shall be submitted to the Engineer for his approval.

114.05 Land for Temporary Works

The Contractor shall make at his expense all necessary arrangements with and obtain permission from the authorities or land owners concerned before constructing temporary works, and they shall obtain the approval of such works from the Engineer.

115 SETTING-OUT

The Contractor shall be responsible for the full and proper setting out of the Works in accordance with Clause 17 of the Conditions of Contract.

115.01 Dimensions and Levels shown on Drawings

The dimensions and levels shown on the Drawings are believed to be correct, but the Contractor shall verify the same on Site and is in no way absolved from responsibility from any consequence arising from the inaccuracy of such dimensions or levels.

115.02 Verification of Bench Marks

The lines and levels shown on the Drawings refer to a series of bench marks located at intervals throughout the length of the road, and whose positions and values are shown on the Drawings.

In the event of any such bench marks having become obliterated, the Contractor shall make such arrangements as are required to establish new bench marks so that the Works can be constructed to the lines and levels shown on the Drawings.

The Contractor shall be entirely responsible for maintaining such bench marks intact and accurate or, alternatively, for accurately replacing them with others for which he shall be equally responsible. The Contractor shall keep up to date a site plan of all such bench marks which shall be made available to the Engineer as required.

115.03 Establishment of Levels

Before the commencement of any part of the Works, the Contractor and the Engineer shall together survey and establish the levels of the whole Site of the Works and agree on the level to be taken. As-built drawings or any record drawings shall be prepared from these levels and these shall form the basis of measurement where required.

115.04 Setting of Horizontal and Vertical Alignments

The Contractor is required to set out the horizontal and vertical alignments in strict accordance with the coordinate table furnished by the Engineer or as directed by the Engineer, and will be held responsible for accuracy and sufficiency thereof. He shall give the Engineer not less than 24 hours notice of his intention to set out or give levels for any part of the Work in order that arrangements can be made for checking.

The approach roads of the over-bridge required to construct shall be well connected and aligned to the satisfaction of the Engineer.

The Contractor shall provide all the necessary instruments, appliances, labour and any materials or staging that the Engineer may require for checking the setting out of levels other than as specified in clause 109 hereof.

Any marks made by the Engineer shall be carefully preserved. Work shall be suspended for such time as it is necessary for checking the lines and levels on any part of the Works.

Throughout the Contract, both the general and detailed methods of the complete setting out of the Works shall be submitted by the Contractor for the prior approval of the Engineer.

116 NOTICE OF OPERATIONS

116.01 General

The Contractor shall, when required by the Engineer, supply full information with respect to the location in which materials are being obtained and in which works are being prepared and carried out.

116.02 Methods of Execution

Before the beginning of each phase of the work the Contractor shall submit to the Engineer a complete description supported with work drawings and catalogues of his method of execution. The Contractor shall obtain the Engineer's approval before proceeding with each phase of the Work.

No important operation shall be carried out without full and complete notice, also in writing, being given to the Engineer sufficiently in advance of the time of the operation so as to enable him to make such arrangements as he may deem necessary for inspection and measurements.

116.03 Inspection and Testing

Notwithstanding the submission of the normal and regular weekly Progress Report, the Contractor shall report to the Engineer promptly and in writing the particulars of any accident or unusual or unforeseen occurrence on the Site whether likely to affect the progress of the Work or not, stating also the steps he has taken or is arranging to take in the matter.

117 PROGRESS REPORT AND PHOTOGRAPH AND AS-BUILT DRAWINGS

117.01 Monthly Report

The Contractor shall submit to the Engineer on the last day of each month a Progress Report with as many copies as is requested by the Engineer showing up-to-date progress during the previous period on all important items in each section of the Work in the manner prescribed by the Engineer. The progress report shall be related to the programme such as defined in sub-section 113 hereof.

117.02 Progress Photographs

The Contractor shall submit photographs showing the progress of the Works, under the direction of the Engineer. The Contractor shall arrange to supply four unmounted enlargements not less than 15 cm by 10 cm of each print chosen by the Engineer for enlargement.

117.03 Weekly Report

The Contractor shall submit to the Engineer when so required by the Engineer on the last day of each week a weekly report for the preceding period showing the number of labourers worked, the machinery and equipment employed and the construction materials used.

The Contractor shall submit to the Engineer when so required by the Engineer on the last day of each week full details of the next week's operations.

117.04 As-built Drawing

The Contractor shall submit to the Engineer 3 (three) copies of the As-built Drawings of the works completed with their original drawings prior to the acceptance of the Project.

118 COOPERATION BETWEEN CONTRACTORS

The Engineer reserves the right to contract for and perform other or additional work on or near the work covered by the contract.

When separate contracts are let within the limits of the project, each contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other contractors as directed by the Engineer.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Employer from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by him because of the presence and operations of other Contractors working within the limits of the project.

The Contractor shall join his work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

119 TOOLS, PLANT AND EQUIPMENT

If at any time before the commencement or during the progress of the work, tools, plant, or equipment appear to the Engineer to be insufficient, inefficient or inappropriate to secure the quality of the work required or the proper rate of progress, the Engineer may order the Contractor to substitute new tools, plant, or equipment as the case may be, and the Contractor must conform to such order, but the failure of the Engineer to demand such increase of efficiency, number, or improvement shall not relieve the Contractor of his obligation to secure the quality of work and the rate of progress necessary to complete the work within the time required by the Contract to the satisfaction of the Employer.

120 EXPLOSIVES AND BLASTING

For handling of explosives and blasting, the Contractor shall employ only men experienced in blasting and these men must be in possession of an approved current blasting certificate. The purchase, transport, storage and use of explosives shall be carried out in accordance with the latest Explosive Ordinance and Rules issued by the Government of Mauritius.

The Contractor shall use explosives for blasting in connection with the Works only at such times and places and in such a manner as the Engineer may approve but such approval shall not relieve the Contractor from his responsibility for injury, loss, inconvenience and annoyance to persons, damage to the work and adjoining structures, roads, places and things, and injury or damage to animals and property consequent to the use of such explosives.

The Contractor shall be entirely liable for any accident which may occur and shall save the Employer harmless and indemnified from all claims arising therefrom. Where loss, inconvenience, injury or accident is likely to be caused to persons, animals, works, property, places and things, the Engineer shall have the power to regulate or prohibit blasting and in the event of such regulations or prohibition the Contractor shall have no claims against the Employer.

The Contractor shall give warning to the Engineer in writing each time of his intention to blast and shall only carry out blasting after receiving the Engineer's written approval. The Contractor shall station men on the roads and elsewhere as necessary who shall take all due precautions to prevent persons, animals, and traffic going into or remaining in the danger zone.

After blasting, no man should enter or approach the blasting area until it has been examined by the foreman or other responsible person and, in case of misfires, the proper precautions shall be taken.

121 LIAISON WITH POLICE AND OTHER OFFICIALS

The Contractor shall keep in close contact with the police and other officials of the areas concerned regarding their requirements in the control of workmen, movement of traffic, passage through the township, or other matters, and shall provide all assistance of facilities, which may be required by such officials, in the execution of their duties.

122 EXISTING UTILITIES AND SERVICES

122.01 Information to Authorities Concerned

Prior to the Contract being awarded the authorities will be informed on the line and levels of the new road and they shall thereafter without unreasonable delay carry out such adjustments, or alterations as are necessary to such services as water-mains, telephone and electricity cables, overhead lines and other utilities. Alternatively, with the Engineer's approval, the Authorities may require the Contractor to carry out such work.

122.02 Existence of Underground Utilities

The existence and location of underground utilities indicated on the drawings are not guaranteed and shall be investigated and verified in the field by the Contractor before starting work. Excavation in the vicinity of existing structures and utilities shall be carefully done by hand.

The Contractor shall be held responsible for any damage to, and for maintenance and protection of, existing utilities and structures.

122.03 Damage to Utilities

The Contractor shall make good at his own expense any damage to utilities caused by him which are outside the area of the works which may be defined as the outside edge of side drains or damage due to over excavation.

In the event of the Contractor damaging water, electricity or telephone services, whether these have been marked or not, the Contractor shall immediately verbally inform the Department concerned and the Engineer.

The Department concerned will carry out the repairs, shall inform the Contractor in writing of the damage and repairs carried out and send the Engineer a copy of this letter or form.

The Contractor shall pay for the cost of repairs within one month of receiving the account. In the event of the Contractor failing to pay the account within one month, the Engineer's Representative will, if requested to do so, inspect the accounts to ensure that they are reasonable and shall then request the Employer to deduct the sum which is assessed as reasonable from any monies due to the Contractor.

122.04 Particulars of Existing Works

Such information as may be given on the Drawings, as to the present condition and character of the existing structures, roadways and other services, and as to the form and dimensions of various parts of the existing structures and positions and particulars of pipes, cables and other mains and information arising as a result of trial pits and boreholes is given without guarantee of accuracy and neither the Employer nor the Engineer will be liable for any discrepancy therein.

123 PROTECTION OF WORKS

123.01 General

The Contractor shall take all steps necessary to protect the Permanent Works and all stores and materials from the effects of weather, flood,

cyclone, theft, and shall be entirely responsible for any delay, damage or loss arising therefrom.

123.02 Protection from Water

The Contractor shall keep the whole of the Works free from water and allow in his prices for all dams, cofferdams, pumping, piling, shoring, temporary drains, stumps, etc., necessary for the purpose and shall clear away and make good at his own cost and to the satisfaction of the Engineer all damage caused thereby. The drainage of the natural ground in the vicinity of the earthworks and drainage work generally shall be carried out in advance of the rest of the Works.

124 PASSAGE OF TRAFFIC

124.01 General

The Contractor shall be responsible for safely maintaining the existing right of way for traffic through or around any part of the Works in the case where any operation connected with the Contract necessitates the obstruction or closure of any road, the approval of the Engineer shall be previously obtained.

124.02 Safe Passage of Traffic

The Contractor shall programme his operations in such a way as to allow for the safe passage of traffic or, alternatively, he shall provide and maintain to the satisfaction of the Engineer all necessary diversions for the construction of the Works. The Contractor shall provide and

maintain all traffic signs, diversion signs, barricading, fencing, lighting, flagmen and "Stop-Go" signs as may be required by the Engineer and Authorities concerned for the safety and protection of traffic. The size, lettering and wording of all such signs shall be as approved by the Engineer.

124.03 Diversion Road for A-1 Road

The temporary construction of a diversion road for A-1 Road is required, and it shall be constructed so as to provide a hard, smooth and even surface, reasonably free from dust, for the passage of public traffic throughout the period during which the diversion is in use as shown on the drawing. The width of the road shall be 6 meters and 9 meters as shown on the Drawings and the cross section shall be properly aligned and cambered. Divisions shall be provided with adequate drainage to ensure that they are kept free of standing water.

124.04 Failure in Provision of Diversion Road

Normally public traffic shall not be permitted on any incompletd part of the new construction. Should, however, the Contractor's failure to provide for safe passage of traffic or in the event of the failure of a diversion road necessitate traffic being run over any incompletd part of the new Work, all damage caused to the new Works shall be made good by the Contractor at his own expense.

124.05 Temporary Roads and Footpaths

The Contractor shall at his own expense, unless otherwise specified, provide and maintain all necessary temporary roads and footpaths to

and about the Site of the Works as may be necessary for the construction and completion of the Works or transport of labour, plant and materials. All of the before-mentioned works which may be constructed and in use for the Works generally shall be available without charge for the reasonable use of the Employer, the Engineer and other Contractors employed by the Employer on the Site.

124.06 Maintenance of Existing Roads

The Contractor shall be responsible for the maintenance of the existing roads of which he has been given possession temporarily and in the case of new alignments for the appropriate lengths constructed. Failure or damage of any part of such existing roads by reason of the constructional use shall be promptly informed and recovered to the satisfaction of the authorities concerned. The expenditure, therefore, shall be borne by the Contractor.

125 ACCIDENTS AND FIRST AID

The Contractor shall provide, at the site, such equipment and medical facilities as are necessary to supply first-aid service to anyone who may be injured in connection with the work.

The Contractor must promptly report in writing to the Engineer all accidents whatsoever arising out of, or in connection with, the performance of the work, whether on or adjacent to the site, which caused death personal injury, or property damages, giving full details and statements of witnesses. In addition, if death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Engineer and the Employer.

If any claim is made by anyone against the Contractor or any

sub-contractor on account of any accident, the Contractor shall promptly report the facts in writing to the Engineer, giving full details of the claim.

126 FILLING IN HOLES AND TRENCHES

The Contractor immediately upon completion and examination of any work shall at his own expense fill in all holes and trenches which may have been made or dug, level the mounds or heaps of earth that may have become superfluous or have been occasioned or made in the execution of such work.

127 WATER FOR USE IN THE WORKS

The Contractor shall maintain an adequate supply of clean water for use in all aspects of the Works.

Except in the case where a specific item is included in the Bill of Quantities, the Contractor shall not be entitled to any payment for the supply of water but the cost shall be deemed to be included in rates and prices for other items in the Bill of Quantities which involve the use of water for proper performance of the Works.

The Engineer may reject any water which in his opinion is contaminated and not sufficiently clean for the purpose intended.

128 JOINT MEASUREMENT OF EXTRAS

In such case as the Contractor shall find it necessary to execute any works or provide any materials which he feels entitled to claim as extras to the Bill of Quantities he shall obtain written permission from the Engineer before commencing such work and shall make arrangements for the Works or materials to be measured and the quantity agreed upon jointly with the Engineer. Neglect to obtain authority to commence any such work shall entitle the Engineer to disallow any claim for extras arising therefrom. The fact that joint measurement took place in no way commits the Engineer to recognizing the validity of such claim, if it is considered unjustified. The Engineer shall at all times have all access to the Contractor's time books and may check the time of any extra works daily with the Contractor's timekeeper or otherwise, but his agreement shall in no way bind the Engineer to value the work other than by measurement if he thinks fit to do so.

129 RE-USE OF THE ABUTMENTS AND PIERS OF EXISTING BRIDGES

The two abutments of the existing St. Louis River Bridge and the two abutments and one pier of the existing G.R.N.W. Bridge shall be dismantled and reinforced for re-use as specified on the Drawings.

130 SPECIAL BRIDGE LOADING TESTS

Notwithstanding the descriptions of sub-clause 1012.05 (b) Testing of Pretensioned Beams, the Contractor shall note the requirements of this Clause.

The Contractor shall supply, install and maintain in place, as specified in the Drawings, the testing or measuring meters, gauges and/or any instruments of the same nature required for Bridge Loading Tests.

The Contractor shall carry out, on completion of the specified bridges or at any time the Engineer may direct, the loading tests by such a procedure as shown in the Drawings or as directed by the Engineer, and shall report the results to the Engineer for his approval.

The entire cost of technicians, operators, labourers, vehicles, plant, equipments, testing or measuring apparatus, temporary stagings or any other work for the loading tests shall be borne by the Contractor.

Measurement and payment shall be made on a lump sum basis in accordance with the requirements shown in the drawings.

131 UNITS OF MEASUREMENT

The metric system of measurement is to be used in connection with this contract.

132 MEASUREMENT AND PAYMENT FOR GENERAL ITEMS

Payment will be made at the contract lump sum price for the items of General Items specified in the Bill of Quantities. The works not specified in the Bill of Quantities will not be paid for separately, but the costs thereof shall be deemed to be covered by the other rates or prices in the Bill of Quantities.

PART 2

DEMOLITION AND CLEARANCE WORKS

PART 2 DEMOLITION AND CLEARANCE WORKS

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PART 2 DEMOLITION AND CLEARANCE WORKS

201 CLEARING AND GRUBBING

201.01 Scope

This work shall consist of clearing, grubbing, removing and disposing of all vegetation and debris within the limits of the right of way and easement areas, except such objects as are designated to remain or are to be removed in accordance with other clauses of these Specifications or the direction of the Engineer. This work shall also include the preservation from injury or defacement of all vegetation and objects designated to remain.

201.02 Construction Requirements and Construction Methods

(1) Clearing and Grubbing

All surface objects and all trees, hedges, shrubs, stumps, roots and other protruding obstructions, not designated to remain, shall be cleared and/or grubbed, including mowing, as required, except undisturbed stumps and roots and non-perishable solid objects which will be a minimum of 1.5 meters below subgrade or slope of embankments. When authorized, the Contractor may leave stumps and non-perishable solid objects provided they do not extend more than 20 centimeters above the ground line or low water level.

The Engineer may permit sound stumps to be cut off not more than 20 centimeters above the ground and to be left outside of the construction limits of cut and embankment areas, except in the area to be rounded at the top of backslopes where stumps are to be cut off flush with or below the surface of the final slope line.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted in accordance with sub-clause 302.03.

If perishable material is burned, it shall be burned under the constant care of competent watchmen at all times and in such a manner that the surrounding vegetation, other adjacent property, or anything designated to remain on the right of way will not be jeopardized. Burning shall be done in accordance with applicable laws and ordinances.

Materials and debris which cannot be burned and perishable materials shall be removed from the right of way and disposed of in the waste areas designated by the Engineer.

(2) Scalping

The Contractor shall scalp areas where excavation or embankment is to be made, except that mowed sod need not be removed where the embankment to be constructed is 1.5 meters or more in height below subgrade elevation. Scalping shall include the removal of material such as brush, roots, sod, grass, residue of agricultural crops, sawdust, and decayed vegetable matter from the surface of the ground.

202 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

202.01 Scope

This work shall consist of the removal, wholly or in part, and satisfactory disposal of all buildings, fences, structures, old pavements, abandoned pipe lines, and any other obstructions which are not designated or permitted to remain, except for the obstructions to be removed and disposed of under other items in the contract. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits.

202.02 Construction Requirements and Construction Methods

(1) General

The Contractor shall raze, remove and dispose of all buildings and foundations, structures, fences and other obstructions, any portions of which are on the right of way, except utilities, and salvable material shall be removed in sections or pieces as the Engineer may approve without unnecessary damage and shall be stored by the Contractor at specified places within the project limits. Unusable perishable material shall be destroyed. Non-perishable material shall be disposed of in the waste areas designated by the Engineer.

Basements or cavities left by structure removal shall be filled to the level of the surrounding ground and, if within the prism of construction, shall be compacted in accordance with sub-clause 302.03.

(2) Removal of Bridges, Culverts and Other Structures

Bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.

Steel bridges as specified, shall be carefully dismantled without unnecessary damage. Steel members shall be match-marked, unless such match-marking is waived by the Engineer. All salvaged material shall be stored in the areas designated by the Engineer.

Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work.

(3) Demolition and Reinforcement of Existing Sub-structures for Re-use

This work shall consist of demolition and reinforcement of existing abutments and piers specified for re-use including scour protection riprap around existing pier in accordance with these Specifications and in reasonably close conformity with the lines, grades and dimensions as shown on the drawings or as directed by the Engineer. Prior to commencement of any part of the works, the Contractor shall examine the conditions of the existing sub-structures to be dismantled and reinforced, and the demolition and removal shall be made in such manner as to avoid damage to any other portion which is to be left without demolition. All demolished materials and false work placed in the stream during construction shall be removed by the Contractor.

202.03 Measurement

Measurement will be made by the following method:

(1) Clearing and Grubbing

The work to be paid for will be the number of hectare and fractions thereof acceptably cleared and/or grubbed within the limits shown on the drawings or staked for clearing and grubbing by the Engineer. Areas not shown on the drawings or not staked for clearing and grubbing will not be measured for payment.

(2) Removal of Structures and Obstructions

The payment will be made for removal of obstructions on a lump sum basis. The pay item "removal of obstructions" shall include all structures and obstructions encountered within the right of way in accordance with the provisions of this clause.

202.04 Payment

(1) Clearing and Grubbing

The accepted quantities of clearing and grubbing will be paid for at the contract unit prices for the areas cleared and grubbed. Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
B01. Clearing and Grubbing	

(2) Removal of Structures and Obstructions ha

The accepted quantities of removal of structures and obstruction will be paid for at the contract lump sum price, which price shall be full compensation for removal and disposal of such items, excavation and subsequent backfill incidental to their removal. The price shall also include salvage of materials removed, their custody, preservation, storage in the areas designated by the Engineer, and disposal as provided herein.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
B02. Removal of Structures and Obstructions	
01 Buildings	Lump sum
02 Concrete structures	Lump sum
03 Existing metal bridge structures	t
04 Existing road pavements and kerbs	Lump sum

PART 3

EARTHWORKS

PART 3 EARTHWORKS

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PART 3 EARTHWORKS

301 ROADWAY EXCAVATION

301.01 Scope

This work shall consist of excavation, disposal or compaction of all material not being removed under some other item which is encountered within the limits of the work necessary for the construction of the roadways including approach and frontage roads and footway in accordance with these Specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the drawings or established by the Engineer.

301.02 Earthwork Programme

The programme for earthwork shall be submitted for approval to the Engineer prior to commencing the works. In preparing such a programme, the Contractor shall pay due consideration to the requirements for construction procedures and steps or the use of space both in earthworks and structure works which are shown on the drawings or in any other stipulation of the Contract.

The programme shall consist of mass diagrams, mass haul diagrams and any other drawings or schedules with haul road to be used showing in as much detail as the Engineer may consider necessary for the programmed movement of the earth.

Such approval shall not be deemed to relieve the Contractor of any of his responsibility under the Contract.

Prior to the preparing the earthwork programme, the Contractor shall carry out such soil testings as necessary to determine the suitability of materials for use in the works, at the Contractor's own expenses.

301.03 Classification of Excavation

All excavation will be classified as "common excavation" or "rock excavation" as hereafter described.

(1) Common Excavation

Common excavation shall consist of all excavation not included as rock excavation. Blasting or any other excavation method, of materials described in Rock Excavation by the Contractor for his convenience, to improve efficiency or for any other reason shall not result in the inclusion of such material under Rock Excavation.

(2) Rock Excavation

Rock excavation shall consist of igneous, metamorphic and sedimentary rock which, in the opinion of the Engineer cannot be excavated without blasting or the use of metal wedges and sledge hammers, or cannot be excavated by ripping with a tractor of at least 270 H.P. All boulders or other detached stones each having a volume of two cubic meters or more shall be included in this class when their nature and size are such that they cannot be removed without recourse to one of these methods.

Where a portion of excavation contains 50% or more by volume of boulders of this order, such portion shall be considered as Rock Excavation throughout.

(3) Final Decision by the Engineer

In the event of a discrepancy of classification of the materials between the Contractor and the Engineer, the opinion of the Engineer shall govern over the Contractor's.

301.04 Construction Requirements and Construction Methods

(1) General

The excavation and embankments for the roadway, intersections and entrances shall be finished to reasonably smooth and uniform surfaces. No materials shall be discarded without the permission of the Engineer. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed. Prior to beginning excavation, grading and embankment operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Part 2 of these Specifications.

(2) Sufficient Compaction Plant

Hauling of material from cuttings to the embankments or other areas of fill shall proceed only when a compaction plant is operating at the place of deposition to ensure compliance with the requirements of sub-clause 302.03.

(3) Excavation Below Embankments and Below Formation Level
in Cuttings

Where any material below the natural ground level under embankments or below formation level in cuttings is required to be excavated, it shall be removed to such depth and over such areas as are shown on the Drawings or as the Engineer shall direct and disposed of in a manner

depending on its nature and condition at the time. The resultant excavation shall be backfilled with suitable material as defined in sub-clause 202.03, deposited and compacted as specified for the forming of the embankments. Nevertheless, where in these circumstances such backfill has to be deposited below standing water the Contractor shall use only an approved granular material. Such material may be deposited below water without the associated use of compaction plant.

(4) Rock Excavation

Material classified as rock shall be excavated to a minimum depth of 20 centimeters below subgrade within the limits of the roadbed and the excavation backfilled with material designated on the drawings or approved by the Engineer. Care shall be taken that undrained pockets shall not be left in the surface of the rock.

Rock removed to a maximum depth of 20 centimeters below subgrade will be measured and paid for at the contract unit price, provided that the rock has been removed sufficiently to permit accurate cross-sectioning. The backfilling of this depth in excess of 20 centimeters with backfill material designated on the drawings or approved by the Engineer will be at the Contractor's expense.

(5) Top Soil for Re-Use

Topsoil which is deemed by the Engineer to be suitable and fertile for agricultural purposes, shall be carefully removed to the depth of 30 cm and used on places which require plantation and/or sodding or stockpiled in areas designated by the Engineer.

(6) Explosives and Blasting

The Contractor shall store explosives in a licensed store or magazine provided with a separate compartment for detonators. Explosives shall be handled only by currently licensed shot firers. The Contractor shall ensure that there is no unauthorized issue or improper use of explosives brought on the Site.

Explosives shall be used in the quantities and manner recommended by the manufacturers. The written permission of the Engineer shall be obtained for each location or series of locations where the Contractor wishes to use more than 10 Kilograms of explosives in one blast. Such permission shall not in any way relieve the Contractor of his liabilities under Clause 22 of the Conditions of Contract and Clause 120 of these Specifications.

When blasting is carried out, the Contractor shall ensure, by adherence to proper safety distances and by the use of heavy blasting mats where necessary to prevent the dispersal of material, that no damage is caused to persons or property on or off Site.

(7) Subgrade in Cut

The plasticity index of materials in the top 30 cm of subgrade in cut shall not be more than 40%. If materials do not comply with this requirement, they shall be removed as directed by the Engineer and replaced by alternate materials.

If the plasticity index of materials in the top 30 cm of subgrade is within the range of 25-40%, the Engineer may require their removal and replacement by alternate materials.

(8) Trimming of Slopes

The slopes of cuttings shall be cleared of all rock fragments which move when pried by a crow-bar.

Where side slopes are over-excavated, no backfilling will be required but the slopes shall be trimmed to a neat shape and safe angle as directed by the Engineer at the Contractor's expense.

(9) Construction Traffic

Construction traffic shall not use the surface of the bottom of a cutting unless the cutting is in rock or the Contractor maintains the level of the bottom surface at least 30 centimeters above formation level. Any damage to the subgrade arising from such use of the surface shall be made good by the Contractor at his own expense with material having the same characteristics as the material which has been damaged.

(10) Surplus of Suitable Material and Top Soil

Suitable material and top soil surplus to the total requirements of the Works and all unsuitable material shall be deposited in the waste areas shown on the drawings or designated by the Engineer.

(11) Waste Area

Any waste areas shown on the drawings or designated by the Engineer shall be left in a smooth, neat and drainable condition, as directed by the Engineer, and all waste material shall be placed in such manner that adjacent property is not damaged or endangered.

(12) Earthworks to be Kept Free of Water

The Contractor shall provide where necessary temporary water courses, ditches, drains, pumping or other means of maintaining the earthworks free from water. Such provision shall include forming the cuttings and embankments in such a manner that their surfaces have at all times a sufficient minimum crossfall and, where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.

302 EMBANKMENT

302.01 Scope

Embankment construction shall consist of constructing roadway embankments including approach and frontage roads and preparation of the areas upon which they are to be placed; the construction of dikes within or outside the right of way; the placing and compacting of suitable material within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits and other depressions within the roadway area. Only suitable and/or selected materials shall be used in the construction of embankments and backfills.

302.02 Materials for Embankment

All fill materials for embankment shall be supplied from the Roadway Excavation or Structure Excavation whenever possible.

302.03 Trial Compaction

Before commencing and embankment construction of each section, the Contractor shall, at his own expense, carry out the trial compactions within the right of way or in sections of roadway the Engineer may approve.

The purposes of these trials are to determine, for each main type of materials to be used in an embankment, the proper compaction equipment to be employed and the number of passes necessary in order to achieve the required degree of compaction

The quantity of trial compaction shall correspond to the cases the material sources may vary and the Engineer considers it be necessary. The approximate dimension of a trial compaction embankment is as follows;

Length: not more than 30 meters

Width: not more than 6 meters

Height: not more than 5 meters

The Contractor shall submit to the Engineer for approval a procedure for carrying out these compaction trials, supplemented by any necessary Laboratory and in-situ tests.

These trials and tests shall be completed before the work with corresponding materials will be allowed to commence.

302.04 Construction Requirements and Construction Methods

(1) Construction of Embankment with Moisture and Density Control

The embankments are to be constructed with moisture and density control as specified or directed by the Engineer.

All material in embankments above the elevation designated on the drawings or as specified shall be placed at the moisture content specified. The first 30 centimeter layer placed with controlled moisture shall be compacted to not less than 90 per cent of the maximum dry density.

The embankment above this layer shall be compacted to not less than 95 per cent of maximum density. The material used for building this portion of the embankment shall be dried or moistured uniformly before compaction as necessary to bring moisture content to the moisture content specified.

Maximum density will be determined by BSHMDD (British Standard Heavy Maximum Dry Density). Density requirements will not apply to portions of embankments constructed of materials which cannot be tested in accordance with BSHMDD.

(2) Benching

When embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when embankment is built in half width at a time, the slopes that are steeper than 4:1 when measured at right angles to the roadway shall be continuously benched over those areas where it is required as the work is brought up in layers. Benching shall be of sufficient width to permit operations of placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Material thus cut out shall be recompacted along with the new embankment material at the Contractor's expense.

(3) Operation of Filling

All materials used in embankments and as filling elsewhere shall be compacted as soon as practicable after deposition. Compaction shall be undertaken to the requirements of this Clause by approved plant.

(4) Construction Traffic in Embankment

During the construction of embankments the Contractor shall control and direct constructional traffic uniformly over their full width. Damage to compacted layers by constructional traffic shall be made good by the Contractor at his own expense.

When it is necessary to complete to formation level and this has been done, the movement and use of constructional plant and vehicles thereon shall be suitable in relation to the conditions of the surface.

(5) Spreading and Compacting in Layers

Roadway embankment of earth material shall be placed in horizontal layers not exceeding 30 centimeters (compacted measurement) and shall be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density.

(6) Embankment Adjacent to the Structure

If an embankment can be deposited on only one side of abutments' wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause the overturning of or excessive pressure against the structure. When an embankment is to be placed on both sides of a concrete wall or box-type structure, operations shall be conducted so that the embankment is always at approximately the same elevation on both sides of the structure.

(7) Rock Fragment in Embankment

When the use of excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the thickness prescribed without crushing, pulverizing or further breaking down the pieces resulting from excavation methods as permitted by the Engineer, such material may be placed in the embankment in layers not exceeding in thickness the approximate average size of the larger rocks.

Each layer shall be leveled and smoothed with a suitable leveling plant and by distribution of spalls and finer fragments. The lifts shall not be constructed above an elevation of 60 centimeters below the finished subgrade.

(8) Construction of Subgrade

The portion above an elevation of 60 centimeters below the finished subgrade of the embankment shall be composed of suitable material smoothed and placed in layers not exceeding 20 centimeters in loose thickness and compacted to not less than 95 per cent of the maximum density.

(9) Surface Finishing Subgrade

Preparation and surface finishing of the formation shall be carried out immediately prior to laying the subbase as agreed by the Engineer.

Where the completed formation is not immediately covered with sub-base, it shall be protected as agreed by the Engineer.

If the Contractor allows the moisture content of accepted compacted material to reach a value above the maximum permitted for the material under the Contract for compaction the Contractor shall allow the material to revert to an acceptable moisture content and, if directed by the Engineer, make good at his own expense the surface by recompaction before laying the subbase or road base.

303 STRUCTURE EXCAVATION

303.01 Scope

This work shall consist of the removal and disposal of all excavation materials required for the construction of box culverts and bridge-works including the work of back-filling, compacting, sloping, disposing of surplus materials and clearing up of the sites. It shall include all necessary clearing and grubbing within the area defined by lines connecting the extremities of the end substructure units; all necessary draining, pumping, bailing, sheeting, and shoring; the construction of cribs and cofferdams and their subsequent removal; and the removal of old structures or parts thereof, as required, except where the contract includes a separate unit price for such item or items.

303.02 Classification of Excavation

Structure Excavation will be classified as "Common Excavation in Box Culverts and Wing Walls", "Rock Excavation Box Culverts and Wing Walls", "Common Excavation in Piers and Abutment of Bridgework", and "Rock Excavation in Piers and Abutments Bridgeworks." Classification of excavated materials shall be in accordance with Clause 301.03 of the Specifications.

303.03 Construction Requirements and Construction Methods

(1) General

The foundation shall be excavated according to the outline of the footings as shown on the drawings or as directed by the Engineer and shall be of sufficient size to permit the placing of the footings with full horizontal bed.

The natural ground adjacent to the footing shall not be disturbed without permission from the Engineer.

(2) Poor Foundation Material

Poor foundation material shall be removed as directed by the Engineer below the normal designed elevation and paid for as structure excavation. Surplus excavated material suitable for embankment shall be used in the construction of embankments, and all unsuitable material shall be discarded. Material removed below designed elevation shall be replaced with selected material.

(3) Rock or Unyielding Material

Where rock or other unyielding material is encountered it shall be removed below the designed grade as directed by the Engineer for a depth of 30 centimeters. This extra depth excavation shall be backfilled with suitable material. The material to replace this extra depth excavation shall be a free-draining material obtained from roadway excavation, if available. Otherwise, it shall be granular backfill or concrete Grade 15.

(4) Backfilling

Backfilling shall consist of suitable materials uniformly distributed in layers of not more than 20 centimeters, in loose thickness and thoroughly compacted by use of mechanical compactors to not less than 95 per cent of the maximum density before successive layers are placed.

No backfill shall be placed against newly constructed masonry or concrete structures for a period of 14 days unless authorized by the Engineer.

(5) Removal of Sheeting and Bracing

Unless otherwise indicated in the drawings or directed by the Engineer, all sheeting and bracing used in making structure excavation shall be removed by the Contractor following the completion of the work.

304 MEASUREMENT

(1) Roadway Excavation

Roadway excavation shall be measured in its original position by cross sectioning the area excavated which will include an authorized excavation of rock, shale, much or other unsuitable material. The removal of materials in slips, slides or subsidences and overbreaks of rock extending beyond the lines and slopes or below the levels shown on the drawings or required by the Engineer will not be paid for unless such occurrences were, in the opinion of the Engineer, beyond the control of the Contractor and could not have been prevented by the exercise of due care and diligence.

Volumes will be computed from the cross-section measurements by the average and area method. Authorized excavation of rock material below grade shall consist of any excavation necessary to provide the designed thickness of backfill. If the plane of the designated bottom of excavation falls within a layer or stratum of rock, the below-grade excavation to the bottom of the layer, not exceeding 30 centimeters below grade, will be considered as authorized and will be measured for payment. Rock excavation more than 30 centimeters below grade will not be paid for.

Measurements will be made for excavation of unsuitable materials and replacement with selected materials to obtain proper compaction of subgrades in cut sections and of foundations in fill sections. Here the selected materials means the materials whose sources are other than road-way excavation or structure excavation specified in these Specifications.

No measurement will be made of the suitable material temporarily removed and replaced in facilitate compaction of the material for the full depth shown on the Drawings.

Where it is impractical to measure material by the cross-section method due to the erratic location of isolated deposits, acceptable methods involving three-dimensional measurements may be used.

(2) Embankment

The work of embankment construction will not be measured for payment and shall be considered incidental to the various classifications of roadway excavation.

The water used will not be measured or paid for but will be incidental to the work.

(3) Structure Excavation

The quantity to be paid for under this item will be the number of cubic meters, measured in its original position, of the material acceptably excavated in conformity with the drawings or as directed by the Engineer.

Structure excavation will be measured below the limits of roadway excavation. When structures are to be placed in embankment sections, the natural ground line as cross-sectioned will be the uppermost level of computation unless otherwise indicated on the drawings or specified in the special provisions.

Unless otherwise specified or indicated on the drawings, no material outside of sloped planes 50 centimeters beyond the bottom edge of the footings with a slope of 1:0.5 thereon will be included with common soil to be excavated, and with slope of 1:0.3 thereon of rock to be excavated.

305 PAYMENT

(1) Roadway Excavation

The accepted quantities of excavation will be paid for at the contract price per unit of measurement for each of the pay items listed below.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
CO1.	Roadway Excavation	
	01 Common Excavation	m ³
	02 Rock Excavation	m ³
	03 Replacing Subgrade in Cut Section with Selected Materials	m ³
	04 Replacing Foundation in Fill Section with Selected Materials	m ³

(2) Structure Excavation

The accepted quantities of structure excavation will be paid for at the contract unit price per cubic meter. The unit price per cubic meter shall include the placing and compacting of all backfill when the materials used are obtained from excavation, any clearing and grubbing required and not paid for under some other item, formation of any embankments made with material from structure excavation, and disposal of all surplus or unsuitable excavation, unless otherwise specified.

Any structure excavation other than in Box Culverts or Bridgeworks shall be deemed to be subsidiary to other item or items in the Bill of Quantities.

Any backfill material or filter material or bedding material required whose source is that other than road excavation and structure excavation will be paid for at the contract unit price for the material being used.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Co2. Structure Excavation	
01 Common Excavation in Box Culverts and Wing Walls	m3
02 Rock Excavation in Box Culverts and Wing Walls	m3
03 Common Excavation in Piers and Abutments of Bridgeworks	m3
04 Rock Excavation in Piers and Abutments of Bridgeworks	m3
05 Supply and Placemet of Selected Backfill Materials	m3

- 06 Supply and Placement of Selected Filter Materials m3
- 07 Supply and Placement of Selected Bedding Materials m3

PART 4

STRUCTURAL CONCRETE AND CONCRETE ANCILLARIES WORKS

PART 4 STRUCTURAL CONCRETE AND CONCRETE ANCILLARIES WORKS

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PART 4 STRUCTURAL CONCRETE AND CONCRETE ANCILLARIES WORKS

401 SCOPE

This work shall consist of furnishing and placing portland cement concrete for structures and concrete ancillaries construction in accordance with these Specifications and in reasonably close conformity with the lines, grades and dimensions as shown on the drawings or established by the Engineer.

Any concrete for Road Ancillaries, Storm Drainage Works and Masonry Works shall not be included in measurement for Structural Concrete.

402 CLASSIFICATION OF CONCRETE

The following classes of Concrete in accordance with BS-CP 110 are included in these Specifications. Each class of Concrete shall be used in that part of the Structure where called for in Table 4-1 hereafter, and shown on the Drawings or as directed by the Engineer.

Table 4-1 Classification of Concrete

<u>Grade</u>	<u>Maximum Size of aggregate (mm)</u>	<u>Part of the works</u>
40	20	Prestressed Concrete Girder
30	20	R.C. Slab, Voided Slab
25	40	Abutment, Pier, Pier footing, Retaining Wall, Wing Wall, Approach Slab

25	20	Box Culvert, Catch Basin, Ditch, Catch Basin Cover, Ditch Cover
15	40	Mass. Concrete, Blinding Concrete, Pipe Foundation, Incidental Structure

403 MATERIALS

Materials shall meet the requirements specified in the following sub-clauses of Clause 900.

	<u>Sub-clause No.</u>
Fine Aggregate	906.05
Coarse Aggregate	906.05
Portland Cement	907
Water	908.01
Air Entraining Admixture	908.02

404 CONCRETE MIX DESIGN AND TRIAL MIXES

404.01 Concrete Mix Design

(1) Classes of Concrete

Mixes for the classes of concrete shown below shall be designed by the Contractor. The class of concrete is denoted by the minimum 28 day works cube strength and the maximum size of aggregate.

(2) Maximum Cement Content

The cement content in any mix shall not exceed 550 Kg per cubic meter of concrete. The quantity of water used shall not exceed that required to produce a concrete with sufficient workability to be placed and compacted where required.

(3) Prescribed Mixes for General Use

Unless specified otherwise, the prescribed mixes for general use shall be as shown in Table 4-2 in accordance with BS5400 Part 7.

Table 4-2 Prescribed mixes for general use BS5400 Part 7

Requirements	Grade	40	30	25	15
Specified Work Cube	28 days	40	30	25	15
Strength (N/mm ²)	7 days	28	20	16.5	10 ^{/1}
Minimum Cement Content (Kg/m ³)		420	400	340	250
Total Aggregate (Kg/m ³)		1700	1700	1800	1850
Fine Aggregate (%)		-	-	-	30 to 40
Sand Zone 2 (%)		36	35	30	-
Workability		Medium	Medium	Medium	-
Slump Limits (mm)		50 to 100	25 to 75	50 to 100	-

^{/1} A figure is derived from CP110 Part 1.

404.02 Trial Mixes

No structural concrete shall be placed in the Works until the relevant mix has been approved by the Engineer.

The Contractor shall give notice to enable the Engineer to be present at the making of trial mixes in accordance with BS5400 and preliminary testing of the cubes. The Contractor shall prepare trial mixes, using samples of approved materials grades to the Engineer's satisfaction prior to commencement of concreting. The Contractor shall determine the workability of the trial mixes.

Sampling and testing procedures shall be in accordance with BS1881.

404.03 Admixtures

Unless agreed by the Engineer neither admixtures nor cements containing additives shall be used.

405 CONSTRUCTION REQUIREMENTS AND CONSTRUCTION METHODS FOR IN-SITU CONCRETE

405.01 Mixing of Concrete

(1) Mixing at Site

Unless otherwise authorised by the Engineer, concrete shall be machine mixed at the Site.

Concrete shall be thoroughly mixed in a mixer of an approved size and type which will ensure a uniform distribution of the materials throughout the mass.

The mixer shall be equipped with adequate water storage and with a device for accurately measuring and automatically controlling the amount of water used in each batch. A mechanical means shall be provided for recording the number of revolutions for each batch and automatically

preventing the discharge of the mixer until the materials have been mixed to the approval of the Engineer.

The entire contents of the mixer shall be removed from the drum before materials for a succeeding batch are placed therein. No mixer having a rated capacity of less than 1 - bag batch shall be used nor shall a mixer be charged in excess of its rated capacity.

All concrete shall be mixed for a period of not less than 1.5 minutes after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at the speed for which it has been designed, but this speed shall not be less than 14 or more than 20 revolutions per minute.

Prior to producing the first daily batch of concrete to be used in the Works, or after the mixer has been cleaned, the mixer shall be operated with a sufficient quantity of water, cement and aggregates to thoroughly coat the inside of the mixer drum, to obviate a deficiency of these materials in the first batch of Works concrete produced. On completion of this coating process, the coating batch shall be removed from the mixer and deposited in an approved location away from the Works.

Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before further concrete is mixed. The mixing plant and concrete transporting equipment shall be thoroughly cleaned before changing from one type of cement to another.

The Contractor will allow in his rates for concrete for all costs involved in complying with the above requirements.

(2) Ready-mixed Concrete

Ready mixed concrete, as defined in BS 1926 and batched off the site may be used only with the approval of the Engineer and shall comply with all requirements of the Specifications.

Ready mixed concrete shall be mixed and delivered to the site of the work by means of one of the following combinations of operation:

- (a) Mixed completely at a central plant and the mixed concrete transported to the point of delivery in truck agitators.
- (b) Mixed partially at a central point and the mixing completed in a truck mixer.
- (c) Mixed completely in a truck mixer.

Mixing at a central plant shall conform to the requirements for mixing on Site. The organisation supplying concrete shall have sufficient plant capacity and transporting apparatus to ensure continuous delivery at the rate required. Mixers may be stationary mixers or truck mixers. Agitators may be truck mixers operating at agitating speed or truck agitators. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates on which is plainly marked the various uses for which the equipment is designed and the manufacturer's guaranteed capacity of the drum or container in terms of volume of mixed concrete and the speed of the rotation of mixing drum or blades.

405.02 Weather Precautions

During hot weather, steps shall be taken to reduce the concrete temperature and the rate of water evaporation by proper attention to the cooling of the aggregate before use, production methods, and handling and curing. The concrete mixing plant shall be screened and covered as a protection from wind, rain and sun and adequate precautions shall be taken throughout the transit, placing and curing of the concrete whenever conditions so require.

During hot weather the coarse aggregate shall be sprayed with water of a temperature not exceeding 20°C and special precautions must be taken during all concreting operations so that the temperature of the concrete when placed does not exceed 30°C. Shading of aggregate bins and plant

is recommended and the cooling of mixing water and other steps taken shall be to the approval of the Engineer.

Fresh concrete placed when temperatures are high shall be efficiently shaded from the direct rays of the sun by approved means.

Concrete is not to be mixed and placed when the air temperature is 40°C in the shade or above. Immediately before commencement of concrete the weather forecast shall be studied with special regard to rising temperatures and strong winds and storms. If the weather forecast normally available is neither sufficient nor frequent enough, the Contractor shall at his own expense arrange for special detailed forecasts from the nearest meteorological authorities.

405.03 Transport of Concrete

Concrete shall be transported in water-tight containers in such a manner that will avoid the segregation of the constituent materials. The time elapsing between the initial mixing of the concrete and finally placing in the work shall not exceed 30 minutes. Concrete remaining unplaced at the end of this period shall not be placed in the work but shall be removed from the Site and disposed of at the Contractor's expense.

405.04 Placing of Concrete

(1) Preparation and Notice to the Engineer

In preparation for the placing of concrete all sawdust, chips, and other construction debris and extraneous matter shall be removed from the interior of forms. Struts, stays and braces, serving temporarily to hold the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

No concrete shall be placed until the Engineer has approved the formwork and reinforcement.

The Contractor shall give at least 48 hours' prior notice to the Engineer when he proposes to concrete and the Engineer may order that no concreting shall take place until either he or his representative is present.

(2) Placing of Concrete, General

Concrete shall not be dropped through a height exceeding 1.2 meters. For lowering concrete through heights in excess of 1.2 meters special methods shall be used, such as shutes, tremies, bottom dumping hoppers, or bagged placing and then only with the approval of the Engineer. All containers, troughs and shutes and apparatus through and in which the concrete is passed shall be kept clean and entirely free from hardened concrete or cement and free from contamination by extraneous material, and where there is an interruption of concreting exceeding 20 minutes, these shall be cleaned and bored down with water.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. Concrete shall be placed in horizontal layers not more than 20 cm thick except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding batch has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the batches. Each layer shall be compacted so as to avoid the formation of a construction joint with a preceding layer which has not taken initial set.

A competent steel fixer shall be in attendance through the whole time concrete is being cast around reinforcement.

Immediately following the discontinuance of placing concrete, all accumulations of mortar splashed upon the reinforcement steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete steel bond at and near the surface of the concrete, while cleaning the reinforcement steel.

(3) Placing of Concrete in Foundations

Before placing concrete in foundations the bottom shall be thoroughly rammed and cleaned up to a neat horizontal plane, or such profile as is shown on the Drawings or as directed by the Engineer. No steps or batters shall be permitted unless shown on the drawings or approved by the Engineer.

Where shown on the Drawings or ordered by the Engineer that the sides of the concrete shall be cast against the existing ground without using shuttering, the faces of the earth shall be trimmed neat and true to line. Where such a hole is over-excavated due to the Contractor's method of working, the void shall be filled with concrete of the same class as specified for the foundation at the Contractor's expense.

(4) Placing of Concrete in Deck, Capping Beams and Columns

Concrete in Deck Slabs shall be placed in one continuous operation for each span unless otherwise shown on the Drawings. Longitudinal construction joints, if required by reason of the width to be placed, shall be located as shown on the Drawings or directed by the Engineer.

The in-situ concrete shall be placed in such sequence that the advancing edge of the freshly deposited concrete over the full width of the deck or between longitudinal construction joints is approximately parallel to the deck support. Edge units shall be prevented from moving laterally during the placing of the in-situ concrete.

Concrete in the capping beams shall be placed in one continuous operation and shall be deposited uniformly for the full length of the girder and brought up evenly in horizontal layers.

Concrete in columns shall be placed in one continuous operation unless otherwise directed. The concrete shall be allowed to set at least 12 hours before the caps are placed. Unless otherwise permitted by the Engineer, no concrete shall be placed in the superstructure until the column forms have been stripped sufficiently to determine the character of the concrete in the columns.

(5) Placing of Concrete in Beams

Concrete in the stem and slab of T-beam spans shall be placed in one continuous operation and shall be deposited uniformly for the full length of the girder and brought up evenly in horizontal layers.

Where the size of the member is such that it cannot be made in one hour, transverse vertical construction joints shall preferably be located within the area of contraflexure as the Engineer may approve. For continuous spans, where required by the design considerations, the concrete placing sequence shall be approved by the Engineer.

(6) Placing of Concrete in Culverts

The base slab or footings of box culverts shall be placed and allowed to set before the remainder of the culvert is constructed. Suitable provision shall be made for bonding the sidewalls to the culvert base, by means of raised longitudinal keys so constructed as to prevent the percolation of water through the construction joint.

Before concrete is placed in the sidewalls, the culvert footings shall be thoroughly cleaned of all shavings, sticks, sawdust, or other extraneous material and the surface carefully chipped and roughened in

accordance with the method of bonding construction joints as specified hereinafter.

In the construction of box culverts the sidewalls and top slab shall be constructed as a monolith. The concrete in the walls shall be placed and allowed to set before the top slab is placed. In this case, appropriate keys shall be left in the sidewalls for anchoring the cover slab.

Each wing wall shall be constructed as a monolith. Construction joints, where unavoidable, shall be horizontal and so located that no joint will be visible in the exposed face of the wing wall above the ground line.

(7) Depositing Concrete Under Water

Concrete shall not be deposited in water except with the approval of the Engineer and under his immediate supervision, and in this case the method of placing shall be as directed by the Engineer.

405.05 Compaction of Concrete

All concrete shall be compacted to produce a dense homogeneous mass. Unless otherwise agreed by the Engineer, it shall be compacted with the assistance of vibrators. Sufficient vibrators in serviceable condition shall be on site so that spare equipment is always available in the event of breakdowns.

Internal vibrators shall be capable of producing not less than 10,000 cycles per minute, and external vibrators not less than 3,000 cycles per minute.

Vibration shall not be applied by way of the reinforcement. Where vibrators of the immersion type are used, contact with reinforcement and all inserts shall be avoided, so far as is practicable.

Concrete shall not be subjected to vibration between 4 and 24 hours after compaction.

405.06 Construction Joints

The position and detail of any construction joints not described in the Contract shall be subject to the approval of the Engineer, and shall be so arranged as to minimize the possibility of the occurrence of shrinkage cracks.

The upper surface of lifts of concrete walls and columns shall be horizontal and if the formwork extends above the joint on the exposed face it shall be cleaned of adhering concrete before the next lift is placed. The concrete placed immediately above a horizontal construction joint shall contain only two thirds the normal quantity of coarse aggregate, shall not be the first batch through the mixer and shall be thoroughly compacted and worked against the existing concrete.

In the case of vertical surfaces, a 1:1 slurry of cement and concreting sand shall, wherever possible, be well worked into them immediately before the fresh concrete is placed.

Where sections of the work are carried out in lifts, the reinforcement projecting above the lift being cast shall be adequately supported so as to prevent movement of the bars during the casting and setting of the concrete.

Wherever possible laitance and all loose material shall be removed while the concrete is still green and no further roughening shall then be required. Where this is not possible, it shall be removed by mechanical means provided the concrete has been in position for more than 24 hours. The roughened surfaces shall then be washed with clean water.

405.07 Concrete Surface Finish

(1) Unexposed Surface Finish

Unexposed surface finish, unless otherwise specified, shall be considered as a final surface finish, on the surfaces which are buried in the ground or covered with embankment or surfaces which are to be enclosed. The removal of fine and form marks and the rubbing of mortared surfaces to a uniform colour will not be required for unexposed surface finish.

All form work bolts or other devices shall be removed to a depth of 2 cm from the surface, and all holes, cavities and honeycombing in the surface shall be cleaned out and roughened to form a good key. These holes shall then be filled with cement grouted as specified.

The irregularities in the finish shall be no greater than those obtained from the use of wrought thickened tongue and grooved boards arranged in a uniform pattern.

(2) Exposed Surface Finish

Exposed surface finish shall be considered as final surface finish on all surfaces of the bridge superstructure, exposed surfaces of the pier columns and capping beams, and retaining walls.

The formwork shall be lined with a material approved by the engineer to provide a smooth finish of uniform texture and appearance. This material 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 one source as far as possible. The Contractor shall make good any imperfections in the resulting finish as required by the Engineer. Internal ties and embedded metal parts will be allowed only with the Engineer's specific approval.

The Contractor shall ensure that permanently exposed concrete surfaces are protected from rust marks, spillage and stains of all kinds.

(3) Concrete Surface Finish to Deck Slabs

The top surface of slabs, such as bridge decks or approach slabs shall be finished with a slightly ridged surface as left by the tamping screed. The screed marks shall be uniformly spaced transverse to the line of the carriageway.

405.08 Curing Concrete

Immediately after compaction the concrete surfaces exposed to conditions causing premature drying shall be protected by covering with canvas, straw, burlap, or other satisfactory material and kept moist. Curing shall continue for a period of not less than seven days after placing the concrete. Details of the method to be used shall be subject to the approval of the Engineer.

The formwork shall also be kept damp, and if struck earlier than seven days, shall be replaced for the remaining period with other approved damp material.

Concrete surfaces of structures which are to be buried in the ground shall be cured as specified above, but care shall be taken to avoid excessive water from curing running into the foundation of the footings.

405.09 Early Loading

Except for the provisions of sub-clause 405.10 concrete shall at no time be subjected to loading, including its own weight, which will induce a compressive stress in it exceeding 33 percent of its compressive strength at the time of loading or of the specified 28 day strength.

For the purpose of this Clause, the assessment of the strength of the concrete and the stresses produced by the loads shall be subject to the agreement of the Engineer.

405.10 Prestressing for Structures

(1) Prestressing Operations

Prestressing operations shall be carried out only under the direction of an experienced and competent supervisor and all personnel operating the stressing equipment shall have been properly trained in its use. In addition to the normal precautions against accident which should be taken at all times for the whole of the Works, special precautions shall be taken when working with or near tendons which have been tensioned or are in the process of being tensioned.

(2) Prestressing Components

Prestressing components shall be stored in clean dry conditions. They shall be clean and free from loose rust and loose mill scale at the time of fixing in position and subsequent concreting. Slight rusting of the steel is acceptable, but the surface shall not be pitted.

(3) Prestressing Tendons

All wires or strands stressed at the same time shall be taken from the same parcel. Each cable shall be tagged with its number and the coil number or numbers of the steel used.

Tendons shall not be welded within the length to be tensioned and, unless other methods of cutting are agreed by the Engineer, shall be sawn or cropped.

Tendons shall be built into the Works strictly in accordance with the system which is being employed.

Cables shall not be kinked or twisted and individual wires or strands shall be readily identifiable at each end of the member. No strand which has become unravelled shall be used in the Works.

(4) Sheaths

All sheaths shall be maintained in their correct positions during the placing of the concrete. Where members are made up of units stressed together, the ducts in the joints between the units shall be in true alignment.

Where sheaths are used, the number of joints shall be kept to a practicable minimum and each joint adequately sealed against the ingress of any material. Joints in adjacent sheaths shall be staggered by at least the length of diameter of sheath.

Sheaths shall be kept free of any matter detrimental to the bond between the sheath and the grouted and, except for material sealing a sheath joint, between the sheath and the concrete.

The ends of all ducts and tendons shall be respectively sealed and protected until the tendon is threaded through and the stressing operations are commenced.

(5) Anchorages

Anchor cones, blocks and plates shall be positioned and maintained during concreting so that the centre line of the duct passes axially through the anchorage assembly.

All bearing surfaces of the anchorages shall be clean prior to concreting and tensioning.

(6) Jacks for Prestressing

All jacks used for prestressing shall be of the type applicable to the system adopted.

The accuracy of all load measuring equipment shall be checked to the satisfaction of the Engineer at the start of work each day it is to be used and whenever the equipment is moved to a different jack.

(7) Post-tensioning Procedure

Tensioning shall be carried out only in the presence of the Engineer or his representative unless permission has been obtained to the contrary.

Immediately before tensioning, the Contractor shall prove that all tendons are free to move between jacking points and that members are free to accommodate the horizontal and vertical movements due to the application of prestress.

Unless otherwise described in the Contract, concrete shall not be stressed until it has reached at least the age at which two test cubes taken from it attain the specified transfer strength. The test cubes shall be made and tested in accordance with BS 1881 but shall be cured in similar conditions to the concrete to which they relate. The Contractor shall cast sufficient cubes to demonstrate that the required strength of the concrete at transfer has been reached.

Where members consist of jointed elements, the strength at transfer of the jointing shall be at least equivalent to the specified transfer strength of the member.

The Contractor shall establish the datum point for measuring extension and jack pressure to the satisfaction of the Engineer.

The tendons shall be stressed at a gradual and steady rate until they attain the force described in the Contract.

The force in the tendons shall be obtained from readings on a load cell or pressure gauge, and the extension of the tendons measured. The two readings shall conform to the limits set by the Engineer.

When stressing from one end only, the pull-in at the end remote from the jack shall be accurately measured and the appropriate allowance made in the measured extension at the jacking end.

When the force described in the Contract, including any overload of short duration, has been applied to the satisfaction of the Engineer, the tendons shall be anchored. The jack pressure shall then be released in such a way as to avoid shock to the anchorage or tendons.

If the pull-in of the tendons at completion of anchoring is greater than that stipulated by the Engineer, tensioning shall be carried out afresh.

If it is necessary to crop the tendons to enable the ducts to be grouted, this shall be delayed as long as practicable up to the time of grouting. In all other cases, unless agreed otherwise by the Engineer, the tendons shall not be cropped less than 3 days after grouting.

The Contractor shall keep full records of all tensioning operations including the measured extensions, pressure gauge or load cell readings and the amount of pull-in at each anchorage. Copies of these records shall be supplied to the Engineer within 24 hours of each tensioning operation.

(8) Grouting Method of Ducts

Grouting trials shall be undertaken when required by the Engineer.

Ducts shall not be grouted when the air temperature in the shade is lower than 5°C.

All ducts shall be thoroughly cleaned by means of compressed air.

Ducts formed without sheathing shall be filled with water at least one hour before grouting. Sheathed ducts shall not be filled with water unless required by the Engineer. Where ducts have been filled with water it shall be blown out by compressed air. All anchorages shall be sealed before grouting.

Ducts shall be grouted as soon as practicable after the tendons in them have been stressed and the Engineer's permission to commence has been obtained. Grout shall be injected in one continuous operation and allowed to flow from the vents until the consistency is equivalent to that being injected.

The ducts shall be completely filled with grout.

Vents shall be sealed consecutively in the direction of flow and the injection tube sealed under pressure until the grout has set. The filled ducts shall be protected to the satisfaction of the Engineer to ensure that they are not subjected to shock or vibration for one day and that the temperature of the grout in them does not fall below 5°C for three days after its injection. Two days after grouting, the level of grout in the injection and vent tubes shall be inspected and made good if necessary.

The Contractor shall keep full records of grouting including the date each duct was grouted, the proportions of the grout and any admixtures used, the pressure, details of any interruptions and topping up required.

Copies of these records shall be supplied to the Engineer within three days of grouting.

Where required by the Engineer, the Contractor shall provide facilities and attendance for the radiographic testing of ducts.

(9) Plant for Grouting of Ducts

The grout mixer shall produce a grout of colloidal consistency. The grout injector shall be capable of continuous operation with a sensibly constant pressure up to 3 Kg/cm² and shall include a system of circulating or agitating the grout whilst actual grouting is not in progress. All baffles to the pump shall be fitted with sieve strainers size BS No. 14.

The equipment shall be capable of maintaining pressure on completely grouted ducts and shall be fitted with a nozzle which can be locked off without loss of pressure in the duct.

The pressure gauges shall be calibrated before they are first used in the Works and thereafter as required by the Engineer. All equipment shall be thoroughly washed with clean water at least once every three hours during the grouting operations and at the end of use for each day.

(10) Grouting Materials for Ducts

Unless otherwise directed or agreed as a result of grouting trials, the grout shall:

- (a) Consist only of ordinary Portland cement and water;
- (b) have a water : cement ratio as low as possible consistent with the necessary workability and under no circumstances shall the water : cement ratio exceed 0.45;
- (c) not be subject to bleeding in excess of 2 percent after 3 hours or 4 percent maximum when measured at 18°C in a covered glass cylinder approximately 10 cm diameter with a height of grout of approximately 10 cm, and the water shall be re-absorbed after 24 hours.

Admixtures containing chlorides or nitrates shall not be used; other admixtures may be used only with the written permission of the Engineer and shall be applied strictly in accordance with the manufacturer's instructions.

The grout shall be mixed for a minimum of 5 minutes and until a uniform consistency is obtained.

The mortar shall be a mix of

- 50 Kg of screened Portland cement
- 20 Kg of sand passing the 1 millimeter BS Sieve

(11) Storage of Prestressed Members

When members are stored, they shall be firmly supported at such bearing positions as will ensure that the stresses induced in them are always less than the permissible design stresses.

(12) Handling and Placing of Prestressed Post Tensioned Members

In handling and placing prestressed post tensioned beam, it shall be lifted or supported only at the points specified, and shall be handled, transported and placed without any impact.

406 FORMWORK

406.01 Construction and Materials

Formwork shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support.

Forms shall be mortar-tight and sufficiently rigid to prevent distortion due to the pressure of the concrete and other loads incidental to the

construction operations including vibration. Forms shall be constructed and maintained so as to prevent the opening of joints due to shrinkage of the lumber.

Form lumber for all exposed concrete surfaces shall be dressed at least on one side and two edges and shall be constructed so as to produce mortar-tight joints and smooth concrete surfaces. Forms shall be filleted and chambered as shown on the drawings, and shall be given a bevel or draft in the case of all projections, such as girders and copings, to assure easy removal.

Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least three centimeters from the face without injury to the concrete. In case wire ties are permitted, the wires shall be cut back at least five millimeters from the face of the concrete upon removal of the forms. The cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in colour.

Where the bottom of the forms is inaccessible, the lower form boards shall be left loose or other provisions made so that extraneous material may be removed from the forms immediately before placing the concrete.

The metal used for forms shall be of such thickness that the forms will remain true to shape. All bolt and rivet heads shall be countersunk. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or do not line up properly shall not be used. Care shall be exercised to keep metal forms free from rust, grease or other foreign matter.

The form used for the void shall be of such thickness that the forms will remain true to shape. The devices for fixing the forms in place shall be designed to hold the forms rigidly in place.

406.02 Preparation of Formwork before Concreting

The inside surfaces of forms shall, except for permanent formwork, or unless otherwise agreed by the Engineer, be coated with an approved material to prevent adhesion of the concrete. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not come into contact with the reinforcement or prestressing tendons and anchorages. Different release agents shall not be used in formwork to concrete which will be visible in the finished Works.

Immediately before concreting, all forms shall be thoroughly cleaned out.

406.03 Removal and Reuse of Forms

The forms for any portion of the structure shall not be removed until the concrete is strong enough to withstand damage when the forms are removed, and the Engineer shall be informed in advance when the Contractor intends to strike any formwork.

The time at which the formwork is struck shall be the Contractor's responsibility, but the minimum periods between concreting and the removal of forms shall be as follows:

Sides of beams, walls, columns	24 hours
Soffits of beams and slabs (props left in)	7 days

The periods stated above are based on a constant surface temperature of the concrete of 16°C and the use of ordinary Portland cement. If necessary they shall be increased as directed by the Engineer, and may be changed if other types of cement are used, subject to the Engineer's agreement.

Formwork shall be constructed so that the side forms of members can be removed without disturbing the soffit forms and, if props are to be left in place when the soffit forms are removed, these props shall not be disturbed during the striking.

For prestressed units the side forms shall be eased as early as possible and the soffit forms shall permit deformation of the member when the pre-stress is applied.

All formwork shall be removed without damage to the concrete.

The shape, strength, rigidity, water-tightness and surface smoothness of reused forms shall be maintained at all times. Any warped or bulged lumber shall be re-sized before being used. Unsatisfactory forms shall not be used.

407 STEEL REINFORCEMENT

407.01 Description

This work shall consist of furnishing and placing reinforcing steel in accordance with these specifications and in conformity with the drawings.

407.02 Materials

Reinforcing steel shall meet the requirements of Clause 908

407.03 Construction Requirements

(1) Bar Bending Schedule

Bar bending schedules are incorporated in the Drawings but the Contractor shall be responsible for their accuracy and shall satisfy himself as to errors or omissions and all other things regarding their suitability for the work. When new bar bending schedules are required or the existing ones required to be amended the Contractor shall prepare such lists and submit them to the Engineer for his approval.

When the necessary erection bars (tie bars) are not shown on the drawings, the Contractor shall prepare and submit the required tie bar list to the Engineer for his approval.

(2) Fabrication

Bar reinforcement shall be bent to shapes shown on the Drawings and bending schedules. All bars shall be bent cold, unless otherwise permitted by the Engineer. All hooks, bends, etc., unless otherwise shown on the Drawings, shall be to BS 4466. Bar reinforcement shall be bundled and each bundle of steel shall be tagged with identifying tags, showing the size and mark of the bar.

(3) Placing and Fastening

The reinforcement shall be accurately placed and held in the positions as shown on the Drawings and subject to the approval of the Engineer.

The minimum spacing centre to centre of parallel bars shall be 2.5 times the size of the bar, but in no case shall the clear distance between bars be less than 1.5 times the maximum size of coarse aggregate in the concrete.

Distances from the forms shall be maintained by means of blocks or other approved supports. Blocks for holding reinforcement from contact with the forms shall be precast mortar blocks of approved shape and dimensions or approved metal chairs.

Layers of bars shall be separated by precast mortar blocks or other approved supports.

(4) Splicing and Lapping

All reinforcement shall be provided in full lengths as indicated on the Drawings and bending schedule. Splicing of bars, except where shown on

the Drawings, shall not be permitted without the written approval of the Engineer. Splices shall be staggered, as directed by the Engineer.

In lapped splices, the bars shall be placed in contact and wired together in such a manner as to maintain a clearance specified in the Code of Practice for Reinforced Concrete CP 114.

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at ends and edges. The edge lap shall not be less than 40 times the diameter of the mesh reinforcement bar or two times mesh in width whichever is the greater or as directed by the Engineer.

(5) Approval before Concreting

The Contractor shall in all cases request the approval of the steel work by the Engineer in sufficient time to allow an inspection to be made and shall not commence concreting until such approval is obtained. The period between the Contractor's request for approval and his intention to commence concreting shall not be less than one clear normal working day and the Engineer may require a longer period if, in his opinion, the reinforcement is of such complexity as to require it.

Such approval shall not absolve the Contractor of his responsibilities under the contract.

408 FALSITY CONCRETE WORK

The Contractor shall on the order of the Engineer remove and reconstruct any such portion of the work which, in the opinion of the Engineer, is unsatisfactory as regards quality of concrete in correct dimensions of the cast portion, badly placed or insufficient reinforcement, honey-combing or other such cause as shall render the construction not up to

the standard required and which, in the opinion of the Engineer, may prejudicially affect the strength or durability of the construction.

No repairing of defective concrete shall be done without the written permission of the Engineer.

409 TOLERANCES

The concrete work shall be constructed as accurately as possible within the following tolerances:

- (a) In the cross-sectional dimensions of precast beams, not more than 5 mm
- (b) In dimensions, other than cross-sectional dimensions of columns and beams, not more than 10 mm
- (c) In any surface, the irregularity shall not exceed 10 mm measured from a 3 meters long straight edge
- (d) No member shall be out of line by more than 5 mm
- (e) No column or wall shall be out of plumb by more than 5 mm or, if battered, out of batter by more than 5 mm.

410 BRIDGE BEARINGS

410.01 General

The bearings shall be installed to the appropriate setting as directed by the Engineer and be maintained in their correct position during the placing of the bridge deck.

After the deck has been completed, each bearing and the area around it shall be left clean.

Bearing shall not be dispatched to the site until the tests described in sub-clause 1011 of these Specifications have been satisfactorily completed and the certified results of such tests approved by the Engineer.

410.02 Rubber Bearings

Rubber bearings shall be as specified and shall be installed to the appropriate setting as directed by the Engineer or shown on the drawings. They shall be maintained in their correct position during the placing of the bridge deck.

Rubber bearing pads or strip bearings shall be designed for the particular requirements described in the Contract and manufactured all in accordance with the requirements. In addition, the bearings shall comply with the manufacturers requirements.

411 METAL PARAPETS

411.01 Description

Type P1 Vehicle Parapets, Type P2 Vehicle Pedestrian Parapets and Type P4 Pedestrian Parapets shall be provided as shown on the Drawings respectively. The parapets shall comply with the requirements of Technical Memorandum (Bridges) NO BE5 Third Revision, November, 1973.

Type P1 Vehicle Parapet and Type P2 Vehicle Pedestrian Parapet shall consist of:

- (a) parapet posts with base plates by which they are bolted and grouted in position, and
- (b) 3 numbers of horizontal rails spanning between parapet posts.

All exposed surfaces shall be protected against corrosion.

The P4 Pedestrian Parapet shall consist of:

- (a) parapet posts with base plates by which they are bolted and grouted in position, and
- (b) panels spanning between posts; each panel comprising of a top and bottom horizontal rail linked by a series of vertical rods.

All exposed surfaces shall be protected against corrosion.

411.02 Materials

Materials shall meet the requirements specified in sub-clause 911.04 of these Specifications.

Guardrails shall consist of specially designed corrugated steel plates which are spliced together with recessed bolts so as to deflect any vehicle out of control.

412 EXPANSION JOINTS

412.01 Expansion Joints for Bridges

Expansion joints for bridges and aquaduct bridges shall be placed as shown on the Drawings or as directed by the Engineer after the wearing course is placed.

Materials shall meet the requirements specified in the Drawings or the sub-clause 911.02 of these Specifications.

412.02 Water-tight Joints for Box Culvert

Water-tight joints for box culvert shall be placed as shown on the Drawings or as directed by the Engineer carefully to prevent water leakage from a vacant space which break out by setting a waterstop.

Waterstop shall be spliced to prevent water leakage by means of heated press apparatus approved by the Engineer.

Materials shall meet the requirements specified in the Drawings or sub-clauses 911.02 of these Specifications.

413 STRUCTURE DRAINAGE

413.01 Bridge Drainage

The transverse and longitudinal drainage of bridges shall be accomplished by providing suitable crossfalls and slopes as shown on the Drawings within the tolerances specified in Clause 409 of these Specifications as directed by the Engineer.

The outlet drains shall be built as shown on the Drawings so as to prevent discharge of water against any portion of the structure.

413.02 Abutment and Retaining Wall Drainage

Abutment and retaining wall drainage shall be carried out as shown on the Drawings or as directed by the Engineer.

414 PRECAST CONCRETE BLOCK FOOTWAY OF BRIDGE

Precast concrete block footway of bridge shall be constructed in accordance with the relevant sub-clauses of Clause 500.

415 PRECAST CONCRETE KERBS FOR BRIDGES

Precast concrete kerbs for bridges shall be constructed in accordance with the relevant sub-clauses of Clause 500.

416 INSTALLATION OF UTILITY LINES ON BRIDGES

Required utility lines on bridges shall be installed as directed by the Authorities under the supervision of the Engineer.

417 NAMEPLATE

At the completion of the bridge specified, the Contractor shall provide a suitable cast-iron nameplate giving at least following information:

- (a) name of the Administration,
- (b) design loading and
- (c) year of completion of the bridge.

The design of the plate and method of fixing shall be as shown on the Drawings or as approved by the Engineer.

418 SCORE PROTECTION RIPRAP COVERED BY CONCRETE

Stones shall be distributed and compacted so that the minimum thickness of the riprap is not less than specified, and covered with Grade 15 concrete with steel reinforcement in accordance with relevant sub-clauses of Clause 400 as shown on the Drawings.

The stones and joint mortar shall meet the requirements specified in Clause 15 of these Specifications.

419 WATERPROOF MORTAR FOR AQUADUCT

Supply and complete the waterproof mortar on the prepared inner surface of the aquaduct as specified on the Drawings or as directed by the Engineer.

420 MEASUREMENT AND PAYMENT

Measurement and payment for the items in this clause of these Specifications will be made as follows.

420.01 Concrete

(1) Measurement

Concrete will be measured by the cubic meter in accordance with the dimensions shown on the drawings or as ordered. No deduction will be made for the volume occupied by pipes less than 8 inches in diameter nor for reinforcing steel, anchors, conduits and weep holes.

(2) Payment

The accepted quantities of structural concrete will be paid for at the contract unit price per cubic meter complete in place.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
D01.	Concrete complete in place, supply of materials, labour, tools and equipment to mix and in site	
	01 Structural Concrete, Grade 40	m ³
	02 Structural Concrete, Grade 30	m ³
	03 Structural Concrete, Grade 25	m ³
	04 Structural Concrete, Grade 15	m ³

420.02 Steel Reinforcement and Prestressing Steel Cable

(1) Measurement

Steel reinforcement will be measured by the tonnage based on the theoretical number of tons complete in place as shown on the drawings or placed as ordered.

The quantities of materials furnished and placed shall be based upon the calculated weights of the reinforcing steel actually placed including tie bars in accordance with these specifications.

(2) Payment

The accepted quantities of reinforcing steel will be paid for at the contract price per ton complete in place. No allowance will be made for clips, wire or other material used for fastening reinforcement in place.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
D02.	Supply and fixing in place of Reinforcing steel	
01	Mild steel bar, not exceeding ϕ 16 mm	t
02	Mild steel, bar ϕ 20 mm or greater	t
03	High yield steel bar, not exceeding ϕ 16 mm	t
04	High yield steel bar, ϕ 20 mm or greater	t
D03.	Supply, fixing in place with necessary accessories, stressing up to required tension and grouting in bridge girders or high tensile prestressing steel cables	
01	ϕ 5 mm steel cable	Kg
02	ϕ 7 mm steel cable	Kg
03	ϕ 12.5 mm strand	Kg

420.03 Formwork

(1) Measurement

Formwork will be measured by the area of the concrete actually in contact with the mould, except that in the case of small fillets and chamfers of size 5 cm x 5 cm and less, the overall area of the concrete will be taken as though the fillets and chamfers had been omitted.

(2) Payment

The accepted quantities of form will be paid for at the contract unit price per square meter or linear meter complete in place.

Formwork for temporary construction joints shall not be paid for and shall be deemed to be included in the Contractor's rates for concreting.

The rates for formwork shall include for all timber or metal moulds inclusive of all necessary supports and stagings (unless billed separately), bolts, nuts, straps, clamps, wedges and other fittings, also all cutting and waste and the cost of all labour, materials and other items in making, erecting and removing the formwork and for any other work required to construct the forms to the shapes, dimensions, slopes and cambers shown on the Drawings, or as directed by the Engineer.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
D04.	Supply, preparation, erection and removal of Formworks	
01	Fair finish plane formworks for walls, piers, culverts and abutments, type A	m ²
02	Fair finish curved formworks for walls, piers, abutments and culverts, type B	m ²
03	Fair finish formworks for supported beams and slabs type C	m ²
04	Fair finish formworks for prestressed post-tensioned concrete beams cast in yard, type D	m ²
05	Plane rough finish formworks for foundation in touch with earth, type E	m ²

06	Supply, preparation and erection of voids, ϕ 700 mm for supported voided slabs, type F	m
07	ditto, but for ϕ 850 mm, type G	m
08	ditto, but for ϕ 900 mm, type H	m

420.04 Bridge Bearing

(1) Measurement

Rubber bearings will be measured by the number complete in place as shown on the drawings or ordered.

(2) Payment

The accepted quantities of rubber bearings will be paid for at the contract unit price per cubic meter complete in place including material, placing and all other items for the satisfactory completion of the work.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
D5.	Supply and fixing in place of Bridge Bearing Pad	
01	Rubber Bearing, type A	nr
02	ditto, type B	nr
03	ditto, type C	nr
04	ditto, type D	nr
05	ditto, type E	nr
06	ditto, type F	nr

420.05 Metal Parapet

The unit for measurement and payment shall be as follows:

The parapet shall be paid for by the linear meter complete in place, and shall include for posts, excavation and formation of pockets in concrete upstands and all other fixings.

	<u>Pay Item</u>	<u>Pay Unit</u>
D06.	Supply and fixing of Metal Parapet	
01	Type P ₁ Vehicle Parapet	m
02	Type P ₂ Vehicle Pedestrian parapet	m
03	Type P ₄ Pedestrian Parapet	m

420.06 Expansion Joints

Expansion joints will be measured by the linear meter in accordance with the dimensions shown on the drawings or ordered. The accepted quantities of expansion joints for bridges will be paid for at the contract unit price per linear meter complete in place. Any expansion joint other than described hereunder shall be deemed subsidiary to the other pay item or items.

The contract unit price shall include all materials, tools, equipment and other items for satisfactory completion of the Work.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
D07.	Expansion Joint for Bridge and Water-tight Joint for Box Culvert	
01	Expansion Joint for Bridge, Type A	m
02	Expansion Joint for Bridge, Type B	m

- 03 Expansion Joint for Aquaduct, Type C m
- 04 Water-tight Joint for Box Culvert,
Type D m

420.07 Positioning of Prestressed Post Tensioned Beam

Positioning of prestressed post tensioned beam on the top of the bearing will be measured by the numbers positioned in place as specified.

The accepted quantities of prestressed post tensioned beams positioned as specified will be paid for at the contract unit price per number complete in place including all materials, labour and equipment required for lifting, handling, transporting and positioning and other necessary implied works.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
D08.	Transport to the site, lifting and fixing of pre-stressed Post Tensioned Beam on the top of bearing	
01	Beams with length not exceeding 25 meters	nr
02	Beams with length of 25 meters or greater	nr

420.08 Precast Concrete Block Footway for Bridge

Precast concrete block footway for bridge will be measured by the square meter of block surface finished.

The accepted quantities of precast concrete block footway will be paid for at the Contract unit price per square meter for precast concrete block footway, and required cement mortar for placing blocks will not be paid separately but the cost thereof shall be included in the cost

of precast concrete block footway for bridge. Precast Concrete Kerb for bridge shall be billed separately.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
D09.	Supply and complete in place of Precast Concrete Block Footway for Bridge	m ²

420.09 Bridge Drainage

Bridge drainage will be measured by the number of units installed in accordance with the Drawings or as ordered.

The accepted quantities of bridge drains will be paid for at the Contract Unit Price per Unit complete in place. The contract unit price shall include all materials, tools, equipment and other item for satisfactory completion of the work.

Payment will be made under:

	<u>Pay Item</u>	<u>Pay Unit</u>
D10.	Supply and fixing of Bridge Drains	
	01 Catch Basin, type A	nr
	02 ditto, type B	nr
	03 ditto, type C	nr
	04 ditto, type C'	nr
	05 Lead Pipe, PVC, ϕ 125	m
	06 ditto, ϕ 200	m

419.10 Precast Concrete (Kerb) for Bridges

Precast concrete kerbs for bridges will be measured and paid in accordance with Pay Item E08 Precast Concrete Kerb, type C.

420.11 Installation of Utility Lines on Bridges

Installation of utility lines on bridges will be paid for at the contract lump sum price, which price shall include all materials, and all other items and costs necessary for the satisfactory completion of the work.

Payment will be made under

	<u>Pay Item</u>	<u>Pay Unit</u>
D11.	Installation of Utility Lines on Bridges	
01	PVC pipe for telephone cable ϕ 150	m
02	ditto, but for ϕ 80	m
03	Steel water pipe ϕ 90	m
04	Steel sewage pipe ϕ 380	m
05	<u>Provisional Sum</u> Provide for additional and contingent works as directed by the Employer in accordance with Pay Item D11	Lump sum

420.12 Score Protection Riprap covered by Concrete

Score protection riprap covered by concrete will be measured by square meters in accordance with the dimensions shown on the drawings or ordered, and will be paid at contract unit price per square meter including all materials, placing and other costs necessary for the satisfactory completion of the work.

Pay Item

Pay Unit

D12. Supply and complete in place of
Score Protection Riprap covered
by Concrete

m²

420.13 Water Proof Mortar for Aquaduct

Measurement and payment will be made by accepted square meters complete
in place as specified on the Drawings or directed by the Engineer.

PART 5

PAVEMENTS AND ROAD ANCILLARIES WORKS

PART 5 PAVEMENT AND ROAD ANCILLARIES WORKS

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