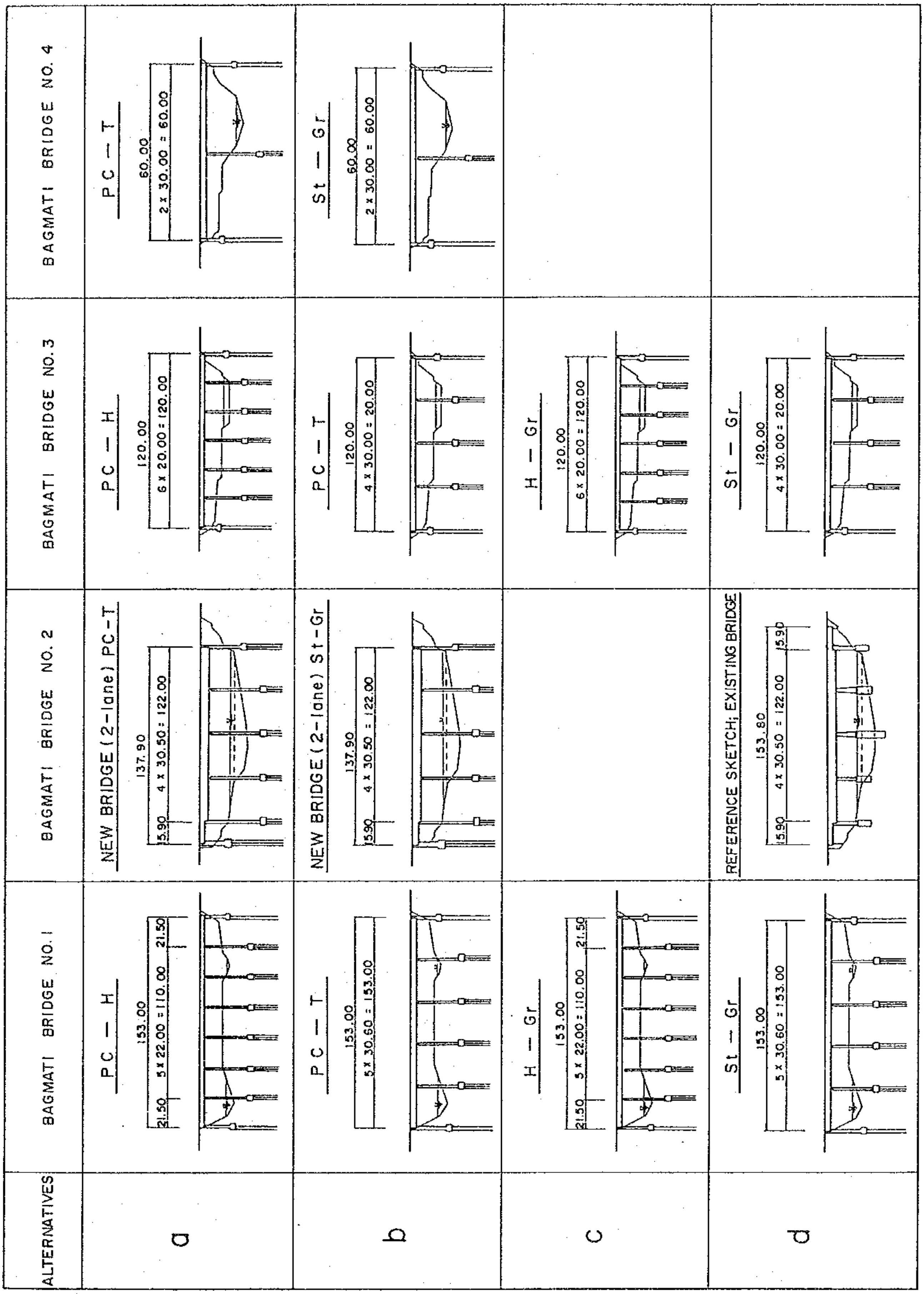


Figure 3.6 BRIDGE TYPE AND ALTERNATIVES

4. ENGINEERING SURVEY AND ANALYSIS

Survey consisted of geological investigation including soil/materials investigation, hydrological survey, seismic survey and topographical survey.

4.1 Geological and Soil Materials Investigations

The geological investigation include sub-surface exploration at the proposed four bridge sites by rotary drilling, carrying out of insitu tests, sampling and laboratory tests of the sampled soil specimen. Similarly properties of sub-grade soil and borrow pit areas are also evaluated by conducting field test and laboratory tests.

All of the four proposed bridge sites are located in the central part of Kathmandu Valley along the east-west stretch of Bagmati River. No significant problem of slope instability is foreseen for all of the bridge sites. However analysis of the liquefaction potential of bank erosion may be necessary to carry out during more detailed study and design.

One of the major problems is lowering of Bagmati river bed causing problem to the existing and new bridges to be constructed. The main causes of lowering of river bed are as follows:

(i) Taking out excessive sand from river bed

(ii) Rocky river bed at Chobhor Gorge going down

(iii) Flow of river at river soil bed

(1) Soil Investigation at Bridge Site

The soil investigation by machine boring was conducted at each proposed bridge site (4 places). The following is the result of soil analysis:

Bagmati Bridge No 1

The soil at the top is deposit of loose sand and gravel. The under lying layer consist of clayey silt upto the investigated depth of 40m. This layer has SPT values (N-value) of 5 to 8.

New Bagmati Bridge (No.2)

The geologic formation consists of alternate layers of clayey silt and sand of varying density and thickness. The N-values of these layer are 10 to 20.

Bagmati Bridge No 3

The soil of this site is mostly soft clayey silt. The N-values of the layer from the top to 10m depth and the under lying layer is 3 to 7 and 10 to 20 respectively.

Bagmati Bridge No 4

The soil at the top is 6.5m to 7.0m thick deposit of sand of medium compactness. The under lying layer consist of firm clayey silt. The N-values of the upper layer and the under layer are 15 to 18 and 6 to 9 respectively.

(2) Evaluation of Subgrade

The proposed roads, from Kuleswor to Koteswor and from Ring Road (Gongabun Bus Park) to Sorhakhutte are located at fluvial deposits of silt and sand.

Test result revealed that average CBR value can be taken as 5 for Kuleswor Koteswor Road and 7 for Ring Road-Sorhakhutte Road for designing flexible type of pavements.

(3) Aggregate and Embankment Materials

Soil: The following borrow pits are recommended for soils:

1. Kapan, 2. Thimi, 3. Gokarna Ban

Gravel: The CBR value of gravel extracted from Chunnikhel is around 40 which is good for sub-base. The materials also can be used for base course if less expensive type of pavement are adopted.

Sand: The borrow pits identified for sands were at Pikhel, Kapan and Basundhara.

Crushed Stone: Three sites at Jhalungtar, Godavari and Thankot were identified for crushed stone. The test results showed that the aggregate are suitable both for pavement and concrete works.

4.2 Hydrological Study and Analysis

(1) Hydrological Survey

The main objective of the hydrological study and analysis carried out for designing bridges, and road drainage to be installed along and crossing the

proposed road is to grasp the hydro-meteorological condition and estimate the peak flood discharge.

The hydro-meteorological data and recorded information relating to the Project area required for evaluating the peak flood discharge are obtained from Department of Hydrology and Meteorology (DOMH) and concerned authorities, and by field surveys. The contents of surveys carried out on field are as follows:

- Change of river course and lowering of riverbed.
- Flood mark of past maximum water level.
- Observation of riverbed materials.
- River cross sectional survey

(2) Review of Hydro-meteorological Data and River Conditions

Annual total mean rainfall during the past 15 year are more than 3000 m/m in height elevation area, 1500 to 2000 m/m in middle elevation area, and less than 1500 m/m in flat area. They mostly occurred for the period from the beginning of July to the beginning of September in the rainy season.

Bagmati River and its tributaries tend to frequent change river course and lower riverbed due to deforested land, steep slop of river bed and high rainfall intensity in the rainy season. Especially river bed of Bagmati, Manohara, Bagmati branch, and Dhobi Khola relating to the project area is considerably lowering and the depth of lowering is assumed at approximately 2.0 m during this past 10 years. The main cause is that sand layer is rapidly being cut down due to taking out excessive amount of sand from riverbed. For the reason of this phenomenon, piers foundation of existing bridge on these river are deeply eroded and scored.

(3) Hydrological Calculation

(i) Frequency Analysis

Frequency analysis is performed using Hazen, Gumbel and Pearson III methods. In Nepal, Pearson III method is considered to be best fit. The result by Pearson III method is summarized as follows.

Return Period (years)	10	20	50	100
Daily Rainfall (mm)	146.5	164.2	188.2	206.0

(ii) Design Returned Period

Design returned period was determined referring to the Design Criteria for Nepal of flood returned period on road design suggested by WECS as follows.

Bridge	100 Years
Road	10 to 20 years

(iii) Hydraulic Calculation and High Water Level

Design flood water level was determined by hydraulic calculation using rational formula.

4.3 Seismic Analysis

Nepal is located in an earthquake-prone area. Kathmandu valley is specified in zone V, maximum hazard by Indian Standard Criteria for Earthquake Resistant Design of Structure, Third Revision, 1980, Indian Standards Institution.

Coefficient of static force was calculated using the formula established by the Indian Standard Criteria mentioned above and determined to be Kh = 0.14.

4.4 Mapping and Topographic Survey

The topographic survey was conducted by the Study Team for reviewing existing topographic map with scale 1/2000. The purpose of the survey is to identify the present condition of landuse, especially public facilities and private houses newly constructed recently in the areas along the proposed roads.

The detailed survey was also conducted around the proposed bridge sites for preparing the map with a scale of 1/500. New benchmarks were established on the permanent structure at the every proposed bridge site. The elevation on the new benchmark was set by leveling from the vicinal National Bench Mark.

The river cross sectional survey was carried out at proposed center line of bridge, 200 m upstream and downstream of Bridges, and some additional points required for hydrological study. The survey sites are total 19 points and the survey length is approximately 200 m.

5. PRELIMINARY DESIGN

5.1 Highway Design

(1) Concept of Highway Design

The proposed roads are located in the urban areas so that they are sensitive to land acquisition and property demolishment. The following concepts was established for the purpose of highway design considering the right-of-way situation of the corridor:

1) Functional requirement as a basic frame of urban road in Kathmandu,
2) Characteristics of traffic component and local traffic movement in Kathmandu,
3) Minimization of demolishing permanent buildings and historical monuments,
4) Acquiring land for road construction should be minimized by utilizing vacant land of the river bed along Bagmati River.
5) Providing space for public utilities in and along the proposed road taking into account the future development in the vicinity.
6) Right-of-way of the proposed South Link of Inner Ring Road should be reserved taking into consideration the future widening to 4 lane.

(2) Geometric Design Standards

The geometric design standards to be applied for the proposed roads is as shown in Table 5.1.

Table 5.1 Geometric Design Standards to be adopted

Items	Unit	South Link of Inner Ring Road	Sanepa Access	Koteswor Access	Patan Access	Central Bus Terminal Access
Design Speed	Km/hr	60	40	40	40	40
Sight Distance	m	85	45	45	45	45
Minimum Radius	m	105	45	45	45	45
Minimum Radius without Transition	m	200	200	200	200	200
Maximum Gradient	%	5.0	7.0	7.0	7.0	7.0
Crossfall	%	2.5	2.5	2.5	2.5	2.5

(3) Lane Numbers

1) South Link of Inner Ring Road

Staged construction is adopted for the South Link of Inner Ring Road considering the future traffic volume in the years 2015. The traffic capacity analysis revealed the following:

- 2 -lane road satisfies the year 1997 traffic demand in the entire length of the South Link of Inner Ring Road, and
- 4 -lane road generally satisfies the year 2015 traffic demand.

2) New Bagmati Bridge and Other Access Roads

Required lane numbers of New Bagmati Bridge and other access road are summarized below:

(i)	New Bagmati Bridge	;	2 lanes
(ii)	Other Access including Sanepa, Koteswor Patan Access	;	2 lanes
(iii)	Access to the New Bus Terminal	;	2 lanes

(4) Typical Cross Sections

1) South Link of Inner Ring Road

The typical cross sections to be applied for the South Link of Inner Ring Road is presented in Fig.5.1 showing initial stage construction (2-lane road) and ultimate stage construction (4-lane road in dotted line). Open space to be utilized for widening to 4-lane carriageway in the future should be used as a green belt for the time being until widening work will be commenced.

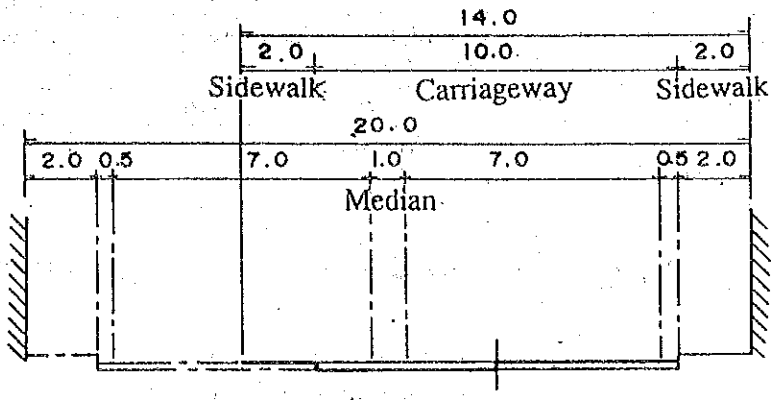
2) New Bagmati Bridge

Typical cross section of proposed New Bagmati Bridge is shown in Fig.5.2.

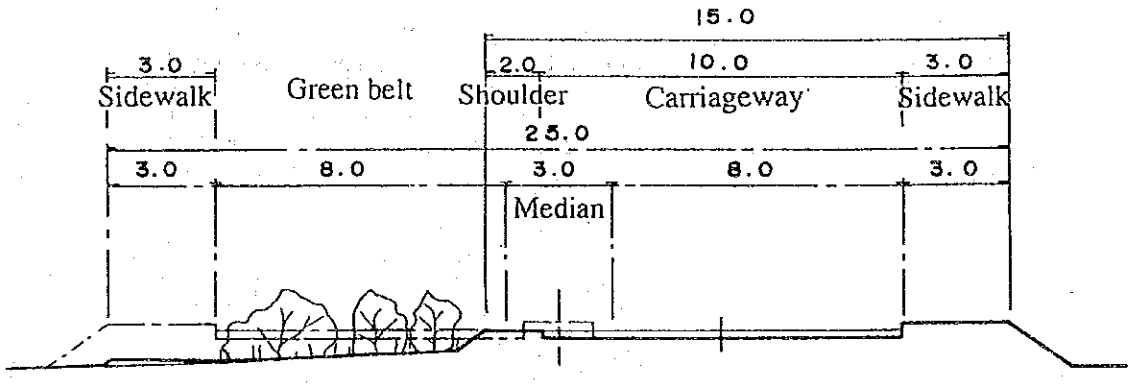
A 3.0 m wide sidewalk was considered in order to keep the safety of pedestrian across the Bagmati River.

3) Other Access Roads

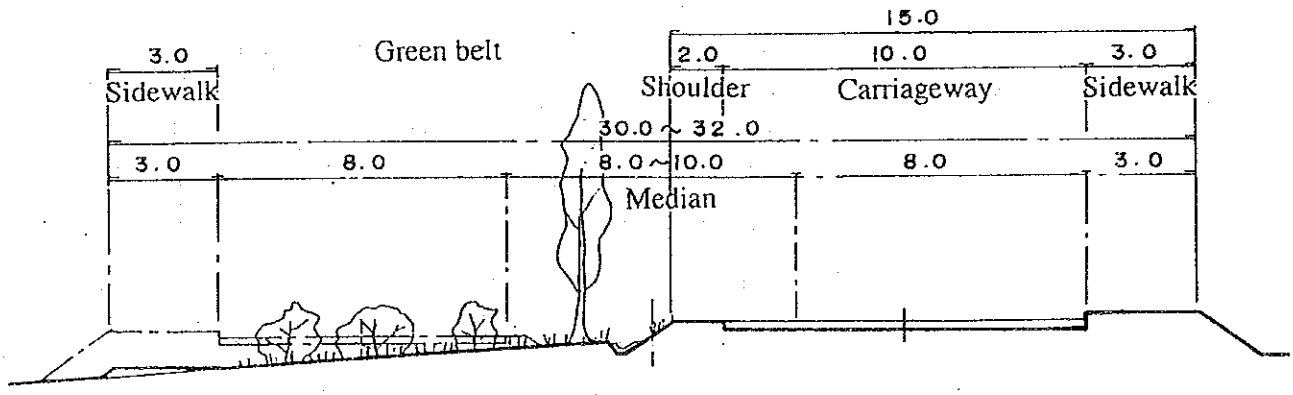
Lane width of access roads are proposed to be 8.0 m to 10.0 m as shown in Fig.5.3.



Type - A (BP ~ STA. 0+ 85)
To be adopted in Kalimati Road



Type - B (STA. 0+390 ~ STA. 1+000)
(STA. 1+500 ~ STA. 3+120)
To be adopted in build up area



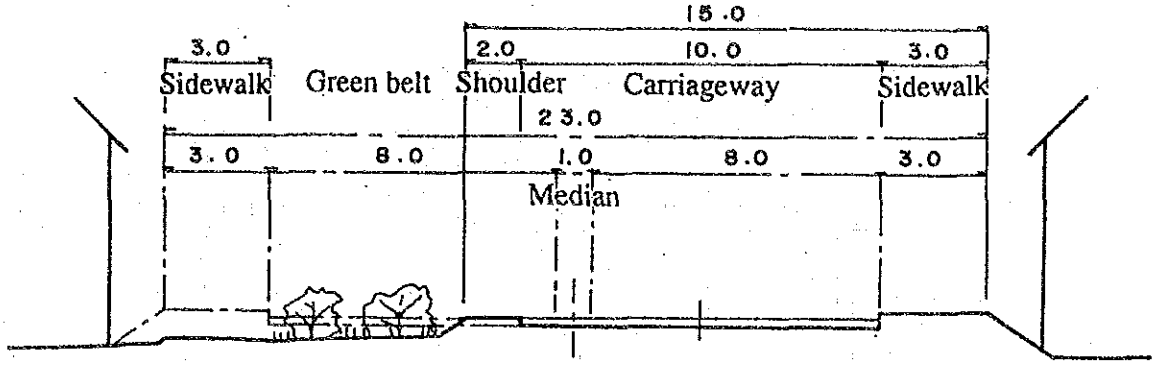
Type - C (STA. 1+000 ~ STA. 1+500)
To be adopted in open area beside the river

Legend:

—— First Stage Construction (2 - Way)

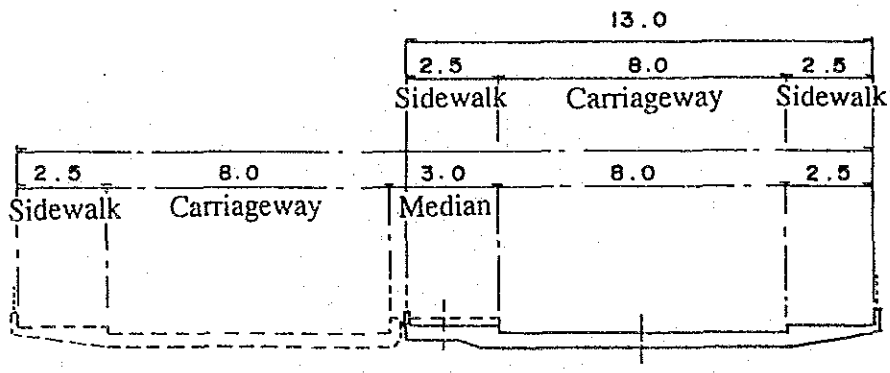
—— Second Stage Construction (4 - Way)

Figure 5.1 Typical Cross-Section of South Link of Inner Ring Road 1/2



Type - D (STA. 3+245 ~ EP)
To be adopted in open area

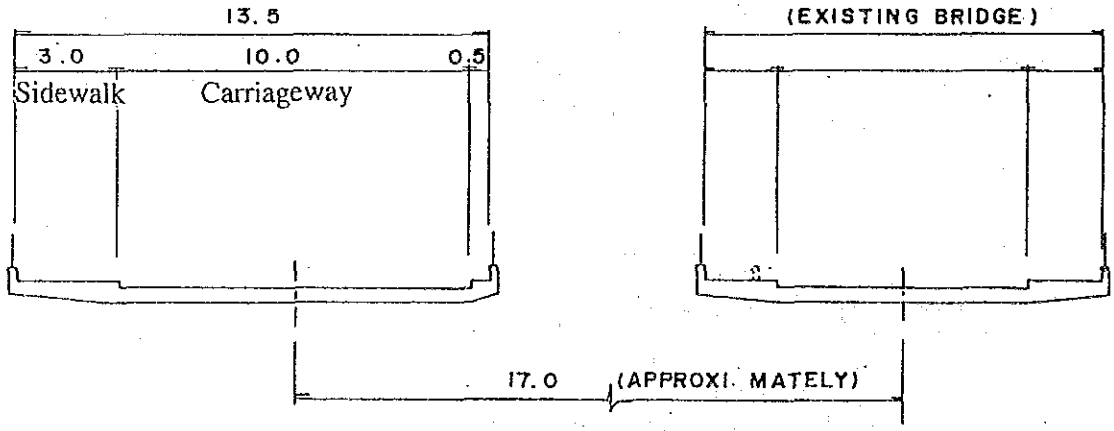
(2nd. Stage Construction) (1st. Stage Construction)



BRIDGE

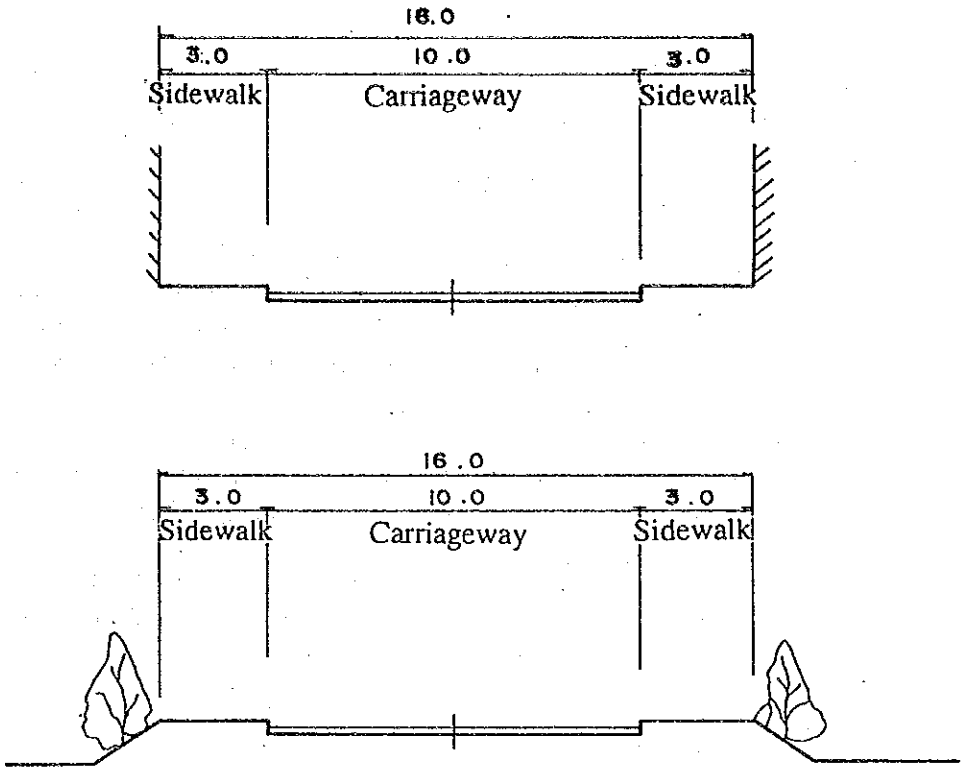
Legend:
——— First Stage Construction (2 - Way)
– – – – Second Stage Construction (4 - Way)

Figure 5.1 Typical Cross-Section of South Link of Inner Ring Road 2/2

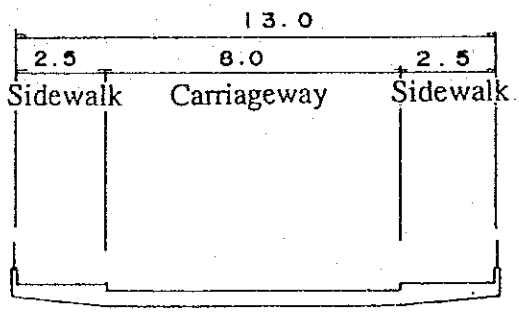


NEW BAGMATI BRIDGE AT THAPATHALI

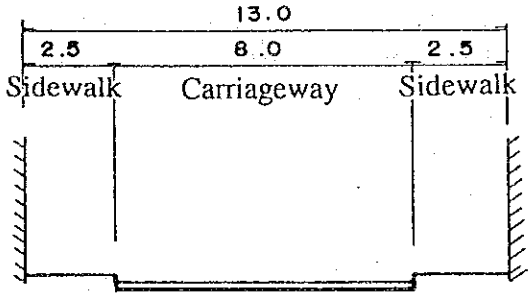
Figure 5.2 Typical Cross-Section of New Bagmati Bridge



SANEPA ACCESS, KOTESWOR ACCESS
AND CENTRAL BUS TERMINAL ACCESS



BRIDGE (KOTESWOR ACCESS)



PATAN ACCESS
(Build up area)

Figure 5.3 Typical Cross-Section of Other Access Roads and Bridge

(5) Alignment Design

1) South Link of Inner Ring Road

The proposed road starts from the intersection of Kalimati - Teku Road and connects with Arniko Highway at east of the Dhobi Khola Bridge with the total length of 3,720 m. The proposed road was aligned near the bank of Bagmati River so that it would give a positive impact on the river environment and public activities as follows:

(i) It will sever the river from the residential area which may stop the pollution activities and result in cleaner river bank.

(ii) The open space between the proposed road and the bank could be used for public facilities such, as play ground, park pedestrian and bicycle road, green belt open market, etc.

2) New Bagmati Bridge

New Bagmati bridge is planned to be constructed in parallel with and close to the existing Bagmati Bridge. It is planned to be connected with the existing Thapathali intersection smoothly without any interfere with the existing temples and ghats located in the vicinity of intersection.

3) Other Access Roads

The alignment of other access roads was determined so as to minimize the construction cost as well as to minimize acquiring land and houses. Temples, historical monuments and public utilities, such as transmission line and water main, were also avoided in order to minimize the affects on environment.

(6) Intersection at New Bagmati Bridge at Thapathali

Existing intersection at Thapathali is one of the bottleneck point of traffic movement in Kathmandu city. In order to operating the traffic flow smoothly and efficiently, pedestrian over bridges is planned to be provided at the both intersection in Kathmandu and Patan sides as shown in Fig. 5.4 so as to separate the vehicular traffic and pedestrian. Guardrail and electric traffic signal will be provided so that the traffic flow in the intersection would not be interfered with the people crossing the intersection.

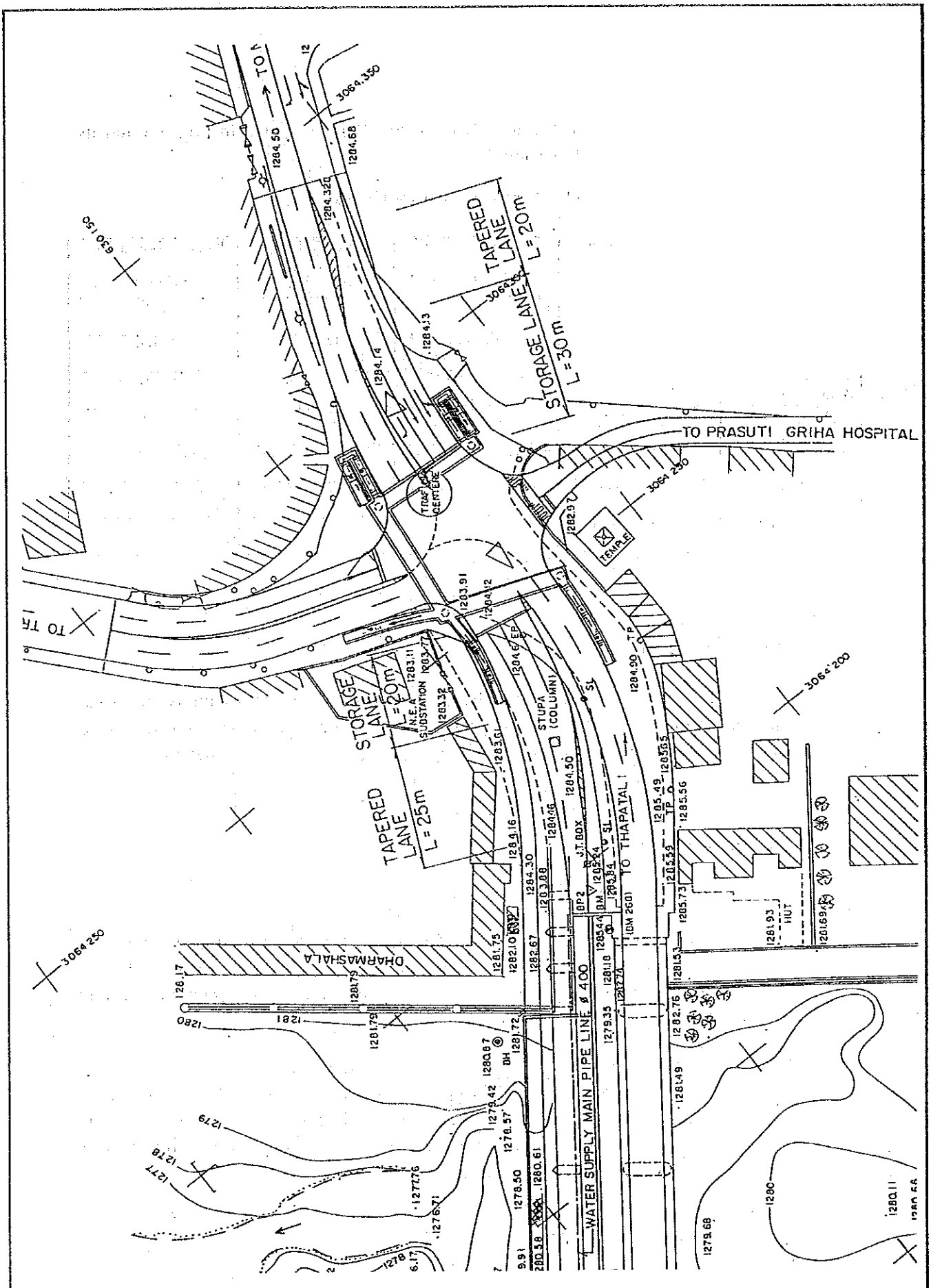


Figure 5.4 Proposed New Intersection at Thapathali

5.2 Bridge Design

General plan of proposed bridges (No.1 to No.4) is presented in Fig. 5.5 and its dimension is summarized in Table 5.1.

Table 5.1 Summary of Proposed Bridges

	Bagmati Bridge No.1 at Kalimat	New Bagmati Bridge (No.2) at Thapathali	Bagmati Bridge No.3 at Chakupat	Bagmati Bridge No.4 at Koteswor
Type of Bridge	St - Gr	St - Gr	St - Gr	St - Gr
Bridge Length	153.0 m	137.9 m	120.0 m	60.0 m
Span Arrangement	5 @ 30.6 m	15.9 m + 4 @ 30.5 m	4 @ 30.0 m	2 @ 30.0 m
Width	8.0 m	10.0 m	8.0 m	8.0 m
Sidewalk	2.5 m (both side)	3.0 m (left side only)	2.5 m (both side)	2.5 m (both side)
Foundation , Type	Steel Pile (800mm)	Steel Pile (800mm)	Steel Pile (800mm)	Steel Pile (800mm)
Length	30.0 m	20.0 m	24.0 m	30.0 m

Note: St-Gr; Composite Steel Girder

5.3 Drainage Design

The road drainage system is broadly divided into two system namely, the road surface drainage and road side drainage. Dimension of drainage facilities were designed to have sufficient capacity taking into account ease of maintenance.

5.4 Pavement Design

(1) Alternative Study

Flexible pavement (asphalt pavement) was selected for the project road taking into consideration the characteristics of flexible pavement including construction practices in terms of design life, construction economy, ground condition and local conditions

Two types of flexible pavement is considered for the alternative study namely, Double Bitumen Surface Treatment (DBST) and Asphalt Mixed Concrete (AMC). Initial cost of AMC is higher than that of DBST, however, Asphalt Mixed Concrete (AMC) was selected for the project roads because of the following reasons:

BAGMATI BRIDGE No.1 SKETCH

Multiple Span Composite Steel Girder Bridge

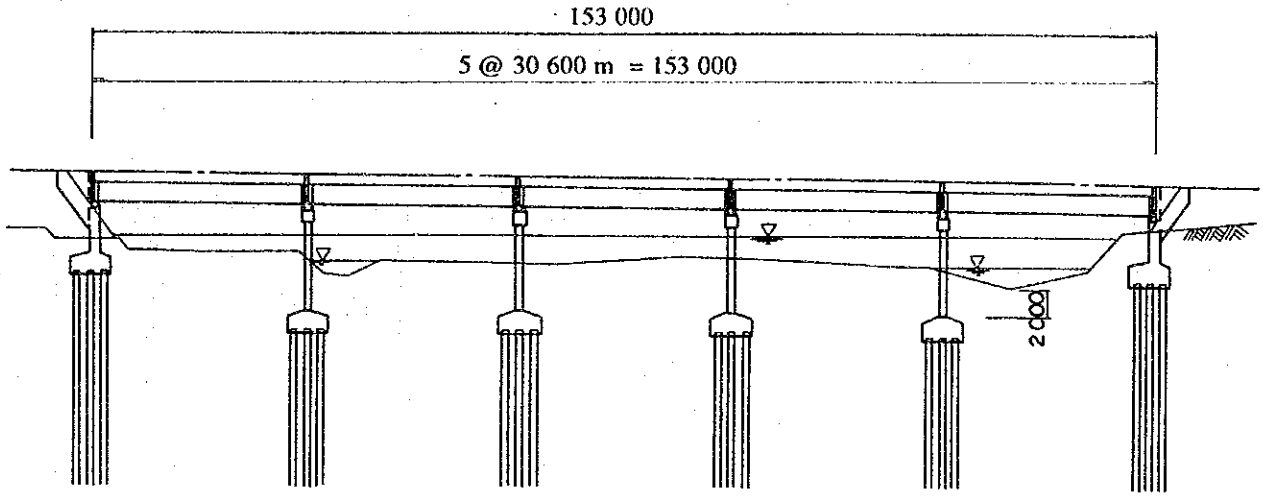


Figure 5.5 (1)

BAGMATI BRIDGE No.2 SKETCH

Composite Steel Girder Bridge

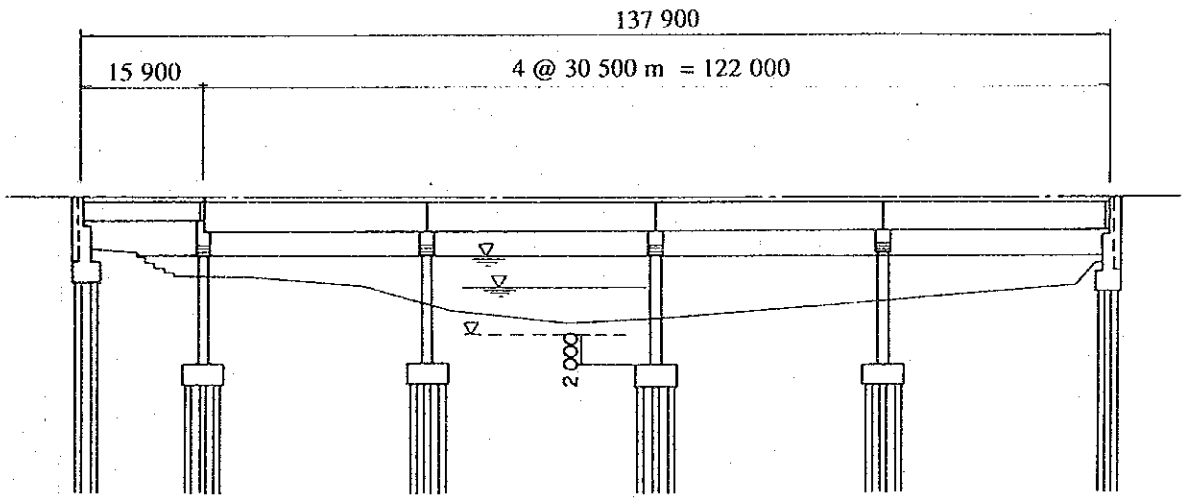


Figure 5.5 (2)

BAGMATI BRIDGE No.3 SKETCH

Multiple Span Composite Steel Girder Bridge

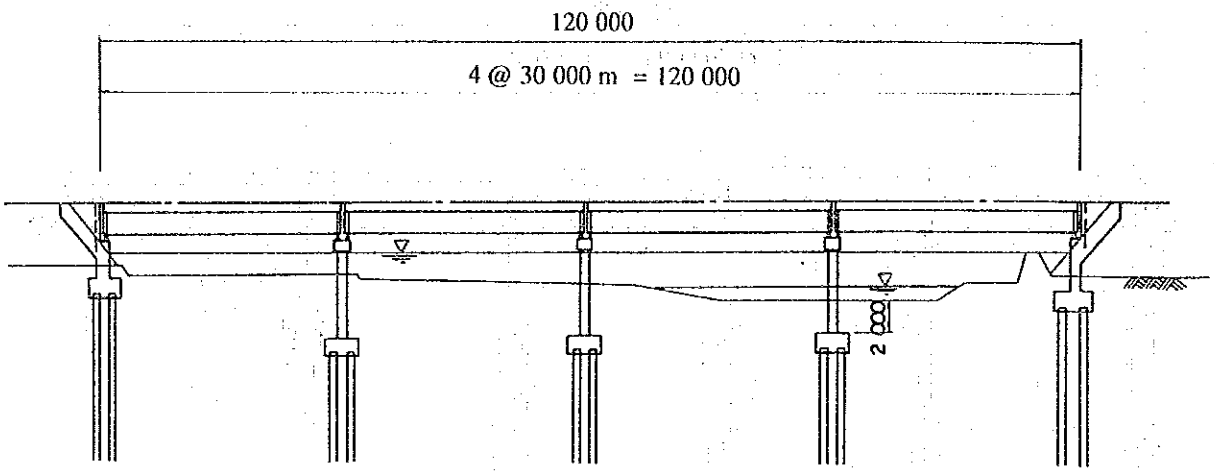


Figure 5.5 (3)

BAGMATI BRIDGE No.4 SKETCH

Composite Steel Girder Bridge

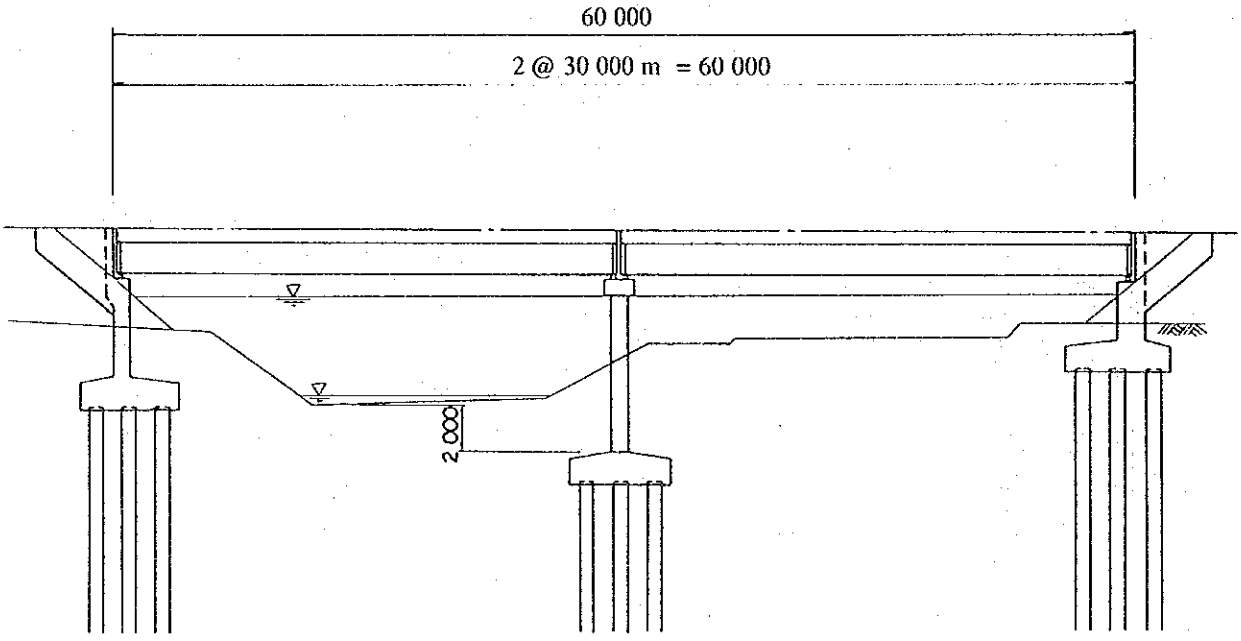


Figure 5.5 (4)

(i) AMC pavement is currently used on urban road, particularly on arterial and highway with heavy traffic.

(ii) ACM has longer design life than DBST and quality of the pavement, such as durability, waterproofing and stability, is superior to DBST pavement,

(iii) ACM is particularly suited to the urban road carrying heavy traffic since it can be opened to traffic immediately after laying pavement so that traffic congestion could be minimized during the construction.

(2) Thickness Design of AMC Pavement

The preliminary thickness design of flexible pavement was carried out in accordance with the "MANUAL FOR ASPHALT PAVEMENT, 1989" published by Japan Road Association. The thickness and the structure of individual layers of pavement are designed based on a comprehensive dugment of various factors including subgrade, traffic and climate conditions as well as economic aspects.

As the result of calculation, the following two (2) type of pavement structures are recommended for the proposed road:

Pavement Thickness Required for Proposed Road

Type	The Desirable T_A	Total Thickness of Pavement (cm)	Proposed Road
Type-I	23.5	50	Sanepa Access Patan Access Koteswor Access Central Bus Terminal Access
Type-II	31.0	61	South Link of Inner Ring Road New Bagmati Bridge at Thapathali

Based on the above thickness design, the following alternative pavement design by materials have been considered as shown in Fig. 5.6. Cement or lime stabilized base course is not recommendable for the project road because of limited construction period and weather condition.

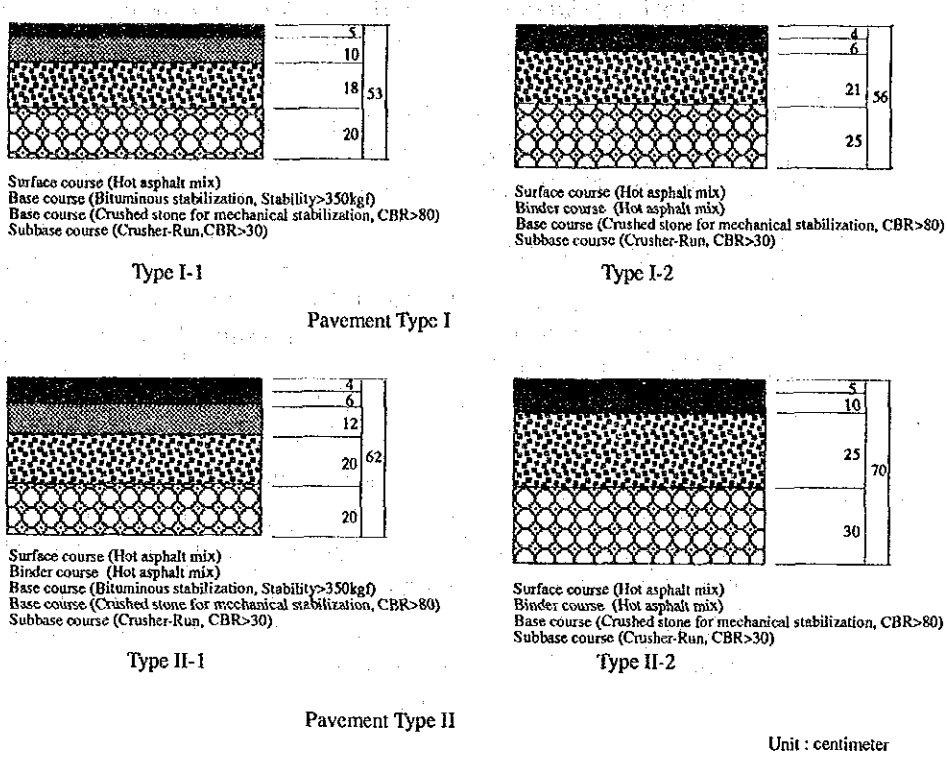


Figure 5.6 Alternative Pavement Structure

(3) Optimum Pavement Structure

Type I-1 and Type II-1 was designed to obtain high quality pavement in terms of durability, waterproofing and stability, however, the construction cost of these is much higher than that of Type I-2 and Type II-2 which were designed to utilize cheaper materials of crushed stone for base course and crusher-run for subbase course.

It is recommended to adopt Type I-2 and Type II-2 for the proposed road taking into account the lesser construction cost.

5.5 Road Facilities Design

.(1) Utilities Space for Public Services

Public services utilities either underground or overhead are planned to be set at either sidewalk or shoulder. The 3.0 m wide shoulder and sidewalk will provide space to contain the public utilities including water main and distribution pipes, electric power ducts, telecommunication line and sanitary sewers.

(2) Bus Bays

Proposed roads will be bus routes and the provision of bus bays will become necessary exclusive spaces for buses to stop.

Final location of bus bays shall be determined after discussions with the relevant authorities.

(3) Pedestrian Crossing Facilities

Two types of facilities is planned for this project namely, at-grade crossing painted on the pavement surface and elevated pedestrian bridges with staircase. No underpasses by box culverts are planned because of the problems on security and drainage.

(4) Street Lighting

Lighting facilities are planned to be provided with the South Link of Inner Ring Road and New Bagmati Bridge at Thapathali including both intersections. No lighting facilities is recommended on Access Roads taking into account the road function, the traffic volume anticipated on the roads and operation and maintenance costs of lighting facilities.

(5) Traffic Signal

Traffic signals shall be installed at major at-grade intersections for traffic control, safety of drivers and smooth handling of traffic flow.

5.6 Relocation and Protection of Public Utilities

Relocation of existing utilities is one of the most awkward aspects of the road construction in urban areas due to involvement of many authorities or agencies who have different policies, development time schedules and technical standards.

The existing utilities were investigated by the Study team, however, detailed data showing the location and dimension could not be obtained from the authorities and agencies concerned. The detailed investigation should be conducted in the detailed design stage prior to the commencement of construction.

Normally the authorities or agencies concerned are responsible for the relocation and replacement works of electric facilities, telephone cable, water main at their own cost.

5.7 Preliminary Right-of-way Plan

The right-of-way (ROW) limit lines for the proposed roads were indicated in the plan showing alignment of road. Standard and minimum width of right-of-way for each proposed road is shown in Chapter 3.

Numbers of houses to be demolished are summarized as follows:

South Link of Inner Ring Road (4 lanes)		
- Western section	:	20 nos.
- Eastern section	:	27 nos.
Sanepa Access	:	5 nos.
Patan Access	:	3 nos.
Koteswor Access	:	17 nos.
New Bus Terminal Access	:	36 nos.
Total	:	108 nos.

5.8 Traffic Management at Intersections

Traffic management at intersections is important so as not to cause the road congestion as well as the traffic accidents in nearby area. Out of the intersections identified in the Master Plan Study, following three (3) location of the intersections are selected to be improved as a model case (See Fig. 5.7):

(1) Intersection of Maitighar which is the beginning point of Arniko Highway

(2) Intersection of Tripureswar near national Stadium

(3) Intersection of Koteswor connecting Arniko Highway with Ring Road

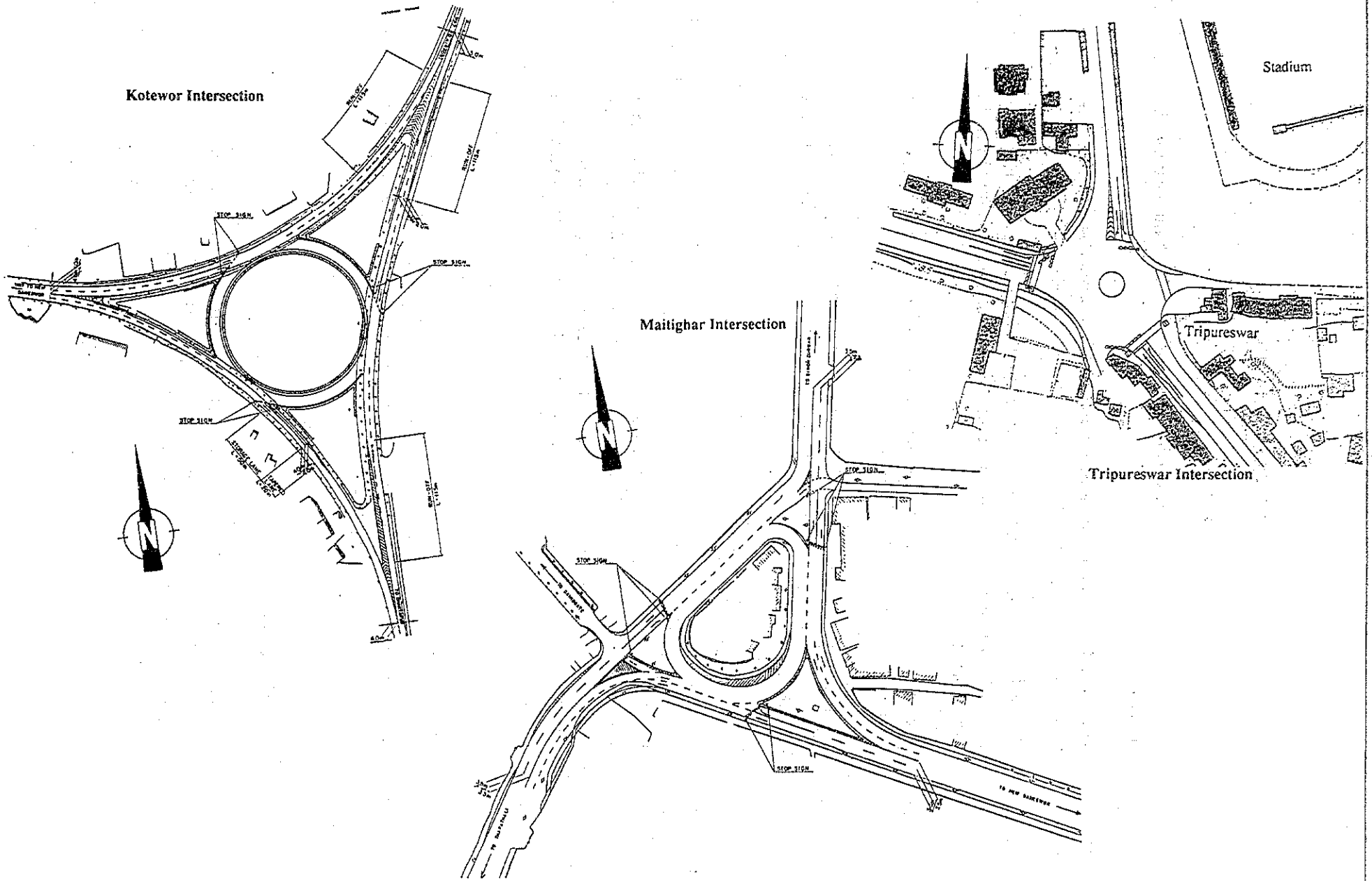


Figure 5.7 Traffic Management at Intersections

6. CONSTRUCTION PLAN AND COST ESTIMATES

6.1 Conditions of Project Cost Estimate

The unit prices were computed in accordance with the following basic assumptions and conditions:

(1) The project cost is estimated assuming that all construction works will be executed on turn key basis by an international contractor.

(2) Unit prices of labor, materials and equipment are computed under the economic conditions or on the basis of market prices prevailing in November, 1992.

(3) The unit price is divided into foreign currency (indicated in Yen) and local currency (indicated in NRs.) portion.

(4) The project cost consists of construction cost, engineering cost, physical and price contingency, land/house acquisition cost and government administration expanses.

6.2 Unit Costs

The unit cost of each work item was calculated on the basis of materials cost, labor cost, operation cost of equipment and contractor's overhead and profit. The calculation was made taking into consideration the local conditions as well as the availability of the local product. The unit cost of each work item is presented in Table 6.1.

6.3 Construction Quantities

Construction quantities are calculated on the basis of preliminary design. Summary of major work quantities is show in Table 6.2.

6.4 Estimated Project Cost

Summary of estimated project cost including construction cost, land/house acquisition cost, physical and price contingency, engineering cost (detailed design and construction supervision) is presented in Table 6.3.

6.5 Maintenance Cost

Road maintenance cost includes electricity cost, cleaning cost and repair cost as follow:

(1)	Electricity cost	:	cost of electricity for lighting and signal operation
(2)	Cleaning cost	:	cost of cleaning the road surface, drainage facilities, guardrails, regulatory traffic sign and other traffic devices.
(3)	Repair cost	:	cost of road surface repair, overlays, painting of bridges and guardrails, etc. inspection of structures, inspection and repair of electricity and traffic control facilities.

Table 6.1 Unit Cost for Work Items

Unit : NRs.

Description	Unit	Foreign Portion	Local Portion	TOTAL
Clear site and stripping	m2	16	4	20
Removal of existing pavement material	m3	308	77	385
Removal of existing bridge at Thaphatali	L.S	4,802,398	1,200,600	6,002,998
Removal of existing structures	m3	1,566	392	1,958
Fill in soft material	m3	335	84	419
Spoil in soft material	m3	241	60	301
Sodding	m2	156	39	195
Plant selected trees	no.	1,292	0	1,292
Gabion	m3	1,957	345	2,302
Stone Masonry	m2	4,885	1,221	6,106
Excavation in soft material for structures	m3	40	10	50
Backfilling with selectedmaterials for structures	m3	36	9	45
Side block	m	558	239	797
Kerb stone (A)	m	1,352	580	1,932
Kerb stone (B)	m	2,668	1,143	3,811
Kerb stone for bridge	m	570	244	814
Pipe culvert D300	m	2,110	904	3,014
Pipe culvert D600	m	3,720	1,594	5,314
Pipe culvert D1000	m	7,445	3,191	10,635
U shaped drain ditch (0.3 x 0.3m)	m	1,384	593	1,977
U shaped drain ditch (0.5 x 0.5m)	m	1,912	820	2,732
U shaped drain ditch (1.0 x 1.0m)	m	4,624	1,982	6,606
Side drain with stone pitching	m	1,373	343	1,716
Catch pit	no.	6,811	2,919	9,730
Manhole	no.	11,379	4,877	16,256
Subbase course	m3	648	162	810
Base course	m3	1,173	293	1,466
Prime coat, 1.0 litre/m2	m2	33	1	34
Tack coat, 0.4litre/m2	m2	11	0	11
Asphalt concrete binder course t=6cm	m2	577	86	663
Asphalt concrete binder course t=10cm	m2	968	145	1,113
Asphalt concrete surfase course t=4cm	m2	415	62	477
Asphalt concrete surfase course t=5cm	m2	512	77	589
Side walk t=13cm	m2	402	60	462
Road lighting	no.	269,413	5,498	274,911
Traffic signal	portion	4,598,410	93,845	4,692,255
Lane marking 15cm	m	54	1	55
Information sign	no.	222,546	4,542	227,088
Steel pile D800	m	22,121	451	22,572
Steel pile D500		11,060	226	11,286
Concrete class-A, 240kg	m3	4,598	94	4,692
Concrete class-C, 180kg	m3	3,627	74	3,701
Formwork for superstructures	m2	632	271	903
Formwork for all structures other than superstructur	m2	408	175	583
Reinforcement	ton	37,914	774	38,688
Prate girder (material,assemble,transportation,electi	ton	488,414	25,706	514,120
Bridge railing	m	21,742	1,144	22,886
Excavation for diversion of the river	m3	40	10	50
Construction and removal of temporary road	m3	335	84	419
Temporary bridge	m	52,156	2,745	54,901
Steel sheet pile	m	2,673	141	2,814

Table 6.2 Work Quantities for Each Proposed Road

Description	Unit	South link of Inner Ring Road	Sanepa Access	Patan Core Access	Koteswor Access	Central bus terminal Access	New Bagmati Bridge No.2	Intersections (3 Places)	TOTAL
Clear site and stripping	m2	76,464	8,830	3,556	45,000	38,012		2,500	174,362
Removal of existing pavement material	m3	100					100		200
Removal of existing bridge at Thaphatali	L.S						1		1
Removal of existing structures	m3	100					100		200
Fill in soft material	m3	121,575	9,582	2,511	68,173	41,384	1,300	5,000	249,525
Spoil in soft material	m3	5,655	1,373	275	11,004	196	130		18,633
Sodding	m2	25,648	2,414	1,086	15,599	10,856		1,250	56,853
Plant selected trees	no.	744							744
Gabion	m3	3,460			620		3,210		7,290
Stone Masonry	m2	5,136		490	250		1,250	150	7,276
Excavation in soft material for structures	m3	9,390			2,630	120	14,610		26,750
Backfilling with selectedmaterials for structures	m3	6,900			2,020	40	10,460		19,420
Side block	m	2,840							2,840
Kerb stone (A)	m	2,521	990	400	4,064	3,730			11,705
Kerb stone (B)	m	1,795			150		400		2,345
Kerb stone for bridge	m	546			120		276		942
Pipe culvert D300	m	1,155	188	80	1,600	750			3,773
Pipe culvert D600	m	1,770	240	200	1,060	760	100	60	4,190
Pipe culvert D1000	m	205	74		81	133	80		573
U shaped drain ditch (0.3 x 0.3m)	m		940	365					1,305
U shaped drain ditch (0.5 x 0.5m)	m	3,167			3,615	3,572			10,354
U shaped drain ditch (1.0 x 1.0m)	m	300				132			432
Side drain with stone pitching	m	1,934						500	2,434
Catch pit	no.	158	47	20	206	187	20	3	641
Manhole	no.	96	102	4	114	90	4	3	413
Subbase course	m3	13,028	638	423	2,894	4,875	290	750	22,898
Base course	m3	11,298	552	368	2,504	4,219	310	500	19,751
Prime coat, 1.0 litre/m2	m2	38,968	4,880	1,600	22,620	18,650	5,565	2,500	94,783
Tack coat, 0.4litre/m2	m2	71,288	4,880	1,600	22,140	18,650	4,185	1,000	123,743
Asphalt concrete binder course t=6cm	m2	1,750	4,880	1,600	22,140	18,650	2,910	2,500	54,430
Asphalt concrete binder course t=10cm	m2	35,100					1,280		36,380
Asphalt concrete surfase course t=4cm	m2	4,480	4,880	1,600	22,620	18,650	4,700	2,500	59,430
Asphalt concrete surfase course t=5cm	m2	35,100					1,280		36,380
Side walk t=13cm	m2	19,335	2,440	1,600	11,370	9,325	1,490		45,560
Road lighting	no.	42					22		64
Traffic signal	portion	4	1	1	1	2	1	2	12
Lane marking 15cm	m	12,694	1,575	690	6,741	5,775	1,258	2,400	31,133
Information sign	no.	19	3	3	3	6	4	9	47
Steel pile D800	m	4,474			1,530		1,680		7,684
Steel pile D500		1,840					1,640		3,480
Concrete class-A, 240kg	m3	3,970			970	73	2,170		7,183
Concrete class-C, 180kg	m3	120			30	8	3,136		3,294
Formwork for superstructures	m2	4,100			910		2,170		7,180
Formwork for all structures other than superstructur	m2	3,290			880	245	8,706		13,121
Reinforcement	ton	472			112	8	250		842
Prate girder (material,assemble,transportation,electi	ton	678			117		405		1,200
Bridge railing	m	546			120		276		942
Excavation for diversion of the river	m3	2,680							2,680
Construction and removal of temporary road	m3	8,290			1,670				9,960
Temporary bridge	m	12					70		82
Steel sheet pile	m						8,260		8,260

Table 6.3 Estimated Project Cost

Unit : 1,000NRs.

No.	Sub-project	Amount			
		Foreign Portion	Local Portion	Total	(1,000yen)
A-1	NEW BAGMATI BRIDGE WITH TWO INTERSECTIONS				
	Demolishing of existing old truss bridge	4,802	1,201	6,003	15,959
	Construction of New Bagmati Bridge at Thaphatali	215,142	10,700	225,842	600,401
	Construction of Patan side Intersection	9,288	1,572	10,860	28,871
	Construction of Thaphatali side Intersection with signal	20,536	2,571	23,107	61,430
	Pedestrian bridge at Thaphatali side Inersection	87,734	4,026	91,760	243,944
	River Improvement, scoring protection by check dam	31,948	4,003	35,951	95,576
	Relocation of water main, electrical wire, telephone line, etc.	36,868	752	37,620	100,013
	TOTAL	406,318	24,825	431,143	1,146,194
A-2	WESTERN SECTION OF SOUTH INNER RING ROAD				
	Construction of road with 2 lanes	107,909	22,617	130,526	347,003
	Construction of No.1 Bridge	243,732	11,594	255,326	678,784
	Riverside protection (1000m x 2.5m = 2500m2 stone masonry)	12,213	3,053	15,266	40,585
	TOTAL	363,854	37,264	401,118	1,066,372
A-3	SANEPA ACCESS				
	Construction of road with 2 lanes	22,467	4,820	27,287	72,542
A-4	EASTERN SECTION OF SOUTH INNER RING ROAD				
	Construction of road with 2 lanes	107,909	22,617	130,526	347,003
	Pedestrian bridge at Patan side Inersection and signal	102,833	4,599	107,432	285,608
	Construction of No.3 Bridge	174,153	9,455	183,608	488,122
	Riverside protection (1000m x 2.5m = 2500m2 stone masonry)	12,213	3,053	15,266	40,585
	TOTAL	397,108	39,724	436,832	1,161,318
A-5	KOETSWOR ACCESS				
	Construction of road with 2 lanes	89,899	22,500	112,399	298,813
	Construction of No.4 Bridge	106,927	5,197	112,124	298,082
	Riverside protection (1000m x 2.5m = 2500m2 stone masonry)	12,213	3,053	15,266	40,585
	TOTAL	209,039	30,750	239,789	637,479
A-6	PATAN ACCESS				
	Construction of road with 2 lanes	13,977	2,419	16,396	43,589
	TOTAL	1,412,763	139,802	1,552,565	4,127,494
	Consultant Fee 10%			155,257	412,749
	A-TOTAL			1,707,822	4,540,243
B-1	CENTRAL BUS TERMINAL ACCESS				
	Construction of road with 2 lanes	79,188	18,360	97,548	259,331
	Consultant Fee 10%			9,755	25,933
	B-TOTAL			107,303	285,264
C-1	IMPROVEMENT OF INTERSECTIONS				
	Intersections at Mitighar, Tripureswar and Koteswor	35,282	4,260	39,542	105,122
	Consultant Fee 10%			3,954	10,512
	C-TOTAL			43,496	115,635
	GRAND TOTAL			1,858,621	4,941,143

7. IMPLEMENTATION PLAN

7.1 Executing Agency

The Director General of Department of Roads (DOR), Ministry of Works and Transport, is the government agency responsible for the execution of the construction of the project roads.

The necessary land acquisition and compensation for land and houses within in the proposed right of way will be undertaken by the same agency prior to the start of construction.

7.2 Construction Packages

The project is divided into three packages with three (3) sub packages taking into consideration the nature of project feature, scale of the work volume and ease of implementation from the land acquisition view point as follows:

Package A	:	Improvement of Bagmati Transport Corridor, dividing into;
	A-1	New Bagmati Bridge at Thapathali
	A-2	Western Section of South Link of Inner Ring Road including Sanepa Access
	A-3	Eastern Section of South Link of Inner Ring Road including Koteswor Access and Patan Access
Package B	:	Construction of Access connecting Nayabazar with New Bus Terminal at Balaju
Package C	:	Improvement of Intersections at Maitighar, Tripureswar and Koteswor

7.3 Implementation Program

Construction period of each package is set up taking into account the work volume, weather condition in Kathmandu Valley, required funds for each package and urgency of the project, etc. as shown in Fig. 7.1.

7.4 Investment Program

Investment program of the project is prepared on the basis of the implementation time schedule and summarized in Table 7.1.

Fig. 7.1: Proposed Implementation Schedule of High Priority Projects

Package No.	Proposed Roads and Bridges To be Improved	Target for Development:	High Priority projects tp be Implemented in the Short-term Plan (1) Improvement of Bottlenecks in Urban Traffic Conditions (2) Relief of Transport Poor				
			1st Year	2nd Year	3rd Year	4th Year	5th Year
		Year:	1993	1994	1995	1996	1997
(1) Package A-1:	Construction of New Bagmati Bridge (2 Lanes) with Improvement of Thapathali Intersection, exsiting Bagmati bridge and River Protection		xxxxxxxxxxxxx	xxxxxxxxxxxxx			
(2) Package B:	Construction of Access to New Bus Terminal		xxxxxxxxxxxxx	xxxxxxxxxxxxx			
(3) Package A-2:	Western section of South Inner Ring Road including Bagmati Bri. No.1, Patan Intersection and Sanepa Access			xxxxxxxxxxxxx	xxxxxxxxxxxxx		
(4) Package A-3:	Eastern section of South Inner Ring Road including Bagmati Bri. No.3, Koteswor Access including Bagmati Bri. No.3 and Patan Core Access					xxxxxxxxxxxxx	xxxxxxxxxxxxx
(5) Package C:	Improvement of Interchages at 3 Locations at Mitighar, Tripureswar and Koteswor		xxxxxxx				

Table7.1: Tentative Investment Programme of High Priority Projects

Unit: NRs. million

Phase	High Priority Projects	Target for Development: High Priority projects tp be Implemented in the Short-term Plan (1) Improvement of Bottlenecks in Urban Traffic Conditions (2) Relief of Transport Poor										Total	
		1st Year		2nd Year		3rd Year		4h Year		5th Year			
	Year:	1993		1994		1995		1996		1997			
		Const. Cost	Land/House	Construction	Land/House	Construction	Land/House	Construction	Land/House	Construction	Land/House	Construction	Land/House
(1) Package A-1:	Construction of Bagmati Bridge No.2 (2lanes) including;	250	6	181								431	6
	Construction of New Bagamti Bridge	170		55									
	Improv. of Existing Bagmati Bridge & River Protection	36											
	Thapathali Intersection with Pedestrian Bridge,			126									
	Demolishing of Existing Old Truss Bridge,	6											
	Relocation of Water main, electric line, etc.	38											
(2) Package B:	Construction of Access to New Bus Terminal	59	78	39								98	78
(3) Package A-2:	Western Section of South Inner Ring Road including;		204	150		278						428	204
	Bagamati Bridge No.1 (2 lane),												
	Sanepa Access,												
	Riverside Protection.												
(4) Package A-3:	Eastern Section of South Inner Ring Road including;						151	350		343		693	151
	Bagmati Bridge No.3 (2 lane) and River Protection												
	Patan Intersection including Pedestrian Bridge												
	Patan Core Access												
	Koteswor Access including Bagmati Bri. No.4												
(5) Package C:	Improvement of 3 Intersections (Maitighar,Tripureswar and Koteswor)	40										40	
	Total :	349	289	370	0	278	151	350	0	343	0	1,690	439
Consultant Fee : D/D & S/V = 10 % of Construction cost in each phase		35		37		28		35		34		169	
	Grand Total :	383	289	407	0	306	151	385	0	377	0	1,859	439
	Equiv. to Yen (Million) Total :	1,019		1,082		814		1,024		1,003		4,942	

Exchange Rate: 1US$ = NRs. 46.568 = ¥ 123.8 (Average rate in the past 6 months from June, 1992 to December, 1992), or 1 NRs. 1.0 = ¥ 2.6585

8. ECONOMIC EVALUATION

8.1 Economic Evaluation

High priority projects proposed in this Study have been economically evaluated in this Chapter. In addition, financial viability of the projects have been evaluated through the budgetary analysis of Nepal's expenditure on transportation section in the past and coming Eight Plan period.

For the economic evaluation, three indicators of evaluation, i.e., IRR, B/C ratio and NPV have been applied to evaluate the project. Conclusively speaking, fairly good results have been obtained as shown in Table 8.1. Highest IRR of 19.5% came up with the Case 1-1 which is the construction project of New Bagmati Bridge followed by 18.8% of IRR in the case of New Bus Terminal Access Road Improvement Project (Case 2). These facts suggest these project are economically feasible and are urgent to be implemented.

On the other hand, Case 1, which is a combination of New Bagmati Bridge Construction Project and South Link of Inner Ring Road Construction Project, came up with moderate size of IRR of 11.5% owing to the large construction cost required by the latter.

IRR only for the construction project of South Link of Inner Ring Road (Case 1-2) solely is 9.7% which is a little bit smaller than the opportunity cost of capital authorized in Nepal (10%). However, the role of this road for the formation of urban road network as a part of the Inner Ring Road is quite important. Especially, its incentive role in the formation of urban road network as a whole is deemed quite important along with the socio-economic impact brought about by this road.

Table 8.1 Results of Economic Evaluation

	IRR (%)	B/C*	N.P.V.* (in Million NRs.)
Case 1	11.5	1.13	136
Case 1-1	19.5	1.95	189
Case 1-2	9.7	0.91	-63
Case 2	18.8	1.99	85

* A 10% discount rate was assumed

In addition to the above tangible benefits derived from the projects under Packages A and B, the improvement of intersections to be conducted under Package C will also contributes to the following benefits:

(i) Decrease of waiting time at intersections or speed-up of running speed of vehicles which will save the large amount of fuel consumption

(ii) Decrease of traffic accidents which will save not only repair and maintenance costs for the vehicles but also insurance and treatment costs for the drivers and pedestrian.

8.2 Financial Consideration

Total cost for the implementation of the above projects is estimated at NRs. 2.298 million which is about 11% of planed expenditure for transportation sector of development expenditure in the nation during the period of 8th Plan. These expenditure will be catered by expected national saving and foreign aid as shown in Table 8.2. The share of the project cost excluding land and house acquisition cost in the expected amount of grant aid during the 8th Plan is about 9%. This fact suggest that these project are financially viable in the budget of the Nepal.

Table 8.2 Investment and Financing Sources of Eighth Plan

	Seventh Plan (1986 - '90)		Eighth Plan (1993 - '97)	
	Amount*	Share (%)	Amount *	Share (%)
Sector Investment Requirement **				
Total Gross Fixed Investment	103,014	100.0	170,332	100.0
Transport & Communication	15,881	15.4	26,119	15.4
Sector Allocation of Development Expenditure				
Total Development Expenditure	74.174	100.0	113,479	100.0
Transport & Communication	11,657	15.7	20,030	17.7
Transport	-	-	13,567	11.95
Source of Finance				
Total Gross Fixed Investment			170,332	100.0
National Saving			95,977	56.3
Foreign Aid			74,355	43.7
- Grant			19,761	11.6
- Loan			54,954	32.1

* in million NRs at 1991/92 prices.

** Sector investment includes private and government investment.

9. ENVIRONMENTAL CONSIDERATIONS

9.1 Present Condition of the Bagmati Corridor

The tradition of using the flood-plain areas as the agricultural land was prevalent in Kathmandu Valley. But rapid growth of population and lack of zoning has lead all most all flood plain in the Valley to be urbanized and this trend is continuing at accelerated rate. The settlement in these flood plain has very poor infrastructure facility and living condition is very low.

In the vicinity of proposed Bagmati transport corridor, there exist many temples and ghats of historical and religious importance, such as Shankhamul ghat, Tripureswor temple complex, Pachli ghat and Ram ghat are important religious places.

People collect sand for construction purposes from the Bagmati river. Large amount of sand is taken from the river which decrease the water level of the river.

The level of dust in the air exceeds accepted standards and the lead content is alarmingly high along the busiest road in the Valley.

9.2 Effect on Economic and Social Activities

Following impacts on economic and social activities are expected through the implementation of the projects:

Short-term impacts caused by the project

The alignment of the proposed roads were located near the river bank along the Bagmati so that the acquisition of land and houses could be minimized, however, the following negative impacts are expected in the short-term:

(1) Approx. 110 houses including squatters should be demolished by the construction of roads and approx. 92,000 m2 (or 9.2 hectare) of the agricultural land is required for road reserve. The owner of land will lose their permanent income.

(2) The road will affect on religious activity and make it difficult for people to use the river.

Long-term impacts caused by the project

(1) The project road will open up a new area and will give opportunities of new activities along the Bagmati river. The farmers, who lose their permanent income from the land, will receive benefit by increased value of the land.

(2) The project road will provide access to areas that have poor access or no access at all, which will promote systematized urban development in the long-term, and the present low density agriculture areas will change their nature from rural to urban.

9.3 Traffic Impacts

(1) The proposed road will give improved access to the areas which currently have poor road access. The improvement of accessibility to the areas will relief the transportation-poor in the areas.

(2) The proposed South link of Inner Ring Road will provide a new east-west connection in the northern part of the Lalitpur, which will reduce the traffic congestion at the existing Bagmati Bridge.

(3) South Link of Inner Ring Road is a major arterial road forming a basic frame of urban road network in Kathmandu city in the long-term. The construction of South Link is significant as the first step to building up the urban road network in the Valley

9.4 Improvement on Environment of Bagmati Corridor

The positive impacts on the river environment is described as below;

(1) The proposed road will sever the river from the settlement. This may stop the pollution and result in cleaner river bank.

(2) Open space between the road and river bank could be used for public facilities, such as play ground, park, pedestrian and bicycle road, green belt, open market and etc.

9.5 Impacts on Natural Environment

[Air pollution]

The emission from vehicle is significant issue in Kathmandu Valley since the vehicles are mostly in a poor condition and old model.

Provision of new road facilities as well as the improvment of major intersections through the implementation of the projects may improve the traffic movement or traffic flow in the city remarkably and average running speed of vehicles might be increased, which will decrease the volume of emission from vehicle.

However, above measures may not be sufficient for improving air pollution in the Valley. The Study Team, therefore, recommends the Nepalese government to study the allowable quality level of emission from vehicles taking into account the local conditions and introduce inspection system on exhaustive gas standard as soon as possible.

[Noise and other environmental problems]

Noise causes sleeping disturbance, stress and concentration problems for the residents nearly the road. The proposed route, however, is located far from the residential area, so that noise will not be a major issue.

10. CONCLUSION AND RECOMMENDATIONS

The following is the conclusion and recommendations related to the project.

10.1 Conclusion

The feasibility study proved that project roads, both of Package A and B is technically and economically feasible with a high economic rate of return of 11.5% and 18.8% respectively.

Therefore, the implementation of the projects should be realized within the earliest possible time, and priority order should be given for the implementation as follows:

Priority	Proposed Roads
(1)	Construction of New Bagmati Bridge (2 lanes) including;
	- Thapathali intersection with pedestrian bridge,
	- Improvement of existing Bagmati Bridge for scouring,
	- Removal of existing old truss bridge, and
	- River improvement against lowering river bed
(2)	Construction of New Access to the New Bus Terminal at Balaju
(3)	Improvement of Intersections at Maitighar, Tripureswar and Koteswor
(4)	Construction of Western Section of South Link of Inner Ring Road including
	- Sanepa Access
	- Bagmati Bridge No.1 at Sanepa
	- Riverside Protection
(5)	Construction of Eastern Section of South Link of Inner Ring Road including;
	- Koteswor Access and Patan Access
	- Bagmati No.3 and No.4 Bridges

Table 10.1 shows the summary of the project features for the above roads.

Table 10.1: Summary of Project Feature

	Project	Major Work Items	Lane Nos.	Design Speed (Km/hr)	Length (m)	Carriageway (m)	Sidewalk (m)	Right-of-way (m)	Remarks
1	New Bagmati Bridge	Main Bridge	2	60	140 m	10 m	3.0m(one side)	50 m	
	(No.2 Bagmati Bridge)	Intersection with Pedestrain							
		Protection of exisiting bridge							
		Removal of old truss bridge							
		Protection against river bed							
2	South Inner Ring Road								
	(i) First stage (2 lanes);	Project Road	2	60	3,750 m	10 m	3.0m(one side)	50m (min. 25m)	Right-of-way shall be acquired for
		No. 1 Bagmati Bridge	2		145 m	8 m	2.5m(both side)		4 lane roads at this first stage.
		No. 3 Bagmati Bridge	2		120 m	8 m	2.5m(both side)		
		Protection of riverside bank							Protection of river bank of Bagmati.
	(ii) Second stage;	Project Road	(total 4	60		2 x 8 m	3.0m(both side)	-	with median slip (3.0m)
	(Widening to 4 lanes)					w/median (3m)			
		No. 1 Bagmati Bridge	4		145 m	8 m	2.5m(one side)		
		No. 3 Bagmati Bridge	4		120 m	8 m	2.5m(one side)		
3	Access Roads								
	(i) Sanepa Access	Project Road	2	60	510 m	10 m	3.0m(both side)	30m (min. 20m)	
	(ii) Koteswar Access	Project Road	2	60	2,180 m	10 m	3.0m(both side)	30m (min. 20m)	
		No. 4 Bagmati Bridge	2		60 m	8 m	2.5m(both side)		
	(iii) Patan Core Access	Project Road		40	220 m	8 m	2.5 m (both side)	13 m	
	(iv) New Bus terminal Access	Project Road	2	40	1,865 m	10 m	3.0 m (both side)	30 m	
4	Improvement of Intersections	Mitighar Intersection	4						Signal with minor improvement
		Tripureswar Intersection	4						Signal with minor improvement
		Koteswor Intersection	4						Improvement of shape of intersection

The following is the significance and benefits expected from the project:

(1) Removal of Traffic Bottleneck between Kathmandu and Patan

Proposed New Bagmati Bridge will not only facilitate the anticipated traffic demand in between Kathmandu and Patan but also release the traffic congestion and solve the bottleneck of the traffic movement in the areas of Thapathali which will improve economic and social activities in the both cities.

(2) Securing the Alternative Route between Kathmandu and Patan

So far there is the only existing Bagmati Bridge at Thapathali connecting Kathmandu and Patan inside the Ring Road. Since lowering of Bagmati River is still progressing, securing of new reliable alternative transport routes between Kathmandu and Patan is essential not only for economic activities but also for the daily life of the people in the city.

(3) Building up the Basic Frame of Urban Road Network inside Kathmandu City

South link of Inner Ring Road is a part of the Inner Ring Road and forms a basic frame of urban road network in Kathmandu City in the long-term. The construction of South Link is significant as the first step to building up the proposed urban road network system in Kathmandu Valley.

(4) Improvement of Accessibility and Enhancement of Regional Development

Proposed South Link of the Inner Ring Road including Sanepa and Koteswor access will improve the accessibility from the existing roads to the inner low density areas, which will enhance the development of these inner areas along the proposed route.

(5) Improvement of Environment along Bagmati River

Proposed South Link as well as Koteswor access would improve the environment of Bagmati river-side through the provision of slope protection of river bank. The open space between the proposed road and the river could be used for public facilities, such as, riverside park, pedestrian and bicycle road, etc.

10.2 Recommendation

In order to materialize the projects, the Study Team recommends DOR to take the following actions:

(1) Urgent Implementation of New Bagmati Bridge

It is strongly recommended for DOR to implement the construction of New Bagmati Bridge within the earliest possible time, since the traffic condition of existing Bagmati Bridge at Thapathali is getting worse and worse due to rapid increase of traffic demand between Kathmandu and Patan city.

The existing Bagmati Bridge, which was collapsed in August, 1991, is still in a serious and dangerous situations requiring immediate protection and repair because of the lowering of Bagmati river bed. At least, emergency protection work on pier No. 5 (nearest to Patan side) as well as reshaping of gabion checkdam locating 20 m downstream should be conducted before coming rainy season from June to September, 1993.

Since the existing Bagmati Bridge is only the vehicular bridge connecting Kathmandu and Patan inside the Ring Road. New Bagmati Bridge is essential not only for facilitating the traffic demands but also for securing a alternative bridge as a detour connecting Kathmandu with Patan.

(2) Securing of Bus Route from New Bus Terminal at Balaju

Construction of new bus terminal project is progressing at Balaju and is expected to be completed in early March, 1993. Since the new bus terminal is located at Balaju where accessibility from the central area of Kathmandu city is very limited, the provision of suitable access is essential for smooth operation of New Bus Terminal.

It is, therefore, recommended to construct the new access to the New Bus Terminal as soon as possible to secure proper and reliable bus route for bus operation, since the bus services is the only means of transportation in Kathmandu.

In the meantime, the Study Team also recommends to improve the roads nearby city center which might be utilized as bus routes if proposed access to the New Bus Terminal is implemented, especially the following routes:

(i) Trisuli road from Royal Palace to Paknajor (reconstruction of pavement and drainage as well as widening of certain section might be necessary)

(ii) Feeder road from Ambassador Hotel at Kanti Path to the New Access through U.K Embassy, Indian Embassy and Samakhusi Road (This road is recommended to be used employing a one-way system from Kanti path up to Samakhusi Road. Pavement and widening of the road between the entrance of Indian Embassy to Samakhusi road is recommended.)

Improvement of the above routes is essential for maintaining the smooth operation of bus services between city center and New Bus Terminal at Balaju.

(3) Securing 4 Lane Right-of-way Width for South Link of Inner Ring Road

Staged construction is recommended for the implementation of Inner Ring Road. Widening of the Inner Ring Road from 2 to 4 lane should be done in future when the traffic demand exceeds the traffic capacity of 2-lane road, however, right-of-way width should be secured for 4 lane at this moment. Additional land acquisition in future might be very difficult because of the increase of land price.

(4) Allocation of Local Budget for Acquiring Land/House

It is recommended to take an action as soon as possible to carry out the land/house acquisition survey and to reserve the necessary amount of local budget to be used for acquiring the lands and houses which will be interfered with the construction of project road and bridge.

Land and house acquisition should be conducted in accordance with the project implementation schedule as follows:

Year	Schedule of Land/House Acquisition
1st year (1993)	Acquiring lands and houses located in the vicinity of New Bagmati Bridge including the intersections at Thapathali and Patan side
2nd year (1994)	Within the ROW along Western section of South Link of Inner Ring Road from the beginning point up to the proposed New Bagmati Bridge including Sanepa Access
3rd year (1995)	Within the ROW along Eastern section of South Link of Inner Ring Road from proposed New Bagmati Bridge up to the end on Arniko Highway including Koteswor Access and Patan Access

(5) Improvement of Intersections and Traffic Management

In order to decrease the traffic accidents and secure a smooth traffic movement on the arterial city roads, it is recommended to improve the intersections and traffic management as shown below:

Location of Intersections	Schedule of Land/House Acquisition
- Intersection at Maitighar (Beginning of Arniko H'way)	Installation of traffic signals with minor improvement
- Tripureswar near National Stadium	Installation of traffic signals with minor improvement
- Intersection at Koteswor (Arniko H'way with Ring Road)	Improvement of intersection shape to the Roundabout intersection

URBAN ROAD DEVELOPMENT

FINAL REPORT

PART B : FEASIBILITY STUDY