CHAPTER 4. OUTLINE OF THE PROJECT

CHAPTER 4 OUTLINE OF THE PROJECT

4.1 Objectives

The objectives of the Project are to give the following solutions to traffic problems in the Kathmandu valley by reconstructing the existing bridges.

(1) To maintain an effective road network and to improve the movements of urban and tourist traffic in the Kathmandu valley

(2) To avoid traffic blockages on existing bridges by reconstructing the bridges to meet the new specifications

4.2 Study and Examination of the Request

4.2.1 Required Plans

The bridges in the Kathmandu valley whose reconstruction is requested by the Government of Nepal are as follows:

Table 4.1 REQUESTED BRIDGES

No.	Bridge Name	Bridge Length	River Crossed
2	Bishnumati	56 m	Bishnumati
4	Dhobi Khola	44 m	Dhobi Khola
6	Dhobi Khola	—	Dhobi Khola
7	Dhobi Khola	56 m	Dhobi Khola
8	Mahadev Khola	42 m	Mahadev Khola
9	Manmatta	42 m	Manohara-Branch

According to the Department of Roads, Bishnumati bridge is on an important road linking Swayambhunath temple and the center of Kathmandu city. It is badly dilapidated. No.8 Mahadev Khola and No.9 Manmatta bridge are situated on the arterial road linking Kathmandu city and Sankhu town. The wooden structures are badly dilapidated so that the bridges are not passable. No.4, No.6, No.7 Dhobi Khola bridges cross over the Dhobi Khola river. No.4 bridge carries an arterial road in the valley with heavy traffic, while No.6 and No.7 bridges carry relatively less traffic. No.6 Dhobi Khola bridge, however, is collapsed at present.

The Department of Roads is unable to allocate funding to cover bridge maintenance and rehabilitation. Also, reconstruction of the bridges needs a high level of technical expertise. Technical cooperation for this Project is, therefore, a suitable form of assistance to the Kingdom of Nepal.

4.2.2 Executing Agency and Operation

(1) Administrative Boundary

The five (5) regions are composed of fourteen (14) zones as follows:

Region	Zone	
1) FARWESTERN	1) MAHAKALI	8) GANDAKI
2) MIDWESTERN	2) SETI	9) NARAYANI
3) WESTERN	3) KARNALI	10) BAGMATI*
4) CENTRAL*	4) BHERI	11) JANAKPUR
5) EASTERN	5) RAPATI	12) SAGRMATHA
	6) DHAWALAGIRI	13) KOSHI
	7) LUMBINI	14) MECHI

The zones are, furthermore, divided into seventy-five districts. The Bagmati zone, the jurisdiction zone of the Project, consists of the following six (6) districts:

1) RASUWA
2) DHADIN
3) SINDHUPALCHOK
4) NUWAKOT
5) KATHMANDU*
6) BHAKTAPUR
7) LALITPUR
8) KABARE PALANCHOWK

*: Related Executing Agency

(2) Organizations

The executing agency of the Project is the Department of Roads (DOR) under the Ministry of Transport as shown on the following organization-chart. DOR intends to establish five (5) regions, eleven (11) zones and forty-two (42) district offices. Maintenance works are normally executed under the district offices.

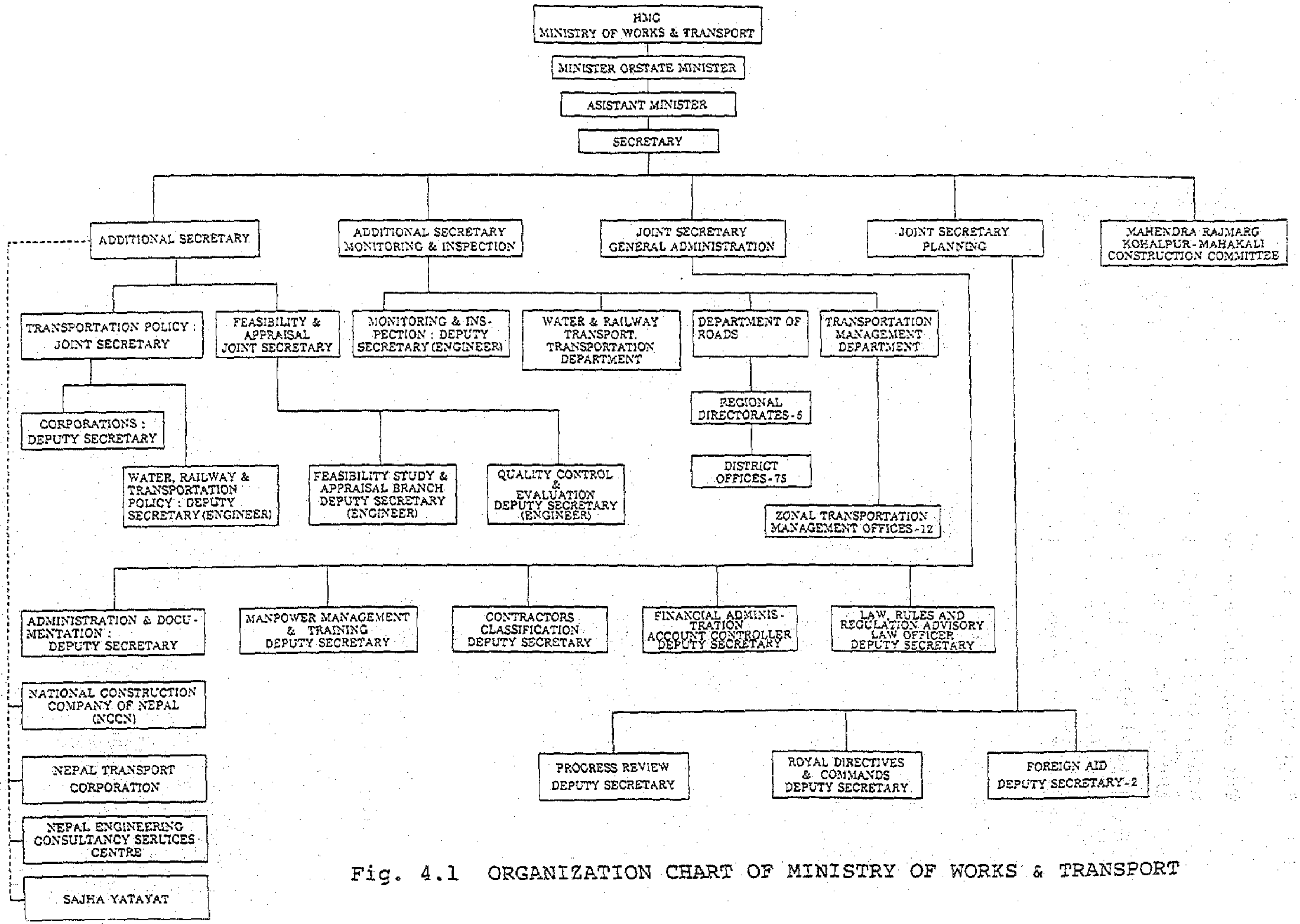


Fig. 4.1 ORGANIZATION CHART OF MINISTRY OF WORKS & TRANSPORT

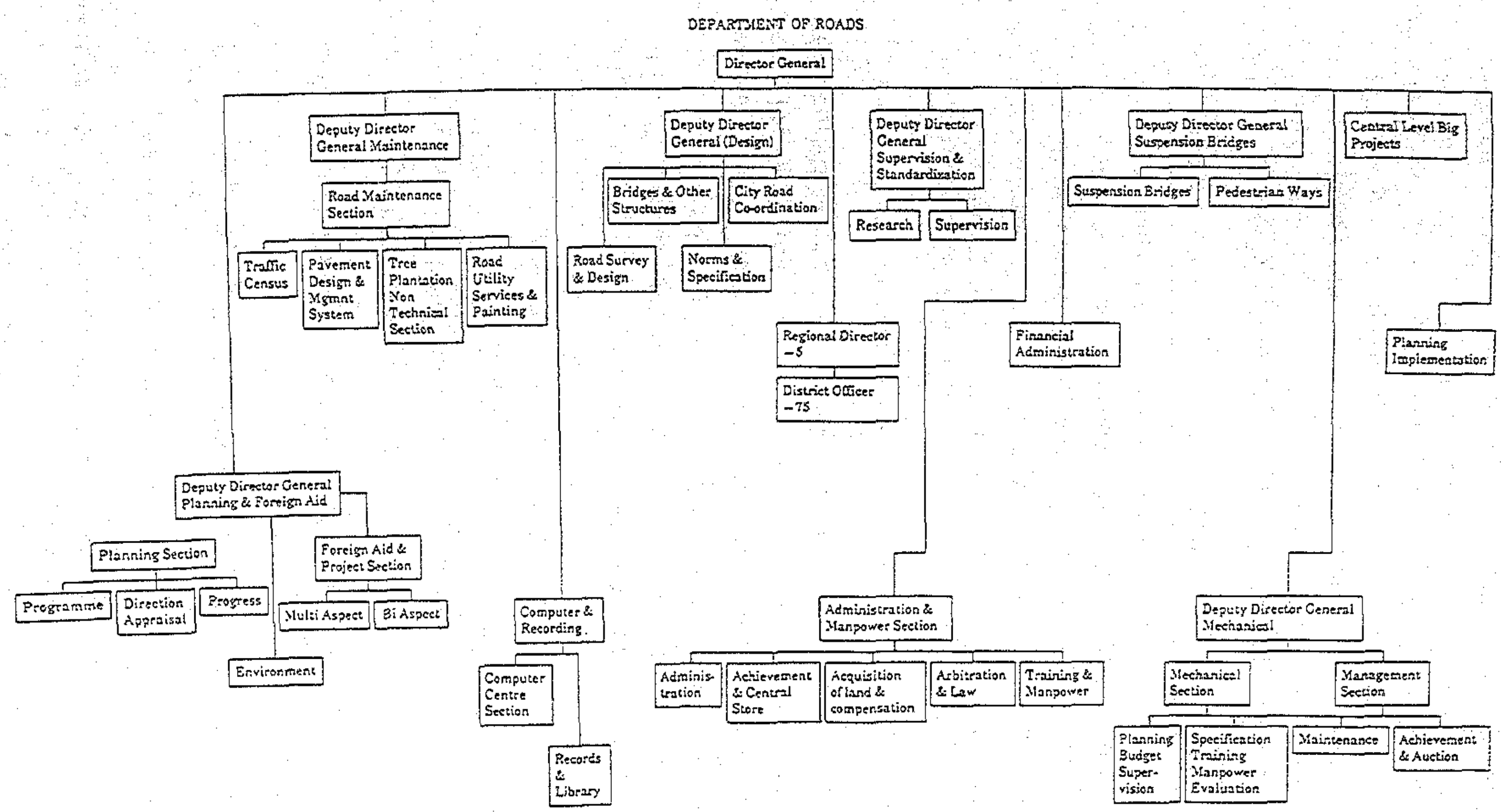


Fig. 4.2 ORGANIZATION CHART OF DEPARTMENT OF ROADS

(3) Budget Allocations

The budget allocations for the last five (5) years of the development plan including highway and bridge projects were as follows:

Table 4.2 BUDGET ALLOCATIONS

Years	DOR (NRs)	MOWT (NRs)
1) 1984/85	750,646,000	923,061,000
2) 1985/86	673,397,000	879,013,000
3) 1986/87	1,077,119,000	1,224,421,000
4) 1987/88	1,514,240,000	1,717,420,000
5) 1988/89	2,091,736,000	2,392,366,000

(4) Maintenance

The District Office under the organization of Department of Roads is in charge of maintenance actions for roads and bridges. The maintenance works for the roads and bridges such as patching works for the pavement surface and the protection of the bridge piers using gabion method are often carried out in the Kathmandu valley.

4.2.3 Related Plans and Aid Programs

Most projects in Nepal are assisted by India, China, Japan and the international banking agencies such as IBRD and ADB. The following recent projects were assisted by IBRD.

(1) Road Rehabilitation of Prithvi Highway between Naubise and Mugling

(2) Ditto, Arniko Highway between Sta. 62 and 82 km

(3) River Training at East/West Highway

(4) Reconstruction of four bridges in Kathmandu Valley

The reconstruction of four bridges in Kathmandu valley is very closely related to the Project. The bridges to be reconstructed are:

(1) No.1 Bishnumati, 80 m, Wooden Bridge
(2) No.5 Dhobi Khola, 45m, Steel Truss Bridge
(3) No.11 Nakkhu, 50 m, Steel Truss Bridge
(4) No.20 Naikap, 30 m, unknown type

According to the Terms of Reference for the above projects, the basic conditions for the reconstruction plan stipulates that the bridge width shall be two lanes with two sidewalks and approach roads to the bridges shall be 50 m long.

4.3 Outline of the Plans

4.3.1 Outline of Reconstruction Plans

(1) No.2 Bishnumati

Since the existing bridge is severely deteriorated and surrounded by residences, the bridge will be reconstructed on the site of the existing bridge which will be demolished before reconstruction work. Bridge configuration such as length, width and level is to be mostly the same as the existing one. Approach roads are to be covered by asphalt. A temporary detour is to be provided when the existing bridge is demolished.

(2) No.4 Dhobi Khola

Since the existing steel-plate girder bridge still has some durability and there are difficulties in connection with foundation works if bridge reconstruction is at the same location, a new bridge location is planned on the upstream side.

The configuration of the new bridge is almost the same as the existing one. The bridge width, however, will be two lanes while the existing width is one lane. The water pipe bridge will be left intact.

(3) No.6 Dhobi Khola

Since the wreckage of the collapsed bridge remains at the site and a realignment of the bridge center line is favorable, the reconstructed bridge is to be located on the upstream side of the existing one. The bridge configuration is mostly the same as the existing bridge. The right bank of the river is a flood area. Therefore, an embankment for the approach road is required. The surface of the embankment slope is to be covered with protection to avoid slope erosion.

(4) No.7 Dhobi Khola

Since the existing wooden structures are severely dilapidated and the abutments are surrounded by buildings, the existing bridge is to be replaced by a new one. The bridge configuration is nearly the same as the existing one. A steel girder bridge combined with concrete bridges on both sides is planned.

(5) No.8 Mahadev Khola

Since the existing wooden structures are severely dilapidated and a temporary detour can easily be provided upstream, the existing bridge is to be replaced by a new bridge. The approach roads are to be treated with bituminous surfacing.

(6) No.9 Manmatta

Since the existing wooden structures are severely dilapidated and a temporary detour can easily be provided on the upstream side of No.8 bridge, the existing bridge is to be replaced by a new bridge. The other requirements on the approach roads are the same as for No.8 bridge.

- Temporary Detours and Bridges

No.2 Bishnumati is to be replaced by a new one. The bridge, however, is situated on the link road between Swayambhunath temple and the central area of Kathmandu city. It is, therefore, necessary to provide a temporary bridge for pedestrians even during the flood season. No.4 bridge requires no temporary detour or bridge because the existing steel bridge is not planned for demolition during reconstruction. Temporary detours for No.6 and No.7 bridges are to be provided though the pedestrians may make a detour during the flood season. Temporary detours for No.8 and No.9 bridge are to be provided on the upstream side.

4.3.2 Planned Bridge Locations

Planned bridge locations can be determined based on factors such as the adjacent buildings, suitable alignment, temporary detour and structural deterioration of the existing bridges.

Table 4.3 PLANNED BRIDGE LOCATIONS

Existing Bridge				Planned Bridge
No.	Bridge Name	Type	Demolishing	Location
(1) 2	Bishnumati	Wooden	Yes	Same as the exst.
(2) 4	Dhobi Khola	Steel	No	Upstream
(3) 6	Dhobi Khola	Wooden	Removing Wreckage	Upstream
(4) 7	Dhobi Khola	Wooden	Yes	Same as the exst.
(5) 8	Mahadev Khola	Wooden	Yes	Same as the exst.
(6) 9	Manmatta	Wooden	Yes	Same as the exst.

The recipient country, the Kingdom of Nepal, must take care of the necessary measures as tabulated in the following:

Table 4.4 UNDERTAKINGS TO BE TAKEN BY EACH GOVERNMENT

No.	Description	to be covered by the Project	to be covered by the recipient
1.	Approach Roads	*	
2.	Land Acquisition		*
3.	Clearing/Grubbing of Project Sites		*
4.	Demolishing the exst. Bridge and Buildings		*
5.	Temporary Detour	*	
6.	Construction Space		*

* : to be covered by the Project or the recipient

4.3.3 Conditions of Existing Bridges and Planning

(1) Conditions of Existing Bridges

The existing bridges in the Kathmandu valley crossing over Bishnumati, Bagmati and Manohara rivers, are mostly wooden or steel pony truss type and have been constructed during the past 50 to 80 years. These bridges have inadequate widths and are located on soft and deep sediments in the valley. Most of the existing bridges are located in areas prone to flooding and riverbed scouring. One bridge collapse occurred due to local scouring around the piers on July 28, 1989. Recently, the Shankhamul bridge fell down due to earthquake damage on August 29, 1988.

The existing bridges under the circumstances described in the previous chapter are lately not adequate or strong enough to sustain increased traffic volumes and vehicle weights. Furthermore, the access roads for the existing bridges are badly damaged due to no maintenance having been carried out for a long time.

Table 4.5 LIST OF THE EXISTING BRIDGES IN KATHMANDU VALLEY

No.	Name of Bridge	Length (m)	Width (m)	Type of Bridge
1.	Bishnumati Bridge at Swaha Bhagwati	80	2.5	Wooden
2.	Bishnumati Bridge at Dallu	80	3.0	Wooden
3.	Bishnumati Bridge at Kankeswari	80	2.0	Suspension
4.	Dhobi Khola at Kalo Pul	45	3.6	Steel plate girder
5.	Dhobi Khola at Rato Pul	45	3.0	Steel truss
6.	Dhobi Khola at Handi Gaon	Washed away by flood		
7.	Dhobi Khola at Babar Mahal	48	3.0	Wooden
8.	Mahadev Khola Bridge	43	3.6	Wooden
9.	Manmatta Bridge	45	3.0	Wooden
10.	Madara Khola Bridge	Destroyed		-
11.	Nakkhu Bridge	43	3.5	Steel truss
12.	Bagmati Bridge	122	2.0	Suspension
13.	Kothu Khola Bridge	20	4.0	Concrete
14.	Hanumante at Hanuman Ghat	30	3.0	Wooden
15.	Hanumante at Ram Mandir	30	3.0	Brick arch
16.	Hanumante at Barahi Than	30	2.0	Brick
17.	Hanumante at Sallaghari	30	6.0	Concrete
18.	Bageswari Bridge	15	3.6	Brick
19.	Ratu Bridge	15	1.0	Wooden
20.	Naikap Bridge	30	3.0	Wooden
21.	Balkhu Bridge	30	3.0	Wooden
22.	Mahedev Khola Bridge	45	3.0	Wooden

The present situation of the existing bridges to be reconstructed are as follows:

Table 4.6 CONDITIONS OF EXISTING BRIDGES

No.	Bridge Name	Bridge Length	Type	Circumstance
2	Bishnumati	56 m	Wooden	Restricted passing
4	Dhobi Khola	44 m	Steel	Narrow width
6	Dhobi Khola	—	—	Washed away
7	Dhobi Khola	56 m	Wooden	Restricted passing
8	Mahadev	42 m	Wooden	Closed to traffic
9	Manmatta	42 m	Wooden	Closed to traffic

(a) No.2 Bishnumati

The access roads to the bridge are narrow where a lot of pedestrians and cyclists are passing. Pedestrians are forced to make a detour from No.1 Bridge, which collapsed in the last flood, to No.2 bridge. Many appurtenances are provided over and inside the bridge. There are brick buildings adjacent to both abutments. The riverbed is covered with sand and scattered boulders and there is general progressive scouring around the piers.

(b) No.4 Dhobi Khola

The bridge type is steel plate girder manufactured in 1906, normally called "the black bridge". Traffic which should pass through No.5 bridge located downstream of No.4 is making a detour to No.4 because of pier-settlement on No.5. The water-pipe bridge adjacent to No.4 crosses over the Dhobi Khola river also. The river stream is meandering and the pier's perimeter is protected with gabions from local scouring.

(c) No.6 Dhobi Khola

The wooden bridge supported by a brick substructure was washed away in the last flood. The area behind the right abutment is subject to flooding and a concrete sewage pipe runs from the right bank towards the river center.

(d) No.7 Dhobi Khola

The Dhobi Khola bridge, like the previous two bridges, also crosses over the Dhobi Khola river. There is a berm on each side of the present riverbed formed by the the high water channel of the old riverbed some 30 years ago. Flood water levels come up to this old riverbed every year.

(e) No.8 Mahadev Khola

The No.8 bridge is situated on the arterial road linking Kathmandu city and Sankhu town. The wooden structure, superstructure and piers, are severely dilapidated so that the bridge is not capable of supporting vehicle loading. A temporary detour is, therefore, provided on the upstream side of the existing bridge. Soil conditions are confirmed to be relatively good by the site reconnaissance survey.

(f) No.9 Manmatta

The No.9 bridge is situated on the same road as the No.8 bridge, further from Kathmandu. The No.9 and No.8 bridges are similar as regards their structural and traffic conditions.

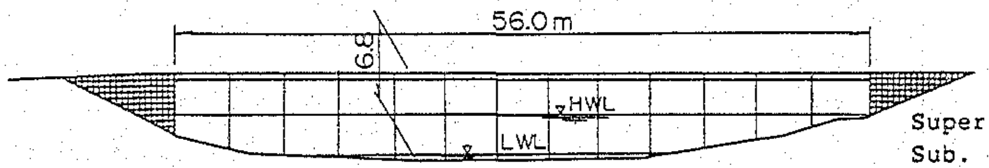
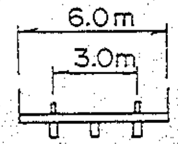
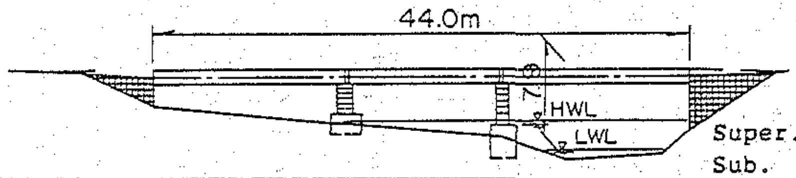
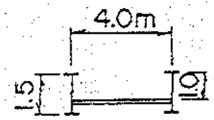
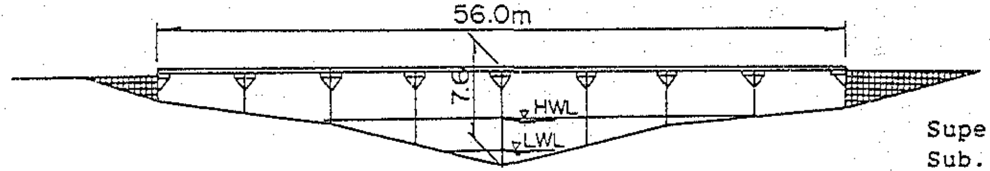
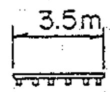
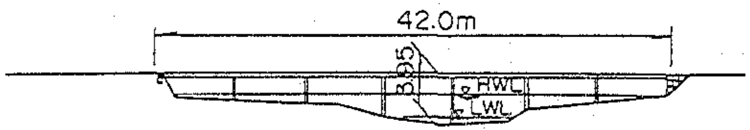
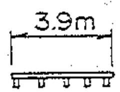
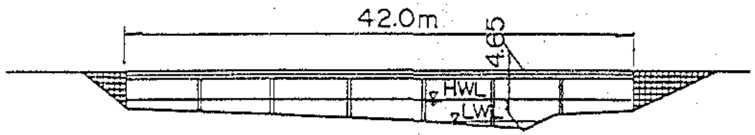
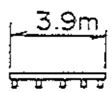
No.	Bridge Name	Elevation		Cross Section
2	BISHNUMATI (DALLU Bridge)		Super. : Wooden Sub. : Wooden	
4	DHOBI KHOLA (KALO PUL Bridge)		Super. : Steel through Girder Sub. : Brick	
6	DHOBI KHOLA (HANDI-GAON Bridge)	Structural size cannot be confirmed because of washing away of the existing bridge.		—
7	DHOBI KHOLA (BABAR-MAHAL Bridge)		Super. : Wooden Sub. : Wooden	
8	MAHADEV KHOLA		Super. : Wooden Sub. : Wooden	
9	MANMATTA		Super. : Wooden Sub. : Wooden	

Fig. 4.3 EXISTING BRIDGE CONDITIONS

4.3.4 Configuration of the Planned Bridges

(1) Width of Planned Bridge

The major factors to determine bridge width are the existing bridge width, access road width and traffic volume. An inventory survey for the existing width and traffic survey were carried out to obtain basic data for the bridge width planning.

Table 4.7 TRAFFIC CONDITIONS

No.	Bridge Name	Existing Bridge Width(m)	Access Road Width(m)	Trafficable Vehicle	Traffic Volume (Vehicle/day)	Pedestrians (person/day)
2	Bishnumati	6.0	4.0~9.0	Light Vehicles	5,188	3,120
4	Dhobi Khola	4.0	5.1~9.0	Truck, Bus	10,375	6,247
6	Dhobi Khola	—	4.2~6.7	Light Vehicles	2,081	1,252
7	Dhobi Khola	3.0	4.5~6.5	Light Vehicles	1,498	901
8	Mahadev Khola	3.9	5.5	Truck, Bus	560	1,422
9	Manmatta	3.9	5.5	Truck, Bus	601	1,319

a) Roadway

Basically, where traffic volume is 10,375 vehicle/day like No.4 Dhobi Khola bridge, it should be two lane roadways, and where volume is from 1,498 to 5,188 vehicle/day one lane is required like No.2 Bishnumati, No.6 and No.7 Dhobi Khola bridge. In the suburbs, where traffic volume is 560 and 60/vehicle/day is also one lane roadway. A one lane roadway is to be 3.5m wide and 2×3.25m for two lanes considering the marginal clearance.

b) Sidewalk

Sidewalks are to be provided on both sides of the bridge in city areas where traffic is composed of cars, bicycles and pedestrians, while it is to be provided on one side in suburban areas. Basically, 1.50m is required as standard width for a sidewalk.

It can be reduced to 1.00m wide taking a single width for bicycles passing into consideration.

Table 4.8 CROSS SECTIONS

No.	Bridge Name	Cross Section			
		Roadway	Sidewalk	Planned Width	
2	Bishnumati	1×3.50	2×1.50	6.50	(B)
4	Dhobi Khola	2×3.25	2×1.00	8.50	(C)
6	Dhobi Khola	1×3.50	2×1.50	6.50	(B)
7	Dhobi Khola	1×3.50	2×1.50	6.50	(B)
8	Mahadev Khola	1×4.00	1×1.50	5.50	(A)
9	Manmatta	1×4.00	1×1.50	5.50	(A)

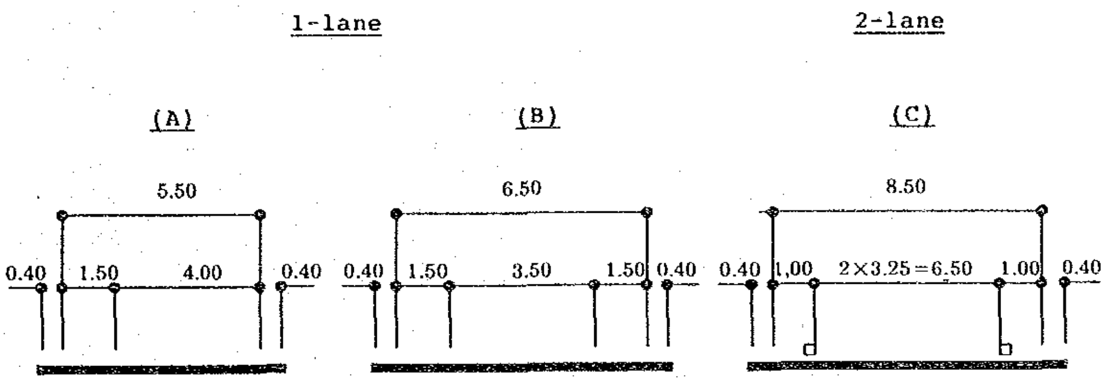


Fig. 4.4 PLANNED CROSS SECTIONS

(2) Bridge Length

Major factors affecting bridge length are the existing bridge length, river width, flood runoff, damage by flood and river orientation. The rivers which the planned bridges cross are often flooded in the rainy season. At No.2, No.4, No.6 and No.7 bridges, the flood water flows against both abutments and sometimes more widely. At the sites of bridges No.8 and No.9, the flood water normally flows in the river width, but often floods the adjacent paddy field. Accordingly, the planned bridge lengths are to be the same as the existing ones.

(3) Bridge Level

Major factors affecting bridge level are design high water level, last highest water level, damage by flood and size of driftage. According to the monitoring survey carried out by the Team, the last maximum high water was up to the level of the river bank at the No.2 bridge site, and it rose up 2 or 3 times a year to the gabions recently installed on the riverbed at the No.4, No.6 and No.7 bridge sites, and the last maximum water rose up close to the girder-bottom at the No.8 and No.9 bridge sites. A large size of driftage is not conceivable since the existing bridge span lengths are short, 4.3m, 7.0m and 15.0m.

For No.8 and No.9 bridges, it is necessary to keep small size beams such as on the existing bridges. The free-board from the last high water levels to the beam soffits of the planned bridges are shown in the following table.

Table 4.9 FREE-BOARD AND FLOOD WATER LEVEL

No.	Bridge Name	Year of Occurrence of M.H.W.L.	Free-Board above M.H.L	Free-Board above A.O.H.W.L
2	Bishnumati	35 years ago	2.00m	2.50m
4	Dhobi Khola	35	0.50	2.85
6	Dhobi Khola	30	0.80	2.00
7	Dhobi Khola	20 to 50	1.05	2.60
8	Mahadev Khola	15	1.00	1.95
9	Manmatta	15	1.00	1.95

Note : M.H.L=Past Maximum Highwater Level
A.O.H.W.L=Annually Occurring High Water Level

The table shows that the past maximum high water levels occurred 15 to 35 years ago and the free-boards against M.H.L are 0.5 to 2.0m and the free-boards against A.O.H.W.L are 1.95 to 2.50m.

CHAPTER 5. BASIC DESIGN

CHAPTER 5 BASIC DESIGN

5.1 Design Policy

The primary considerations for the basic design with respect to bridge girders, span arrangement, substructure type and foundation type are as follows:

Based on the present situation of the existing bridges, basic considerations for bridge planning are as follows:

(1) The damage and washing away of the existing bridges is often caused by river flooding. Planning of bridge lengths and levels should be based on flood records and analyses. Local scouring around piers must be particularly considered.

(2) It is a feature of the Kathmandu valley that the ground consists of very soft sediments to a depth of 650 m at the deepest point, and is dominated by clay and silt near the surface. Foundation depth, therefore, must be carefully studied.

(3) The Kingdom of Nepal is situated in a strong seismic zone. The Shankhanul bridge crossing over the Bagmati river in Kathmandu city collapsed after an earthquake in August 1988. Earthquake resistant design is, therefore, important, including determining the most suitable configuration of the foundations. This will have considerable bearing on the construction costs.

(4) Foundation type and construction method will be limited by the water level in the rainy season.

(5) Maintenance-free bridges must be considered to minimize maintenance costs.

(6) It is important to establish bridge planning so as not to disturb adjacent residences and to take care of the appurtenance facilities such as electric and telephone cables.

The design conditions for the basic design based on the above primary consideration are formulated as follows:

(1) To keep the span length over the main river current more than 20 m;

(2) To avoid locating the bridge piers in the middle of the river;

(3) To minimize the size of the abutment to resist the earthquake-soil pressure; and

(4) To minimize the superstructure weight directly affecting the foundations.

5.2 Establishment of Design Conditions

5.2.1 Design Criteria

Design criteria, discussed with DOR during the field survey, are to be based on the following policies:

(1) Bridge width should be based on Nepal Road Standard (NRS) and Japanese Standards (JS).

(2) Design live loads should be based on Japanese Standards (JS) and NRS referring to AASHTO.

(3) Earthquake load should be based on the National Building Code of India 1970 and Japanese Earthquake Specification.

(4) Japanese specifications should be referred to on matters not covered in local standards and specifications.

The loads and forces to be considered in the design are as follows:

a) Principal loads (P) :
  1) Dead load (D)
  2) Live load (L)
  3) Impact (I)

4) Effect of creep of concrete (CR)
5) Effect of shrinkage of concrete (SH)
6) Earth pressure (E)
7) Hydraulic pressure (HP)
8) Buoyancy or uplift (U)

b) Subsidiary loads (S):
1) Wind load (W)
2) Thermal force (T)
3) Earthquake force (EQ)

c) Particular loads (P):
1) Effect of movement of ground (GD)
2) Effect of displacement of supports (SD)
3) Centrifugal force (CF)
4) Braking force (BK)
5) Temporary load and force during erection (ER)
6) Collision force (CO)
7) Other forces

d) Dead loads

The unit weights as given in the following table are used for the calculation of dead loads. Actual weight should be, however, used for materials not specified here.

Table 5.1 UNIT WEIGHT OF MATERIALS

Material	Unit Weight (kg/m^3)	Material	Unit Weight (kg/m^3)
Steel, Cast Steel	7,850	Concrete	2,350
Cast iron	7,250	Cement mortar	2,150
Aluminum alloys	2,800	Asphalt Pav.	2,300
Reinforced concrete	2,500	Concrete Pav.	2,350
Prestressed concrete	2,500	Timber	800

e) Live loads

Live loads consist of a moving load of trucks (T-loading and the L-loading) and sidewalk loading.

- Live load for slab and floor systems

Slabs and floor systems should be designed for the following live loads. 1) On the roadway, T-loading shall be placed. In the longitudinal direction of a bridge, only one T-loading shall generally be placed, and in the transverse direction, an arbitrary number of T-loadings shall be placed so as to produce the maximum stress in the member to be designed.

Table 5.2 T-LOADING

Class of bridge	Loading	Gross Weight W(ton)	Weight of a front wheel 0.1W(kg)	Weight of a rear wheel 0.4W(kg)	Width of a front wheel b_1(cm)	Width of a rear wheel b_2(cm)	Length of contact area of a wheel on the road-surface a(cm)
1st	T-20	20	2000	8000	12.5	50	20

2) On sidewalks, a uniform live load of 500 kilograms per square meter of sidewalk area shall be applied.

- Live load for main girders

A main girder shall be designed for the following live loads:
1) On the roadway , the L-loading, consisting of the line load, P, and the uniform load, p, defined as "main loads" in the Table, shall be placed on the area up to 5.5 meters in width of the roadway, and P/2 and p/2, defined as "sub-loads" in the Table, shall be placed on the remaining area of the roadway, so as to produce the maximum stress in the member to be designed.

Table 5.3 L-LOADING

Class of bridge	Loading	Main loads (up to 5.5 meters in width)			
		Line load P(kg/m)	Uniform load, p (kg/m^2)		
			L≦80	80<L≦130	L>130
1st	L-20	5,000	350	430-L	300
2nd	L-14	70% of those of 1st class			

Note:

Sub-loads should be 50% of main loads

L=Span length in meters

2) On sidewalks, a uniform live load given in the Table shall be applied.

Table 5.4 UNIFORM LOAD FOR SIDEWALKS

Span length, L (m)	L≦80	80<L≦130	L>130
Uniform load (kg/m^2)	350	430-L	300

Basically, the Japanese Standard for design live loads shall be applied for designing the bridges. The bridges shall also be checked for the design live load specified in NEPAL ROAD STANDARDS (NRS) referring to AASHTO.

5.2.2 Determination of Bridge Types

(1) Suitable Bridge Types

Based on natural conditions, construction circumstances and planning conditions, suitable bridge types for the Project are as follows:

a) Reinforced Concrete T-Girder (RC-T)
b) Prestressed Concrete T-Girder (PC-T)
c) Steel Plate Girder (St-Gr)
d) Steel Truss (St-Truss)

RC-T bridge is advantageous for its easier material procurement, but the superstructure is relatively heavy preventing spans of more than 15m because of the influence on foundation size.

PC-T bridge is not realistic because of technical problems in producing higher strength concrete for prestressing the bridge girders. A steel girder bridge is advantageous for shortening the construction period and minimizing the forces on the foundations. A steel-truss bridge is advantageous for its longer possible span length (about 60m) and smaller transportable member-size. But it is disadvantageous in construction cost and period, and concentration of the reaction from the superstructure although it is possible to minimize the number of foundations. Accordingly, considering the advantageous and disadvantageous points it is recommended to use reinforced concrete-T girder and steel girder bridge types.

(2) Bridge Type Alternatives

Based on the previous study, the following 18 alternatives can be formed in considering suitable span arrangements.

Table 5.5 BRIDGE TYPE AND ALTERNATIVES

No.	Bridge Name Bridge Length(m)	Alter- natives	Bridge Type	Span Arrangement
2	Bishnumati 60	a) b) c)	St-Gr RC-T RC-T	3×20 4×15 5×12
4	Dhobi Khola 45	a) b) c)	St-Gr St-Gr RC-T	30+15 3×15 3×15
6	Dhobi Khola 45	a) b) c)	St-Gr St-Gr RC-T	10+25+10 3×15 3×15
7	Dhobi Khola 60	a) b) c)	St-Gr St-Gr/RC-S RC-T	18+24+18 2×8.5+25+2×8.5 4×15
8	Mahadev Khola 42	a) b) c)	St-Gr St-Gr/RC-S RC-T	25+17 8.5+25+8.5 3×14
9	Manmatta 42	a) b) c)	St-Gr St-Gr/RC-S RC - T	2×21 8.5+25+8.5 3×14

Note : St - Gr : Steel plate Girder
RC - T : Reinforced Concrete T-Girder
RC - S : Reinforced Concrete Slab

(3) Major factors in Selecting Bridge Type

a) Earthquake Resistance

As the Kathmandu valley is situated in a hazardous zone in accordance with the Indian Building Code and strong earthquakes have often been recorded in this area during the past, earthquake resistant structures are required for the new bridges.

b) Soil Conditions

Each bridge site is covered with soft soils, clay and silt. The superstructure type needs to be a longer span bridge to minimize the number of piers and a lighter weight structure to reduce the reaction on the foundations.

c) River conditions

The river is meandering and generally scoured, and recently settlement of piers and bridge collapse have occurred. Thus, span arrangements to avoid these accidents is important.

d) Construction period

In Nepal, the rainy season is normally from June to October. In this season, the rivers which the bridges cross will flood, and the highways used to transport materials and equipment into the Kathmandu valley will suffer from road disasters such as landslides. It is, therefore, important to consider the rainy conditions in planning the bridge type.

e) Maintenance

For recording the future maintenance budget, maintenance-free bridges must be considered in selecting the bridge type.

f) Construction Costs

Reducing the number of piers must be considered to minimize construction costs and shorten construction periods.

(4) Selecting Bridge Types

a) No.2 Bishnumati

A simple 3-span steel plate girder bridge is selected for the reasons that the lightweight superstructure is earthquake-proof, the longer girder will avoid local scouring around the piers, and it has the lowest construction cost.

b) No.4 Dhobi Khola

A 2-span steel plate girder bridge is selected for the reason that it will avoid local scouring around the piers with a 30m span length girder.

c) No.6 Dhobi Khola

A 3-span simple steel plate girder bridge is selected for the reasons that the lightweight superstructure is advantageous to the foundations. The steel girders are earthquake-proof and it can minimize the construction period.

d) No.7 Dhobi Khola

A simple steel plate girder combined with reinforced concrete slabs (RC-Slab) for both side spans is selected for the reasons that the longer main girders are advantageous to the foundations and the combination of steel girder and reinforced concrete slabs will minimize the construction costs.

e) No.8 Mahadev Khola

A simple steel plate girder combined with reinforced concrete slabs for the side span portions is selected for the reason of minimum cost construction.

f) No.9 Manmatta

A simple steel plate girder combined with reinforced concrete slabs for the side span portions is selected for the same reason as for No.8 bridge.

5.2.3 Span Arrangement

The following figures indicate the span arrangements of the selected bridge types.

(1) 20.0 (St-Gr)+20.0 (St-Gr)+20.0 (St-Gr)=60.0 m

(2) 15.0 (St-Gr)+30.0 (St-Gr)=45.0 m

(3) 10.0 (St-Gr)+25.0 (St-Gr)+10.0 (St-Gr)=45.0 m

(4) 2×8.50 (RC-Slab)+25.0 (St-Gr)+2×8.5 (RC-Slab)=59.0 m

(5) 8.5 (RC-Slab)+25.0 (St-Gr)+8.5 (RC-Slab)=42.0 m

(6) 8.5 (RC-Slab)+25.0 (St-Gr)+8.5 (RC-Slab)=42.0 m

Note: St-Gr : Steel Plate Girder
RC-T : Reinforced Concrete T-girder
RC-S : Reinforced Concrete Slab

Table 5.6 BRIDGE TYPE SELECTION

No.	Bridge Name Bridge Length(m)	Alter-natives	Earthquake -Proof	Soil Condition	River Condition	Construction Period	Maintenance	Construction Cost	Selected type
2	Bishnumati 60	a)	○	○	○	○	△	1.00	a)
		b)	×	×	△	△	○	1.00	St-Gr
		c)	×	×	×	△	○	1.01	3×20
4	Dhobi Khola 45	a)	○	○	○	○	△	1.00	a)
		b)	○	△	△	△	△	0.95	St-Gr
		c)	×	△	△	△	○	1.08	30+15
6	Dhobi Khola 45	a)	○	○	○	○	△	1.00	a)
		b)	○	△	△	○	△	1.01	St-Gr
		c)	×	△	△	△	○	1.00	10+25+10
7	Dhobi Khola 60	a)	○	○	○	○	△	1.00	b)
		b)	△	○	○	△	△	0.98	St-Gr/RC-S
		c)	×	×	×	×	○	1.17	2×8.5+25+2×8.5
8	Mahadev Khola 42	a)	○	○	△	○	△	1.00	b)
		b)	△	○	○	△	△	0.91	St-Gr/RC-S
		c)	×	×	×	×	○	0.99	8.5+25+8.5
9	Manmatta 42	a)	○	○	×	○	△	1.00	b)
		b)	△	○	○	△	△	0.92	St-Gr/RC-S
		c)	×	×	△	×	○	1.01	8.5+25+8.5

Note : ○ : Good

△ : Fair

× : Bad

a), b), c) : as designated in Table 5.5

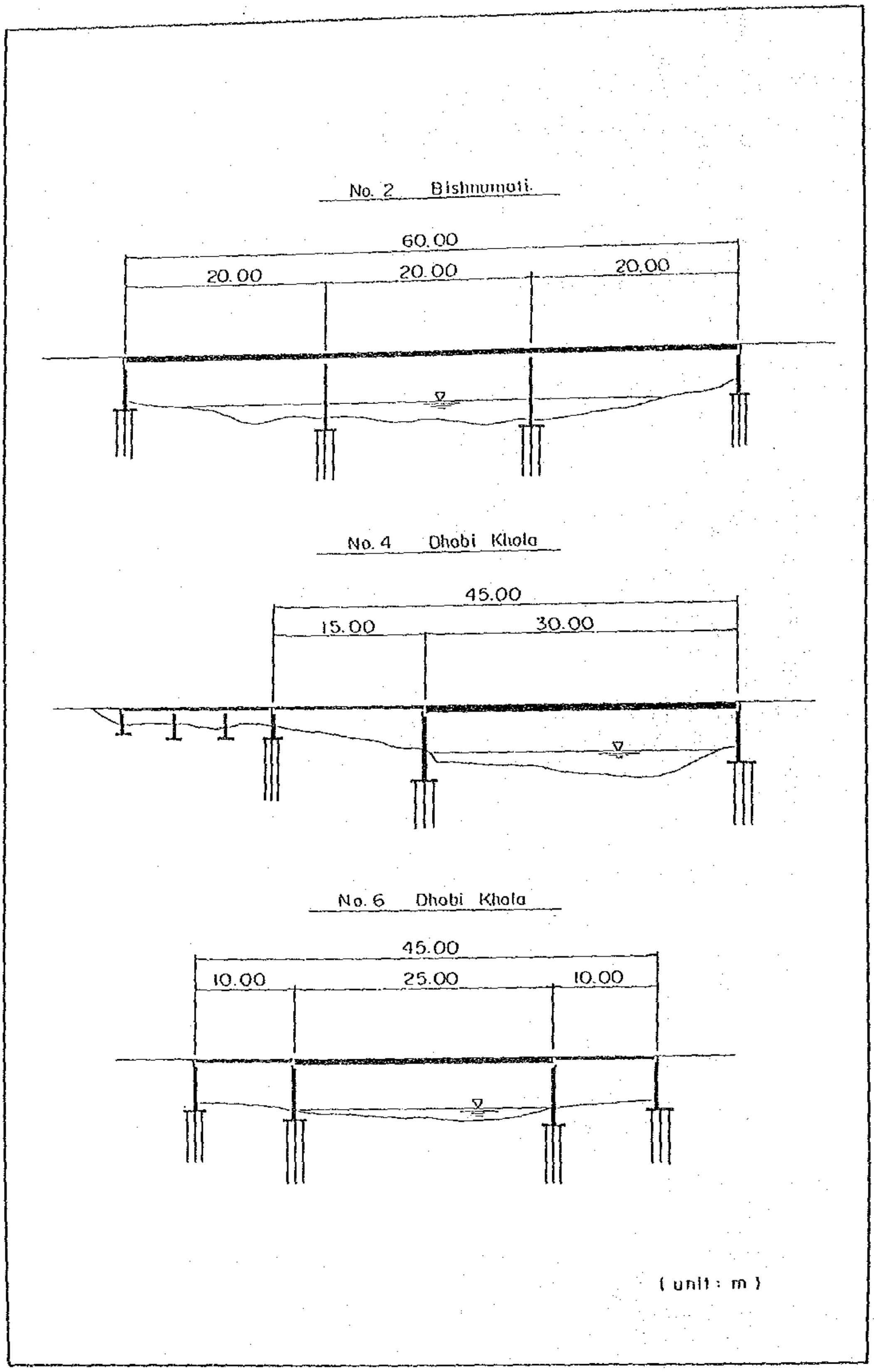


Fig. 5.1 SPAN ARRANGEMENT OF PLANNED BRIDGE

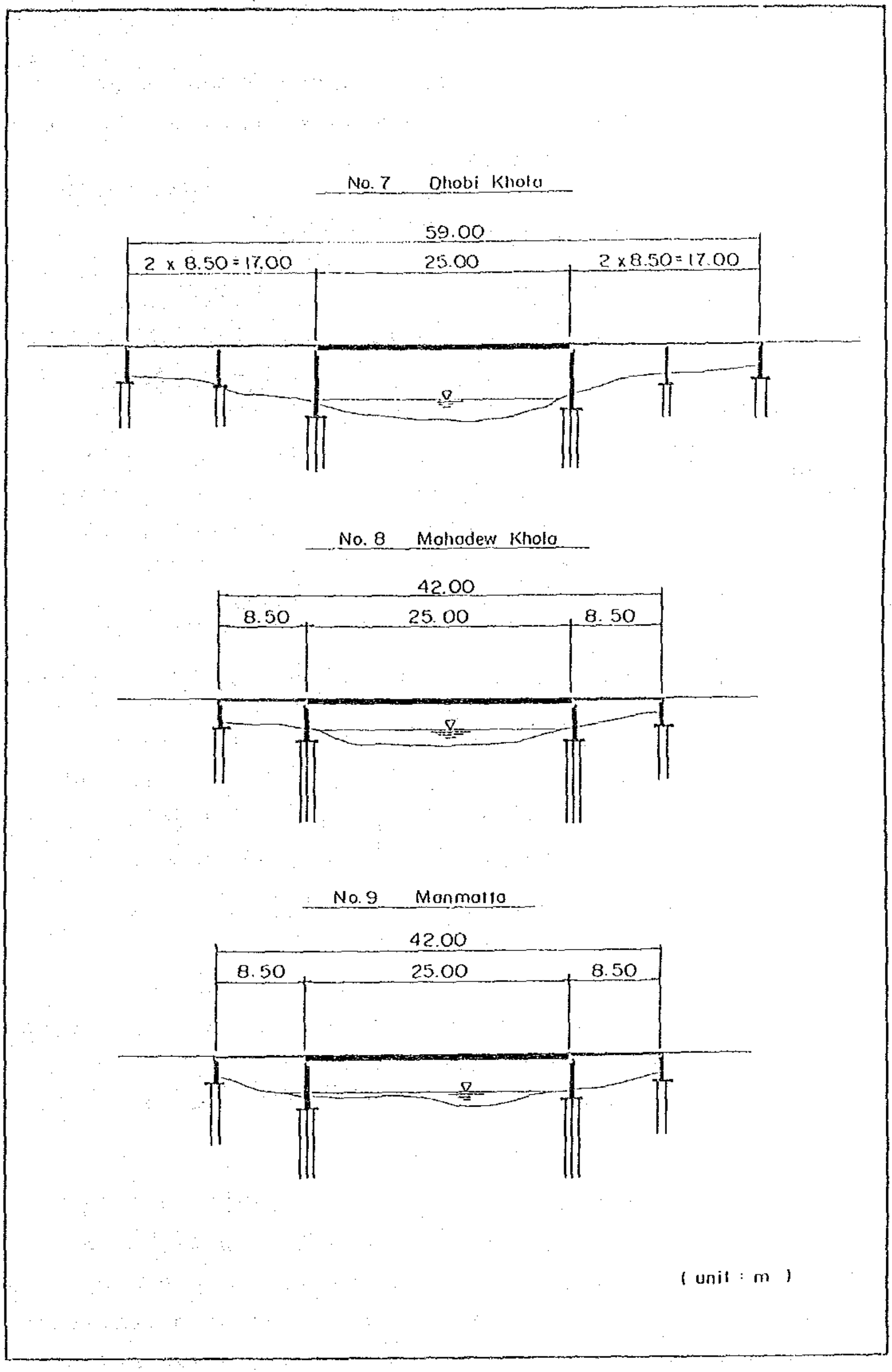


Fig. 5.2 SPAN ARRANGEMENT OF PLANNED BRIDGE (continued)

5.2.4 Appurtenances

The facilities appurtenances such as water pipes, electric cables and telephone cables on the existing and on the planned bridges are as follows:

Table 5.7 APPURTENANCES

Bridge Name		Existing	Planned		
		Water Pipe	Water Pipe	Electric Cable	Telephone Cable
No.2	Bishnumati	—	Ø9"×1	11kVA	Ø110mm×1
No.4	Dhobi Khola	Ø24"×1 *	Ø36"×1	11kVA	Ø110mm×1
No.6	Dhobi Khola	—	Ø6"×1	11kVA	Ø110mm×1
No.7	Dhobi Khola	Ø8"×1	Ø8"×1 Ø3"×1	—	Ø110mm×1
No.8	Mahadev Khola	—	Ø6"×1	11kVA	Ø110mm×1
No.9	Manmatta	—	Ø6"×1	11kVA	Ø110mm×1

* : Water-pipe upstream of the existing No.4 Bridge.

An 11kVA electric cable is not allowed in and/or on the bridge because it is dangerous to the bridge and difficult to maintain. Since a 36-inch water pipe is too large a size as a bridge appurtenance, the planned water pipe should be considered independently from the planned bridge.

5.3 Basic Design

In basic design, bridge materials to be used and girders to be employed are carefully studied based on the planning conditions, bridge types and design criteria stated previously.

Non-composite and composite steel plate girders as main bridge girders, and reinforced concrete hollow slabs and reinforced concrete solid slabs for the side spans are compared. The necessity of atmospheric corrosion resistant steel is discussed for a maintenance-free bridge. For the substructure, reinforced concrete wall, rigid frame and multicolumn types are compared. For the foundations, cast-in-place concrete piles, open caissons and precast concrete piles are compared.

5.3.1 Design of Superstructure

(1) Using H-beams

3 types of main girder are compared as follows:

Table 5.8 COMPARISON OF STEEL BRIDGES

Bridge type	Girder Depth (ℓs=25m)	Cost Ratio	Ease of construction
· Non-Composite Gr.	1.00 m	1.10	Fair
· Composite Gr.	0.90 m	1.00	Fairly Difficult
· Composite H-Beam	0.85 m	1.00	Good

In addition to the above comparison, composite H-beams can be adopted for the main span for the following prominent reasons:

a) H-beams can shorten the construction period since beam production requires fewer processes than do welded steel girders.

b) H-beams are advantageous for construction when replacing the existing bridges because of their smaller beam depth allowing the bridge surface level to be lowered.

c) H-beams are cheaper than welded steel girders.

d) H-beams can be manufactured out of atmospheric corrosion resistant steel and their roundish shape is corrosion resistant.

(2) Using atmospheric corrosion resistant steel

Using atmospheric corrosion resistant steel (ACRS) is effective in countries where maintenance activities, inspections and budget-keeping, are insufficient. On the bridge beams, the oxide forms a dense, tight film to protect the steel from corrosion. ACRS allows big savings in painting and maintenance work. Accordingly, ACRS H-beams are used for the Project as a form of maintenance-free beam.

For the side spans, reinforced concrete T-girders (RC-T) and reinforced concrete slabs (RC-Slab) are suitable bridge types. A comparison of their features is as follows:

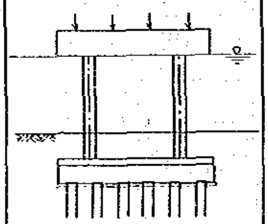
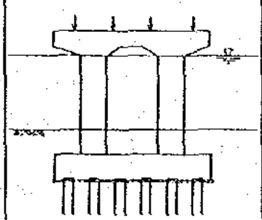
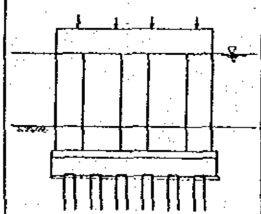
TABLE 5.9 COMPARISON OF CONCRETE BRIDGES

Bridge Type	Girder or Slab Depth ℓs=8.5m	Cost Ratio	Ease of Construction
· Reinforced Concrete T-Girder	0.80 m	1.10	Fair
· Reinforced Concrete Slab	0.70 m	1.00	Fairly Difficult

The reinforced concrete slab is adopted for the Project since the slab depth is smaller and the cost is less.

5.3.2 Design of Substructure

In general, the substructure type is determined by the magnitude and direction of the reactions from the superstructure, river conditions and earthquake resistance. These factors are considered under structural features, ease of construction, river-flow disturbance and construction cost. 3 suitable substructure types, wall type, rigid frame type and multi-column type, are compared in the following table.

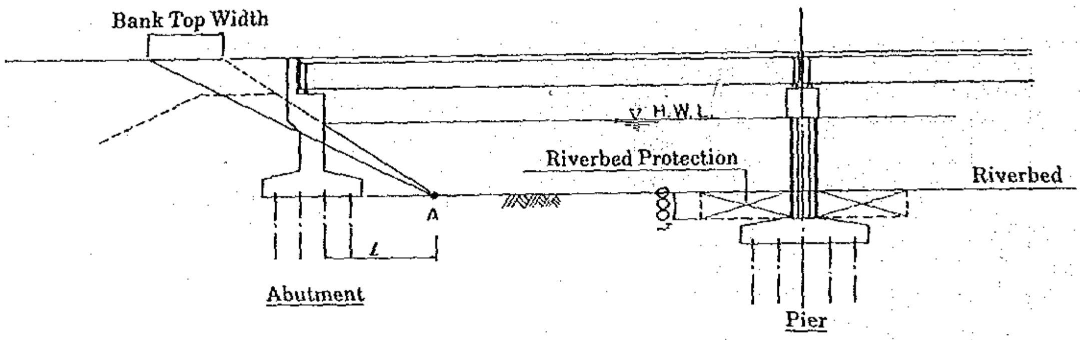
Type	Sketch	Structural Feature	Ease of Construction	River - Flow - Disturbance	Construction Cost	Remarks
Wall Type		Enough earthquake resistance ○	No need for scaffolding △	Suitable ○	1.00	Recommended
Rigid Frame Type		Relatively complex structure △	High quality control required △	Problems with driftage ×	1.00	—
Multi - Column Type		Influence of temperature stress ○	· Scaffolding required · High quality control required △	Problems with driftage ×	1.20	—

○ Good
△ Fair
× Bad

Fig. 5.3 COMPARISON OF SUBSTRUCTURES

As a result of the comparison, the wall type is adopted as the substructure type because of its advantages in the selected areas of structural features, ease of construction, river-flow disturbance and construction cost.

(1) ·········No. 2, No. 4, No. 6, No. 8, No. 9 Bridge :



(2) ·········No. 7 Bridge :

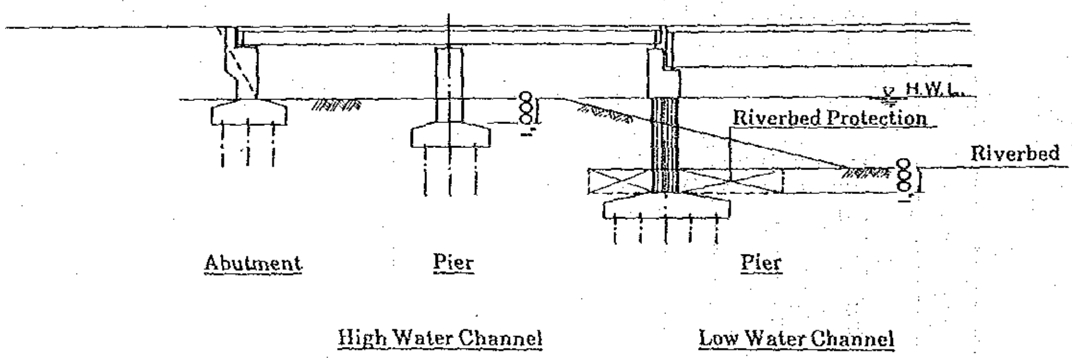


Fig. 5.4 COVERING DEPTH ABOVE FOOTING

5.3.3 Design of Foundations

The foundation type can be determined mainly from the soil conditions, soil bearing capacity and analyzed soil constants. In addition, the factors of ease of construction, material procurement, foundation depth and minimum cost are carefully considered.

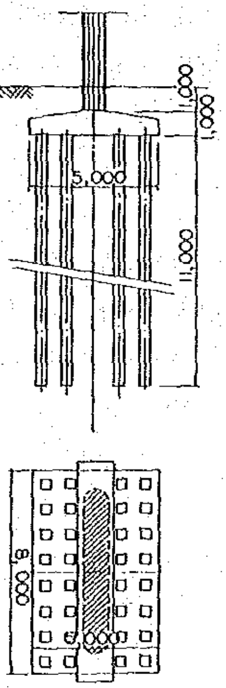
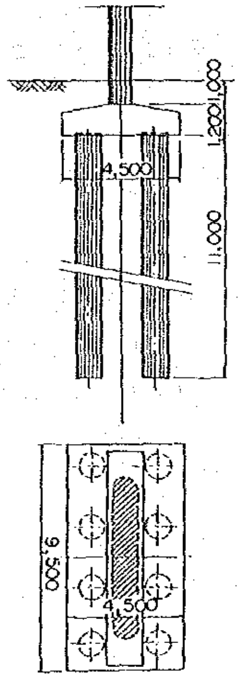
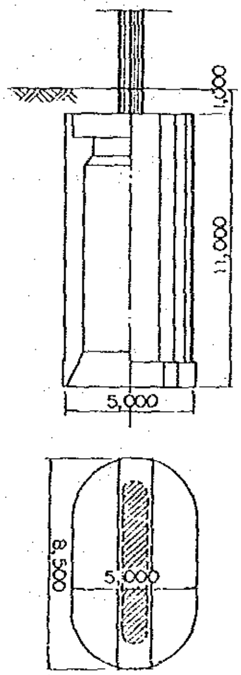
Type	Precast Concrete Pile	Cast - in Place Pile	Open Caisson
Sketch			
Structural features	Distributes the reaction from the superstructure ○	Thick and wise footing due to large diameter of pile △	Not enough bearing capacity due to soft soils ×
Ease of Construction	Shorter pile driving time ○	Water - contamination due to slime circulation △	Longer construction period △
Construction Cost	1.00 ○	1.10 △	1.50 ×
Remarks	Recommended	—	—

Fig. 5.5 COMPARISON OF FOUNDATIONS

Suitable foundation types for the Project are precast concrete piles, cast-in-place piles and open caisson foundations. Precast concrete piles are made from local materials and are therefore cheapest. Cast-in-place piles have problems with respect to grout-contamination, unreliable construction and poor earthquake resistance due to the lower number of piles.

Open caisson foundations have problems regarding construction accuracy during sinking of the caisson body and construction time. Thus, precast concrete piles are adopted for this Project. The design length of precast pile to be adopted is approximately 14 m long. A joint at the middle of the pile is designed for ease of construction in the narrow construction space.

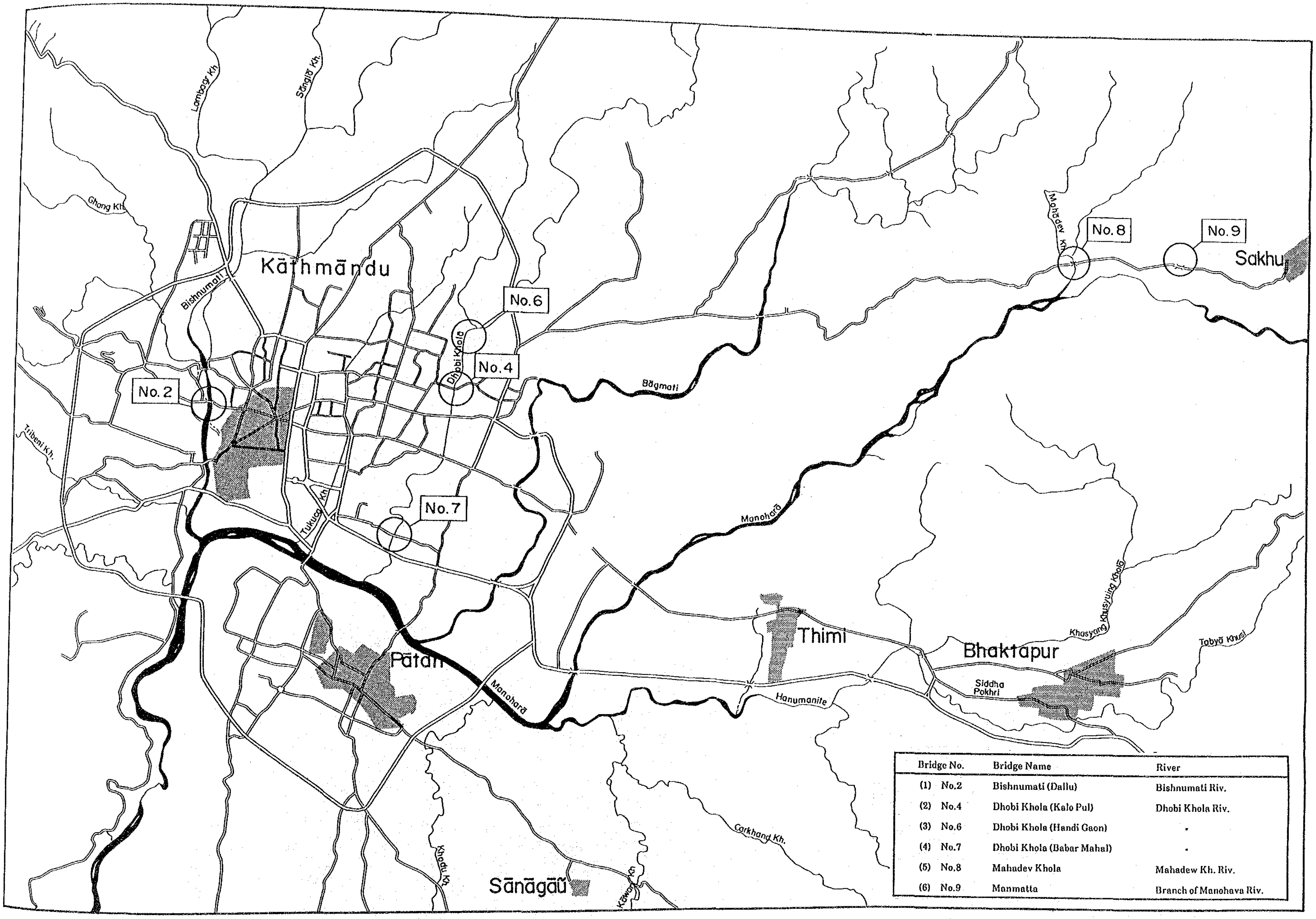
5.4 Design Drawings

The design drawings consist of a general view, a drawing showing structural details and other required miscellaneous drawings. Preliminary design quantities are computed for the cost estimate based on these drawings.

5.5 Design Quantities

The design quantities have been preliminarily calculated from the previous design drawings as follows:

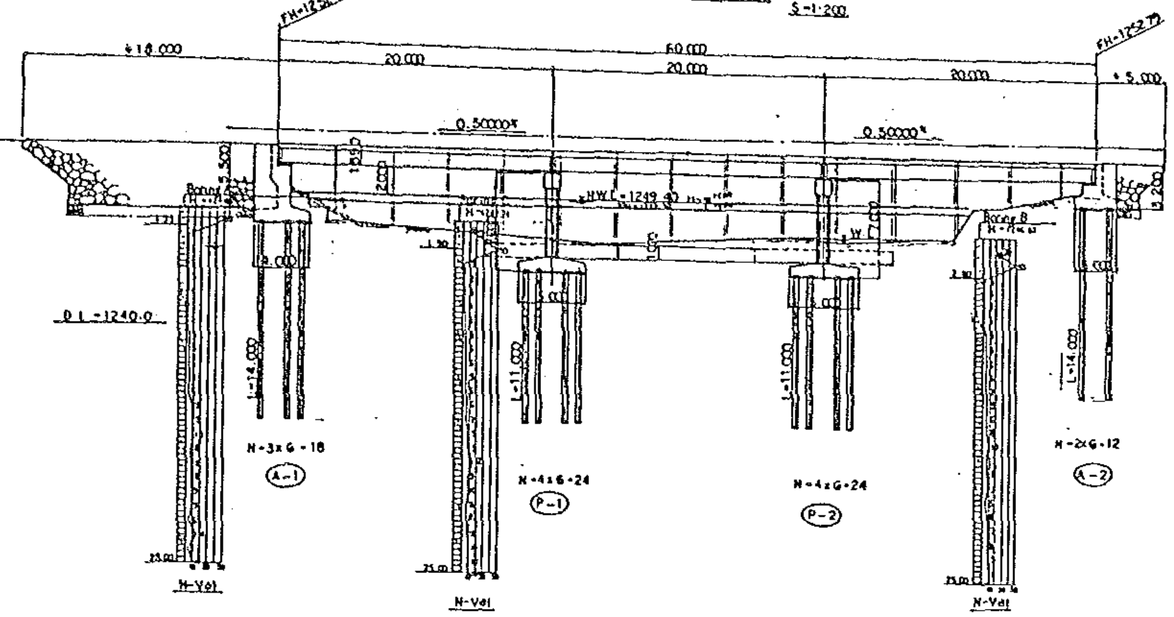
• Bridge Area	2,145 m^2
• Abutment	12 No
• Piers	14 No
• Steel Structure	347 ton
• Concrete	2,627 m^3
• Reinforcing Steel Bar	297 ton
• Reinforced conc. Pile	5,284 m (534 each)



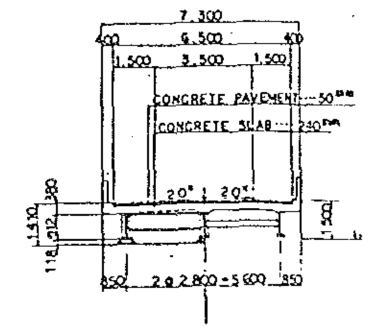
Bridge No.		Bridge Name	River
(1)	No.2	Bishnumati (Dallu)	Bishnumati Riv.
(2)	No.4	Dhobi Khola (Kalo Pul)	Dhobi Khola Riv.
(3)	No.6	Dhobi Khola (Handi Gaon)	"
(4)	No.7	Dhobi Khola (Babar Mahal)	"
(5)	No.8	Mahadev Khola	Mahadew Kh. Riv.
(6)	No.9	Manmatta	Branch of Manohava Riv.

Fig. 5.6 LOCATIONS OF BRIDGES TO BE RECONSTRUCTED

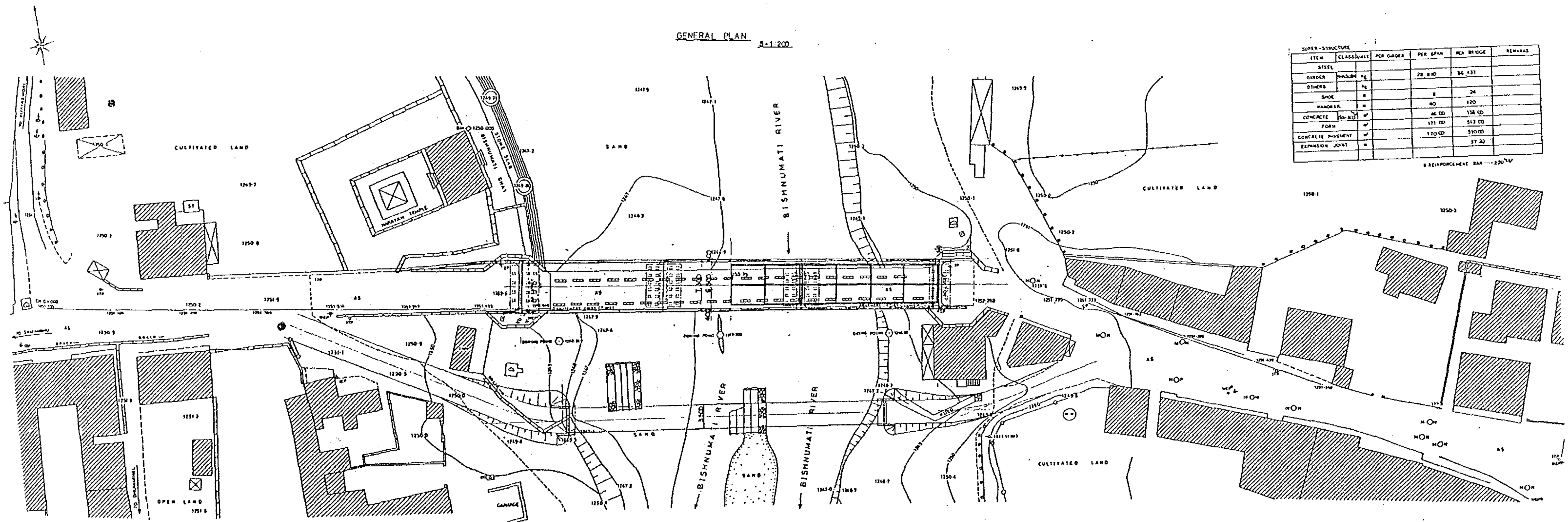
GENERAL ELEVATION S=1:200



CROSS SECTION S=1:100



GENERAL PLAN S=1:200

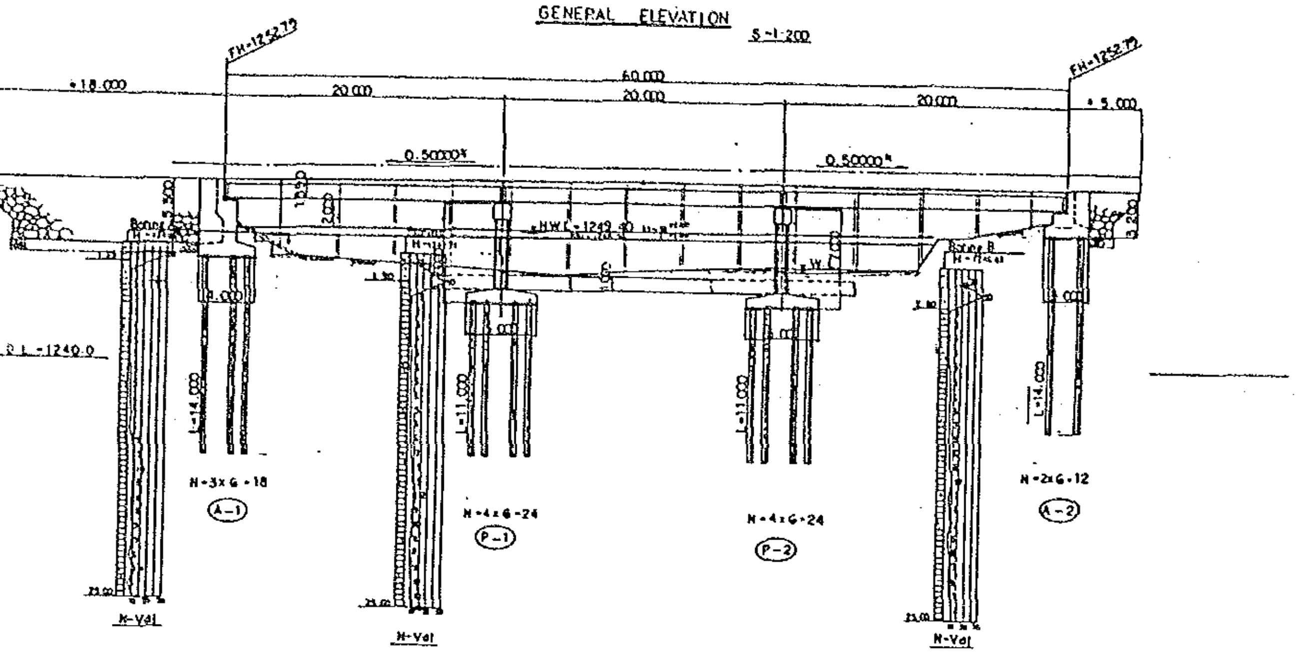


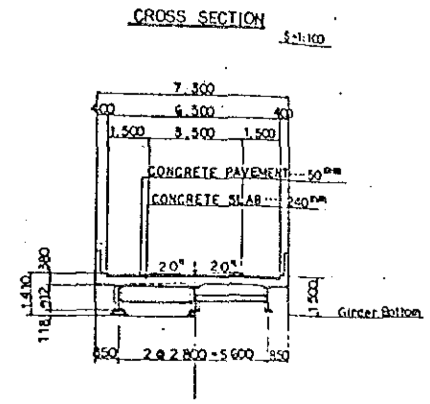
SUPER-STRUCTURE

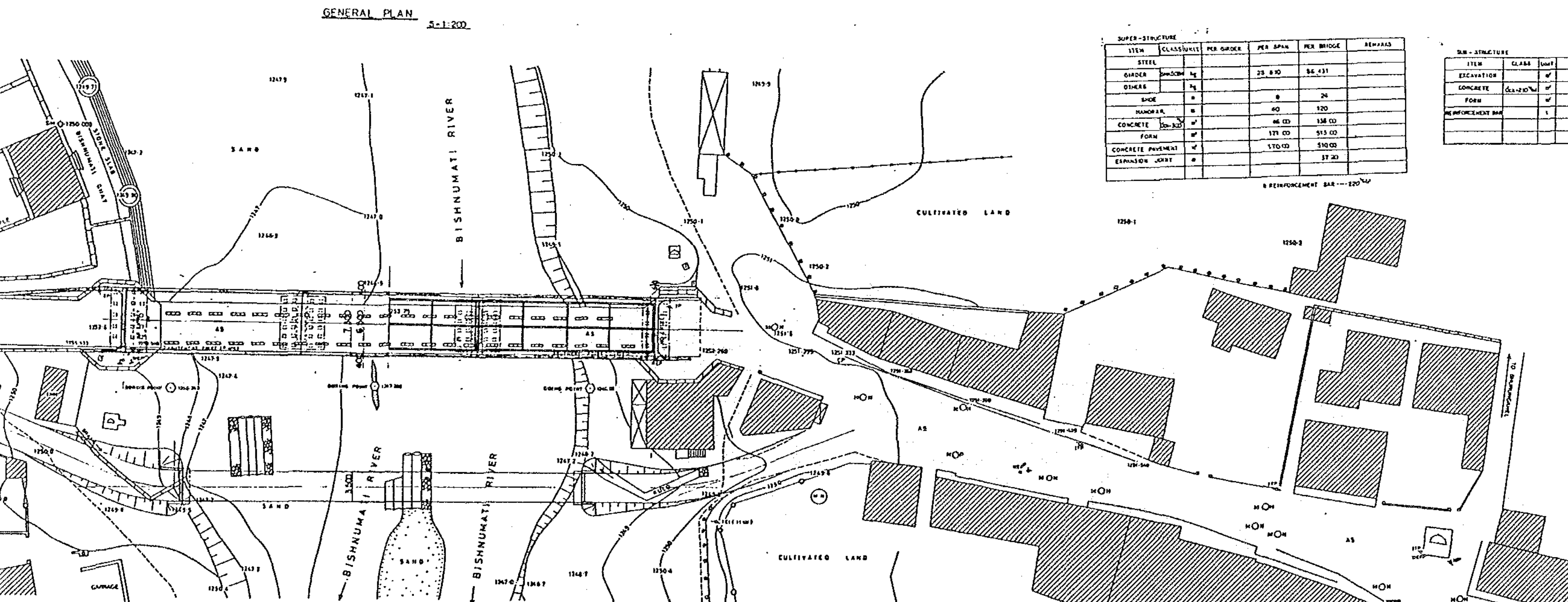
ITEM	CLASS	UNIT	PER GIRDER	PER SPAN	PER BRIDGE	REMARKS
STEEL						
GIRDER	[illegible]	kg		28 810	86 431	
OTHERS		kg				
SHOE		[illegible]		8	24	
HANDRAIL		[illegible]		40	120	
CONCRETE	[illegible]-300	m³		46 00	138 00	
FORM		m²		171 00	513 00	
CONCRETE PAVEMENT		m²		170 00	510 00	
EXPANSION JOINT		[illegible]			37 20	

REINFORCEMENT BAR ··· 220 kg/m³

Fig. 5.7







SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER GIRDER	PER SPAN	PER BRIDGE	REMARKS
STEEL						
GIRDER	SM50M	kg		25,810	56,431	
OTHERS		kg				
SHOE				8	24	
HANDRAIL		m		40	120	
CONCRETE	σck=300	m³		46.00	138.00	
FORM		m²		171.00	515.00	
CONCRETE PAVEMENT		m²		170.00	510.00	
EXPANSION JOINT		m			37.20	

REINFORCEMENT BAR ---- 220 kg/m³

SUB-STRUCTURE

ITEM	CLASS	UNIT	A-1	P-1	P-2	A-2	QUANTITY	REMARKS
EXCAVATION		m³	131	203	205	106	645	
CONCRETE	σck=210 kg/cm²	m³	77	74	74	41	265	
FORM		m²	152	100	100	77	429	
REINFORCEMENT BAR		t	4.6	4.4	4.4	2.7	16.1	SD-30

DESIGN CONDITION

TOTAL BRIDGE LENGTH	60.000 m
GIRDER LENGTH	
SPAN	
WIDTH	6.500 m
LIVE LOAD	TL-20
IMPACT COEFFICIENT	
SEISMIC COEFFICIENT	kh=0.10
ANGLE OF SKEW	θ=90°
RADIUS OF CURVATURE	R=—
LONGITUDINAL SLOPE	LEVEL

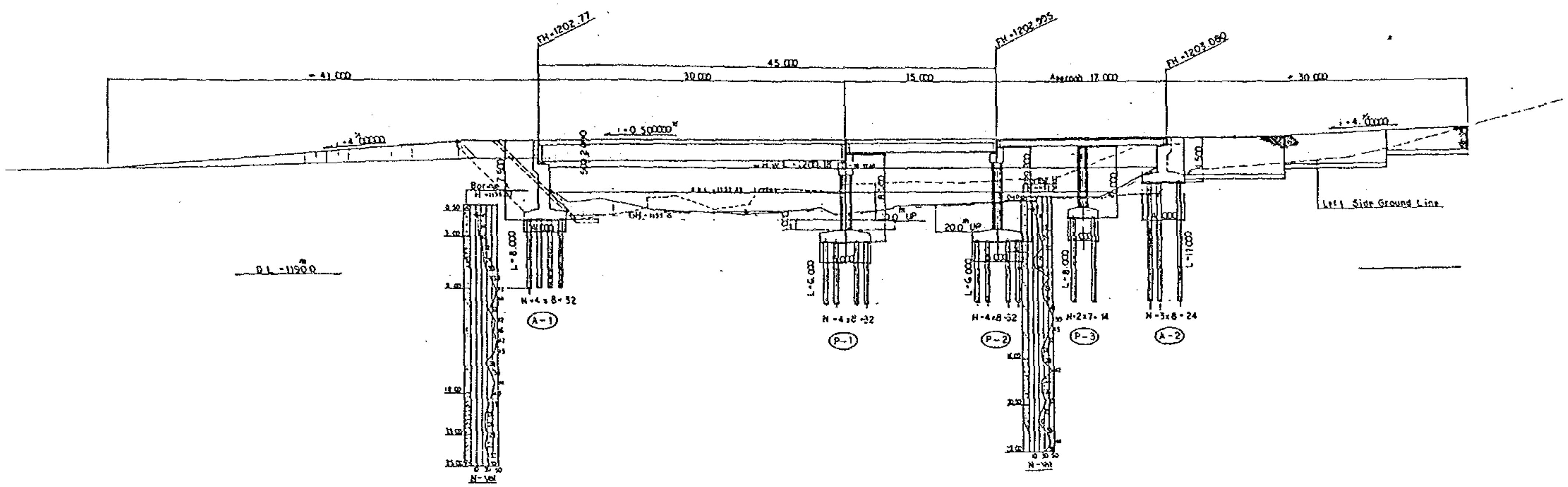
5 0 5 10 15 m

SCALE 1:200

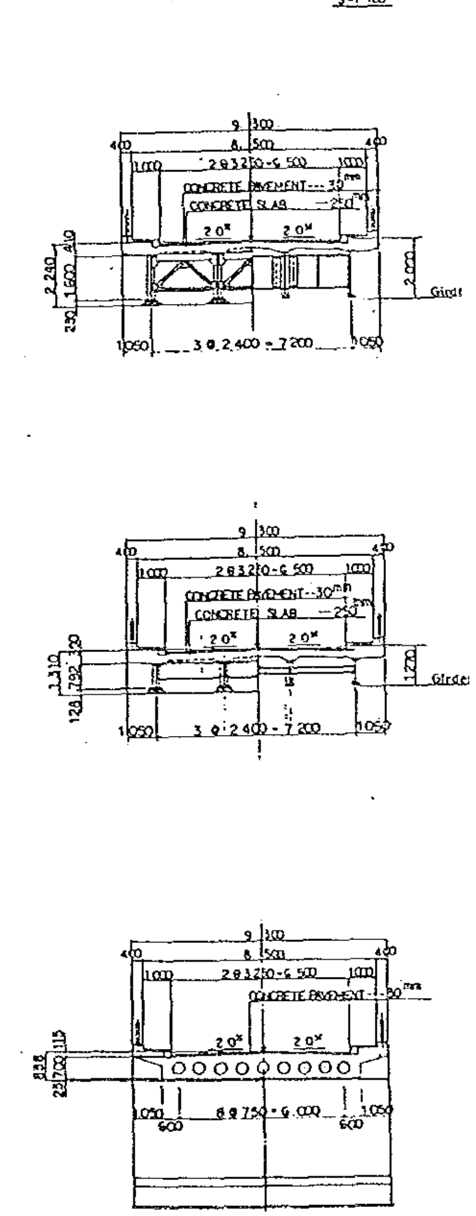
HIS MAJESTY'S GOVERNMENT OF NEPAL	
BASIC DESIGN STUDY ON RE-CONSTRUCTION OF KATHMANDU VALLEY BRIDGES	
BISHNUMATI BRIDGE No.2 DALLU	SHEET NO 1
SCALE HOR VER	DATE
JAPAN INTERNATIONAL COOPERATION AGENCY	

Fig. 5.7 GENERAL VIEW OF NO.2 BISHNUMATI BR.

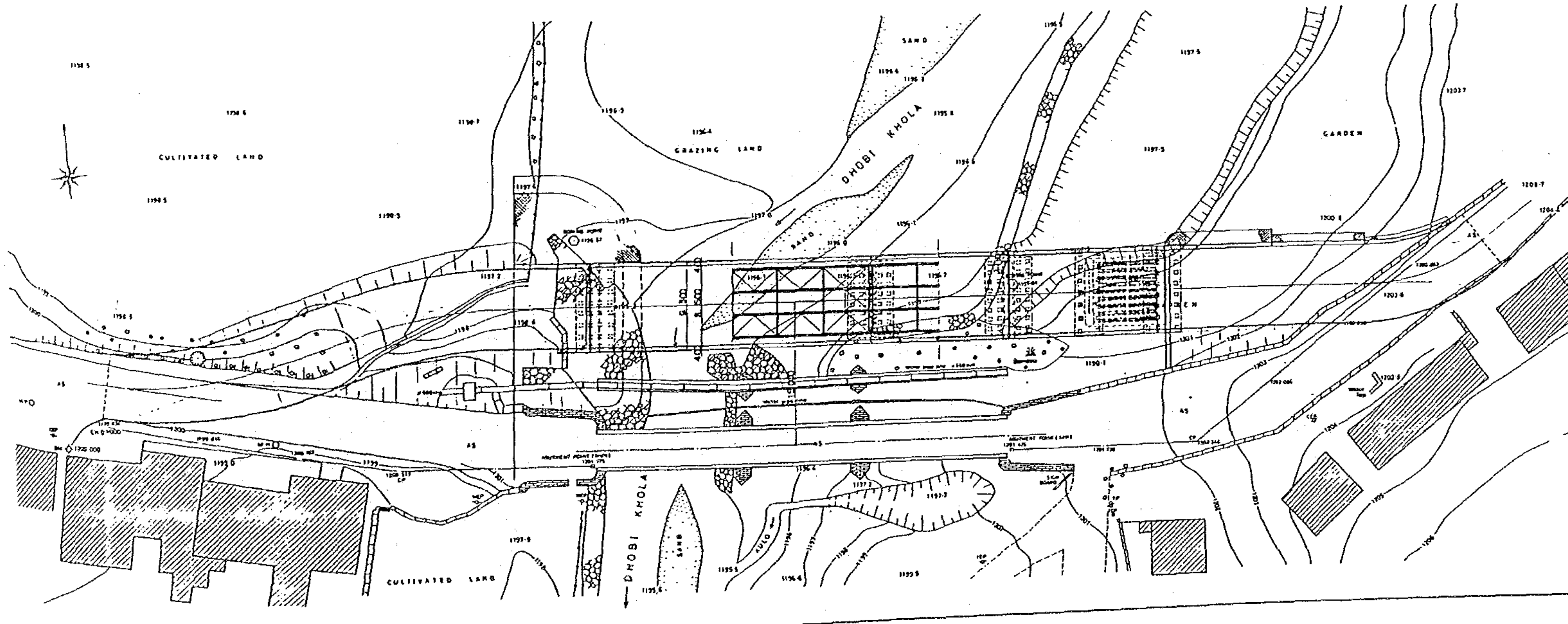
GENERAL ELEVATION S=1:200



CROSS SECTION S=1:100



GENERAL PLAN S=1:200



SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER SPAN (L=30m)	PER SPAN (L=15m)	PER BRIDGE	REMARKS
STEEL						
GIRDER	SM50OM	t	52.131	18.646	70.777	
OTHERS		t				
SHOE			8	8	16	
HANDRAIL		m	60	30	90	
CONCRETE	σck=300	m³	71.00	36.00	107.00	
FORM		m²	244.00	128.00	372.00	
CONCRETE PAVEMENT		m²	255.00	128.00	383.00	
EXPANSION JOINT		m			27.50	

REINFORCEMENT BAR ---- 220 kg

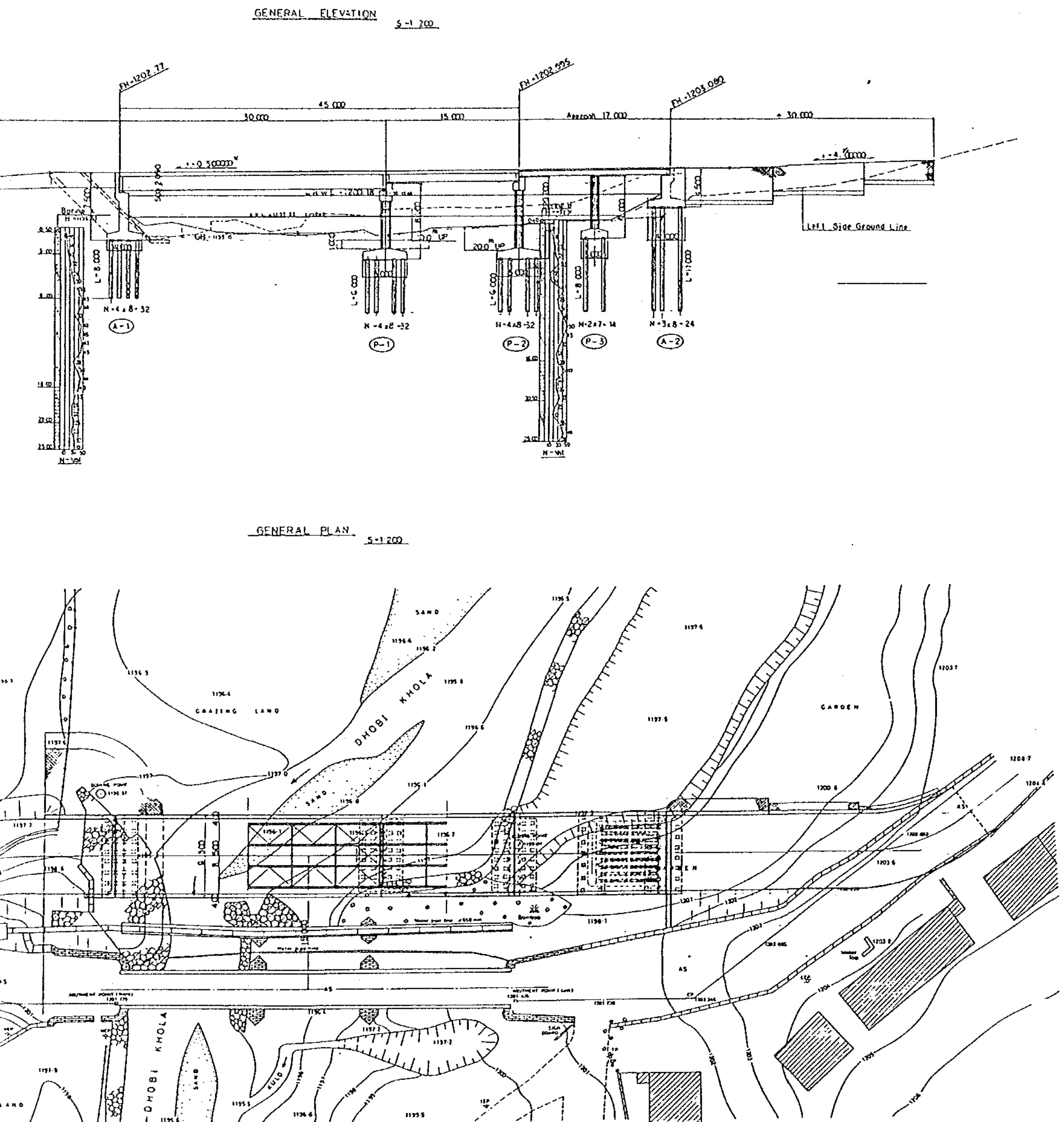
SUPER-STRUCTURE

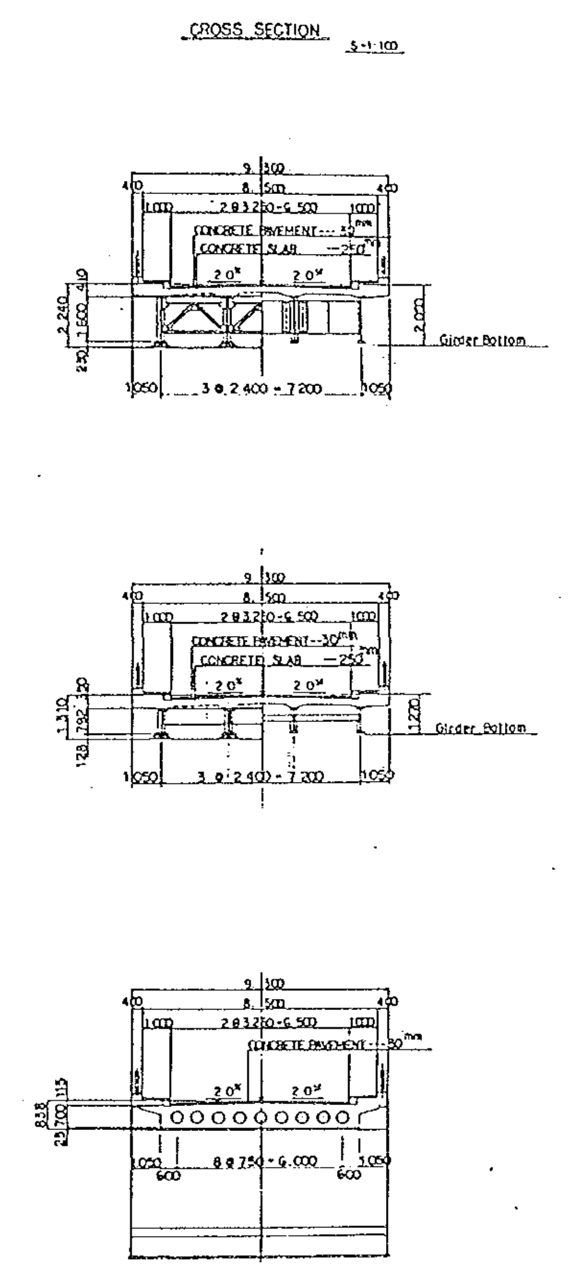
ITEM	CLASS
CONCRETE	
CONCRETE	σck=24[illegible]
FORM	
REINFORCEMENT BAR	SD-3[illegible]
SHOE	
EXPANSION JOINT	
HANDRAIL	
CONCRETE PAVEMENT	

SUB-STRUCTURE

ITEM	CLASS	UNIT	A-1	P-1	P-2	P-3	A-2	QUANTITY	[illegible]
EXCAVATION		m³	251	244	324	126	85	1 028	
CONCRETE	σck=210 kg/cm²	m³	25	82	80	71	58	397	
FORM		m²	210	139	133	92	118	712	
REINFORCEMENT BAR		t	3.3	4.9	5.5	5.5	4.1	21.6	

Fig. 5.8 GE[illegible]





SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER SPAN (L=30m)	PER SPAN (L=15m)	PER BRIDGE	REMARKS
STEEL						
GIRDER	SM50YA	kg	52 131	18 646	70 777	
OTHERS		kg				
SHOE		n	8	8	16	
HANDRAIL		m	60	30	90	
CONCRETE	σck=300 kg/cm²	m³	71.00	36.00	107.00	
FORM		m²	244.00	128.00	372.00	
CONCRETE PAVEMENT		m²	255.00	128.00	383.00	
EXPANSION JOINT		m			27.50	

* REINFORCEMENT BAR ---- 220 kg/m³

SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER BRIDGE	REMARKS
CONCRETE				
CONCRETE	σck=240 kg/cm²	m³	100	
FORM		m²	377	
REINFORCEMENT BAR	SD-30	kg	18.00	
SHOE		n	21.60	
EXPANSION JOINT		m	9.30	
HANDRAIL		m	34.00	
CONCRETE PAVEMENT		m²	145.00	

SUB-STRUCTURE

ITEM	CLASS	UNIT	A-1	P-1	P-2	P-3	A-2	QUANTITY	REMARKS
EXCAVATION		m³	251	243	324	126	84	1 028	
CONCRETE	σck=210 kg/cm²	m³	56	82	80	71	68	327	
FORM		m²	210	139	133	99	118	712	
REINFORCEMENT BAR		t	5.7	4.9	4.8	4.3	4.1	23.8	SD-30

DESIGN CONDITION

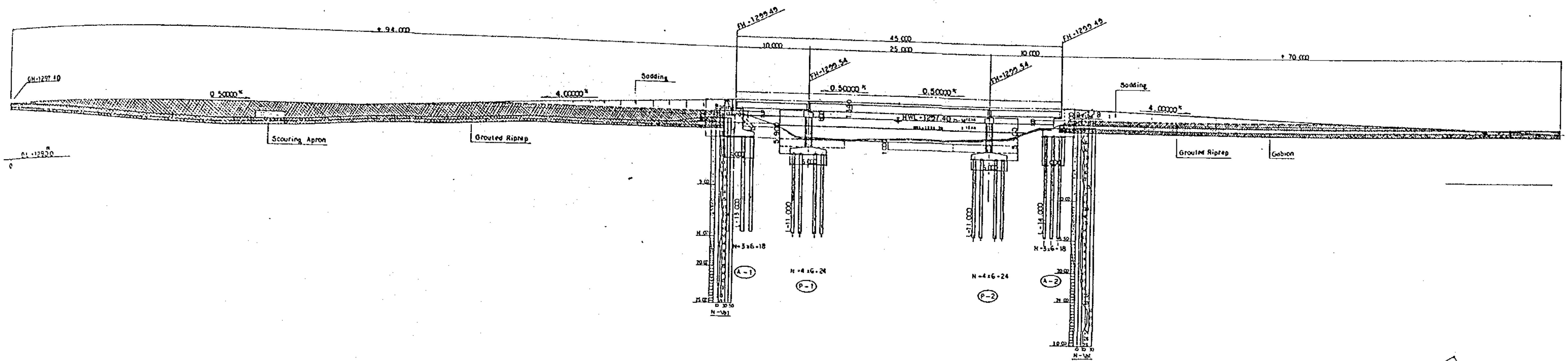
TOTAL BRIDGE LENGTH	62.000 m
GIRDER LENGTH	
SPAN	
WIDTH	1.000 m + 6.500 m + 1.000 m
LIVE LOAD	TL-20
IMPACT COEFFICIENT	
SEISMIC COEFFICIENT	kh = 0.10
ANGLE OF SKEW	θ = 90°
RADIUS OF CURVATURE	R = ---
LONGITUDINAL SLOPE	i = -2.00000 %

SCALE 1:200

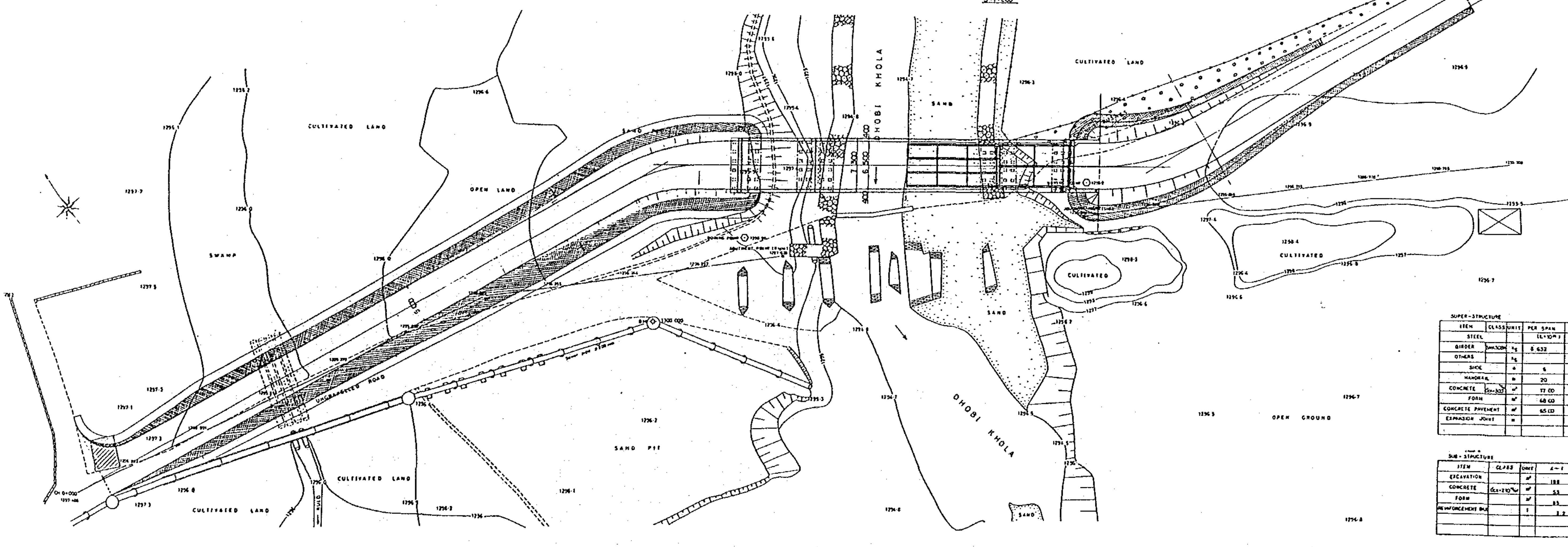
HIS MAJESTY'S GOVERNMENT OF NEPAL	
BASIC DESIGN STUDY ON RE-CONSTRUCTION OF KATHMANDU VALLEY BRIDGES	
DHOBI KHOLA BRIDGE No.4 KALO PUL	SHEET NO 2
SCALE HOR VER	DATE
JAPAN INTERNATIONAL COOPERATION AGENCY	

Fig. 5.8 GENERAL VIEW OF NO.4 DHOBI KHOLA BR.

GENERAL ELEVATION S=1:200



GENERAL PLAN S=1:200



SUPER-STRUCTURE

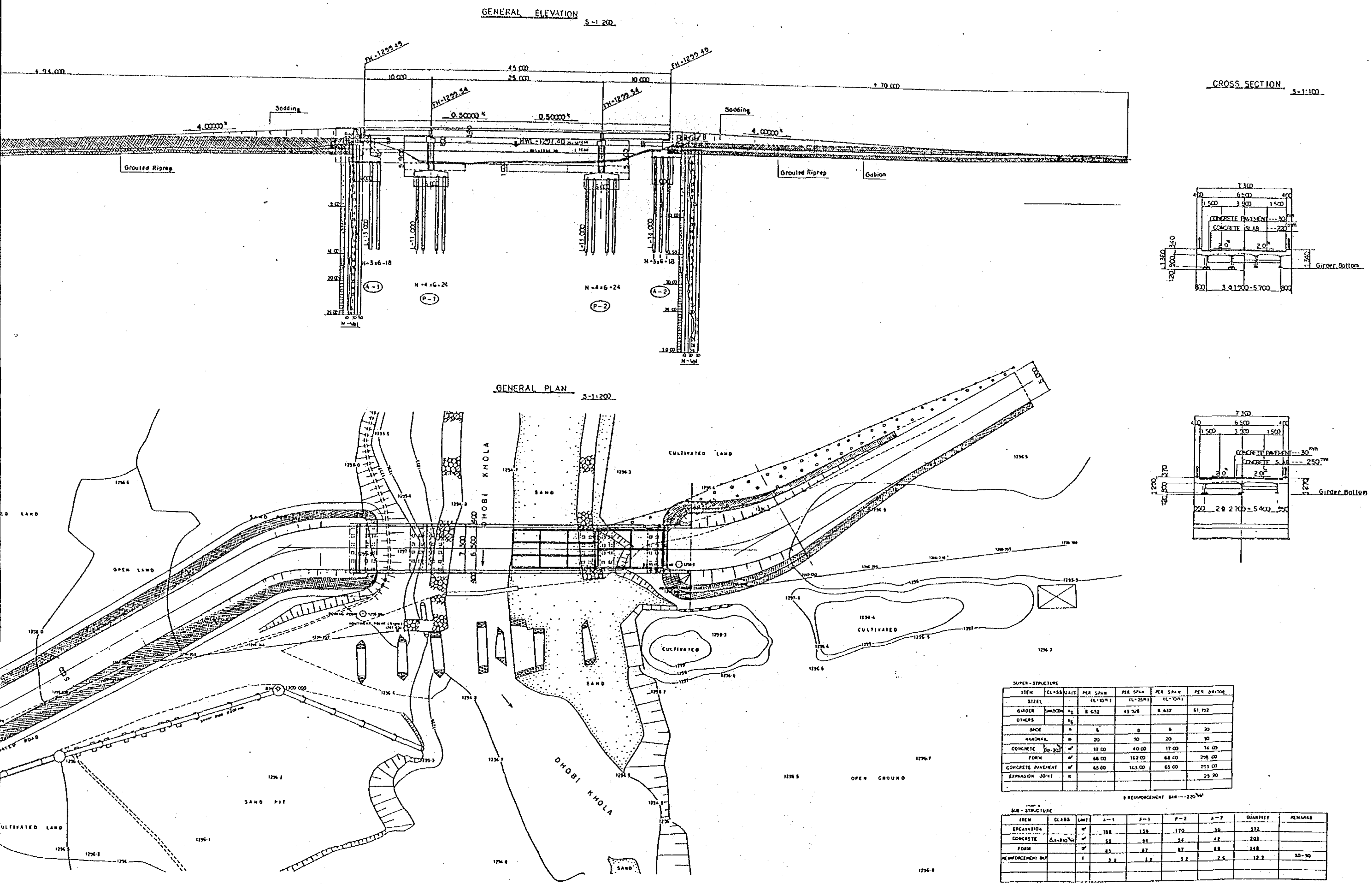
ITEM	CLASS	UNIT	PER SPAN	PER SPAN	PER SPAN
STEEL			(L=10m)	(L=25m)	(L=10m)
GIRDER	SM50BM	kg	8 632	43 928	8 632
OTHERS		kg			
SHOE			6	8	6
HANDRAIL		m	20	50	20
CONCRETE	σck=300	m³	17.00	40.00	17.00
FORM		m²	68.00	163.00	68.00
CONCRETE PAVEMENT		m²	65.00	163.00	65.00
EXPANSION JOINT		m			

REINFORCEMENT BAR

SUB-STRUCTURE

ITEM	CLASS	UNIT	A-1	P-1	P-2
EXCAVATION		m³	188	138	170
CONCRETE	σck=210	m³	53	51	51
FORM		m²	85	87	87
REINFORCEMENT BAR		t	3.2	3.2	3.2

Fig. 5.9 GE



SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER SPAN (L=10m)	PER SPAN (L=25m)	PER SPAN (L=10m)	PER BRIDGE
STEEL						
GIRDER	SM53B	kg	8 632	43 928	8 632	61,192
OTHERS		kg				
SHOE			6	8	6	20
HANDRAIL		m	20	50	20	90
CONCRETE	σck=300	m³	17.00	40.00	17.00	74.00
FORM		m²	68.00	162.00	68.00	298.00
CONCRETE PAVEMENT		m²	65.00	163.00	65.00	293.00
EXPANSION JOINT		m				29.20

REINFORCEMENT BAR --- 220 kg

SUB-STRUCTURE

ITEM	CLASS	UNIT	A-1	P-1	P-2	A-2	QUANTITY	REMARKS
EXCAVATION		m³	188	158	170	56	572	
CONCRETE	σck=210 kg/cm²	m³	53	54	54	42	203	
FORM		m²	85	87	87	89	348	
REINFORCEMENT BAR		t	3.2	3.2	3.2	2.6	12.2	SD-30

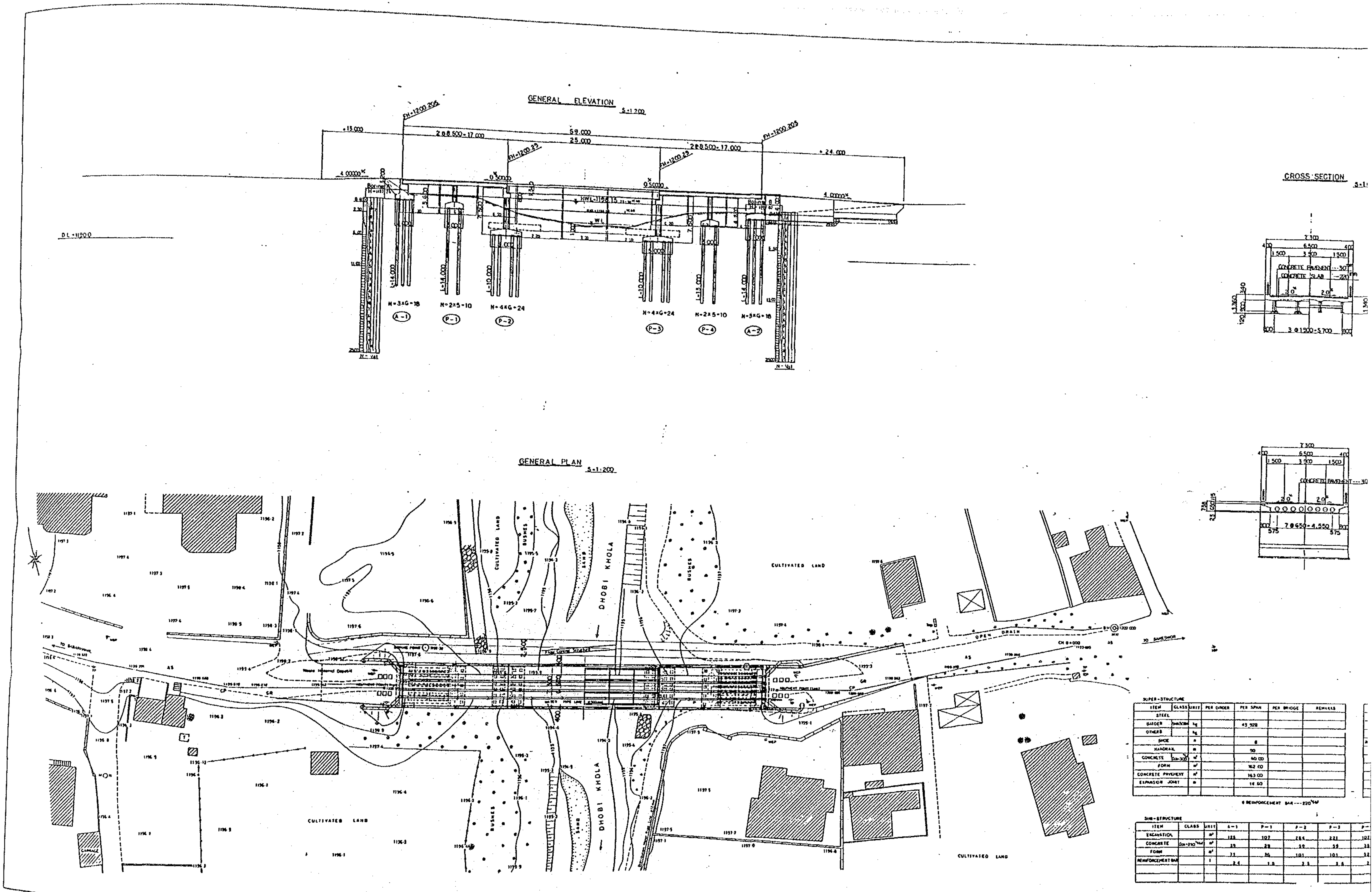
DESIGN CONDITION

TOTAL BRIDGE LENGTH	45.000 m
GIRDER LENGTH	
SPAN	
WIDTH	6.500 m
LIVE LOAD	TL-20
IMPACT COEFFICIENT	
SEISMIC COEFFICIENT	kh = 0.10
ANGLE OF SKEW	θ = 90°
RADIUS OF CURVATURE	R = ----
LONGITUDINAL SLOPE	LEVEL

5 0 5 10 15 m
SCALE 1:200

HIS MAJESTY'S GOVERNMENT OF NEPAL	
BASIC DESIGN STUDY ON RE-CONSTRUCTION OF KATHMANDU VALLEY BRIDGES	
DHOBIKHOLA BRIDGE No.6 HANDIGAON	SHEET NO 5
SCALE HOR VER	DATE
JAPAN INTERNATIONAL COOPERATION AGENCY	

Fig. 5.9 GENERAL VIEW OF NO.6 DHOBI KHOLA BR.



SUPER-STRUCTURE

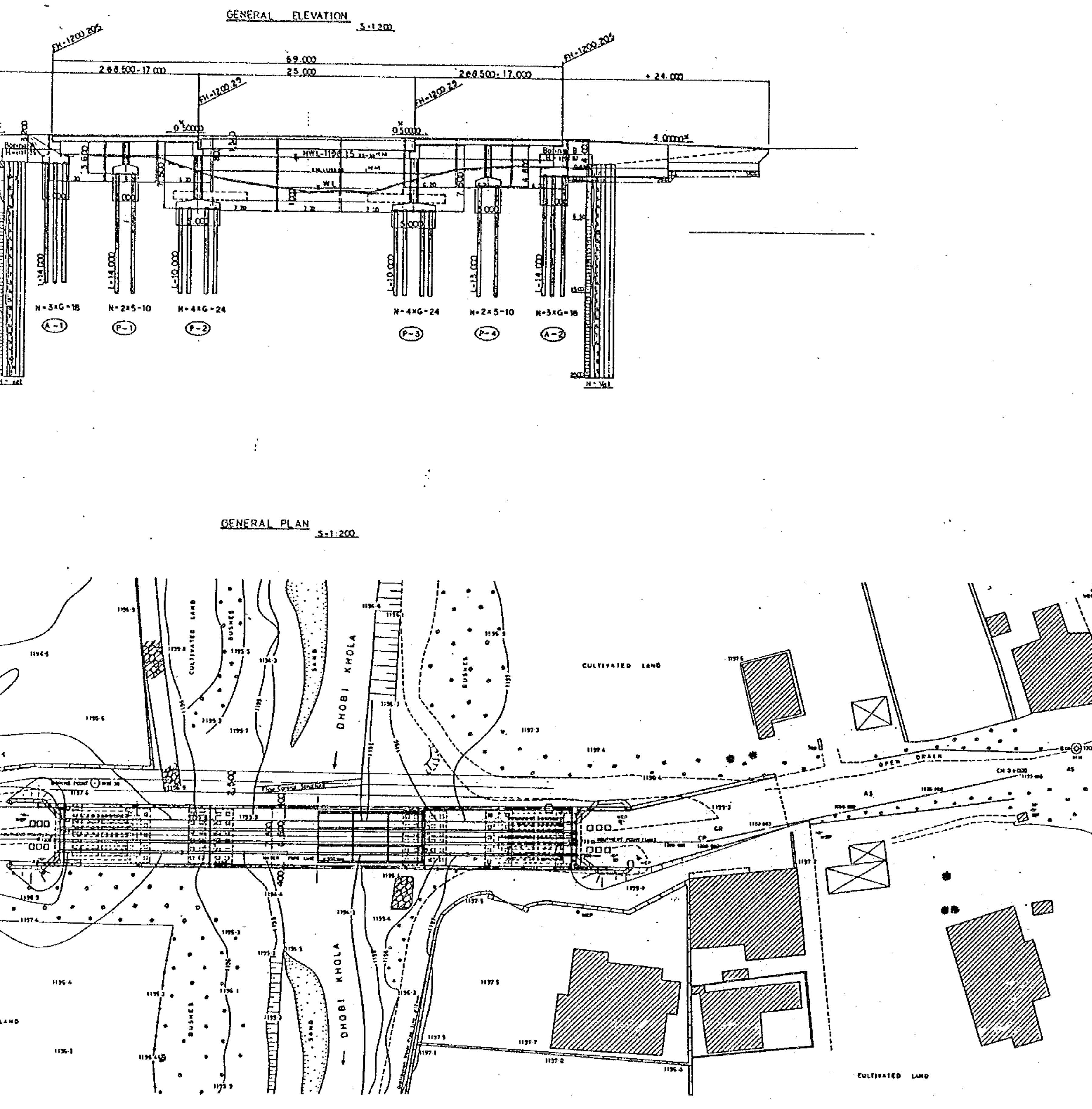
ITEM	CLASS	UNIT	PER GIRDER	PER SPAN	PER BRIDGE	REMARKS
STEEL						
GIRDER	[illegible]	kg		43.528		
OTHERS		kg				
SHOE		#		8		
HANDRAIL		m		50		
CONCRETE	σck=300	m³		40.00		
FORM		m²		162.00		
CONCRETE PAVEMENT		m²		163.00		
EXPANSION JOINT		m		14.60		

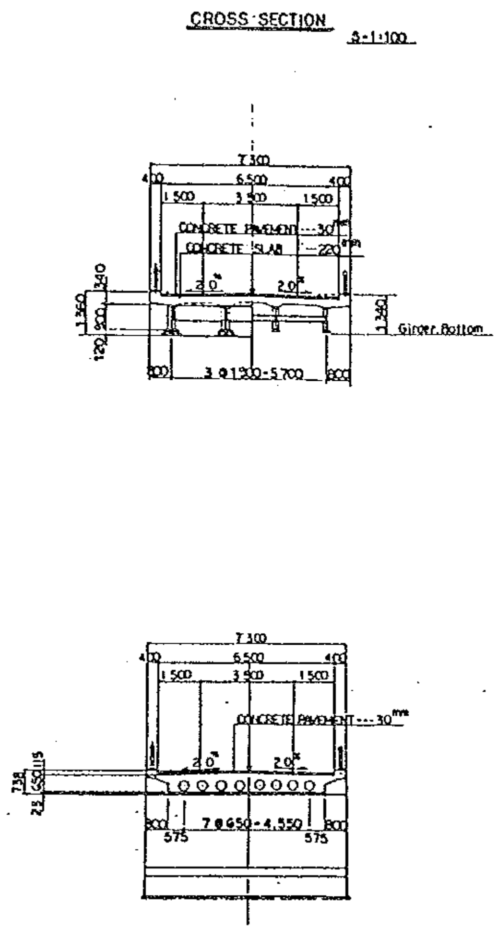
※ REINFORCEMENT BAR --- 220 kgf

SUB-STRUCTURE

ITEM	CLASS	UNIT	A-1	P-1	P-2	P-3	P-4
EXCAVATION		m³	125	107	284	221	107
CONCRETE	σck=210 kgf	m³	35	28	59	59	33
FORM		m²	71	86	101	101	32
REINFORCEMENT BAR		t	2.4	1.8	3.3	3.5	2

Fig. 5.1





SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER GIRDER	PER SPAN	PER BRIDGE	REMARKS
STEEL						
GIRDER	SM50(B)	kg		45,528		
OTHERS		kg				
SHOE		●		8		
HANDRAIL		m		50		
CONCRETE	σck=300	m³		40.00		
FORM		m²		162.00		
CONCRETE PAVEMENT		m²		163.00		
EXPANSION JOINT		m		14.60		

● REINFORCEMENT BAR---220 kg/m³

SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER BRIDGE	REMARKS
CONCRETE				
CONCRETE	σck=240	m³	193	
FORM		m²	482	
REINFORCEMENT BAR	SD-30	kg	34.80	
SHOE		●	34.20	
EXPANSION JOINT		m	14.00	
HANDRAIL		m	65.00	
CONCRETE PAVEMENT		m²	222.00	

SUB-STRUCTURE

ITEM	CLASS	UNIT	A-1	P-1	P-2	P-3	P-4	A-2	QUANTITY	REMARKS
ESCAVATION		m³	125	107	284	221	107	56	900	
CONCRETE	σck=210 kg/cm²	m³	35	29	59	55	35	41	262	
FORM		m²	21	56	101	101	52	67	428	
REINFORCEMENT BAR		t	2.4	1.8	3.5	3.6	2.2	2.6	16.0	SD-30

DESIGN CONDITION

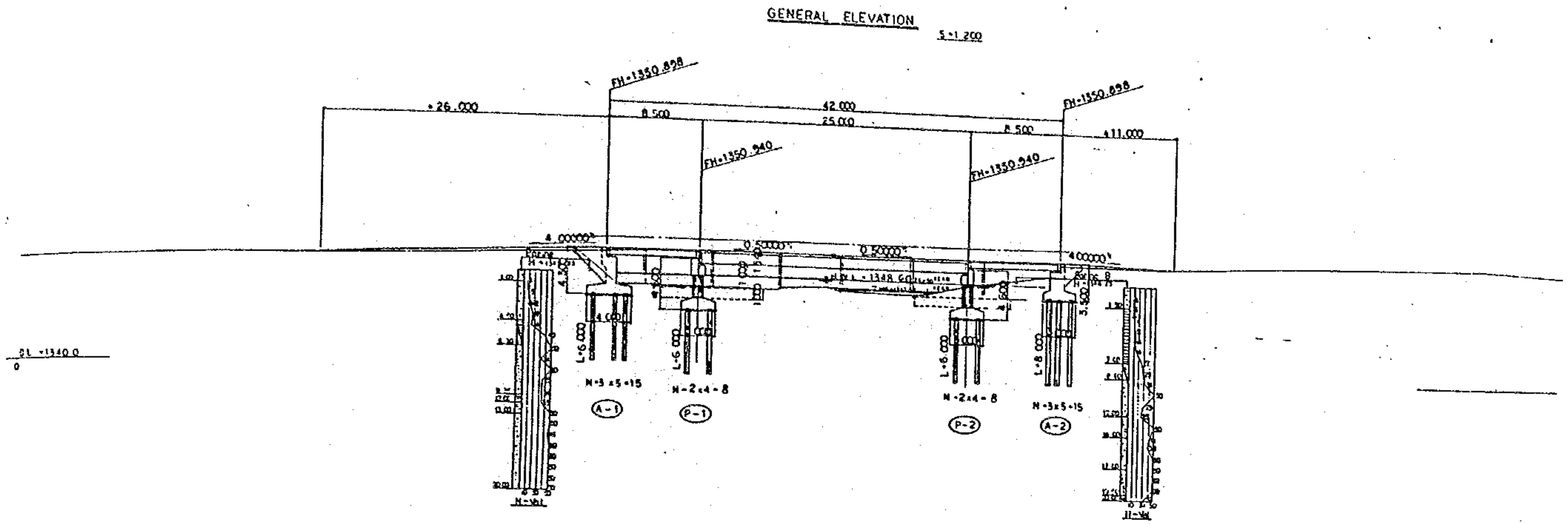
TOTAL BRIDGE LENGTH	59.000 m
GIRDER LENGTH	
SPAN	
WIDTH	6.500 m
LIVE LOAD	TL-20
IMPACT COEFFICIENT	
SEISMIC COEFFICIENT	kh=0.10
ANGLE OF SKEW	θ=90°
RADIUS OF CURVATURE	R=—
LONGITUDINAL SLOPE	LEVEL

5 0 5 10 15 m
SCALE 1:200

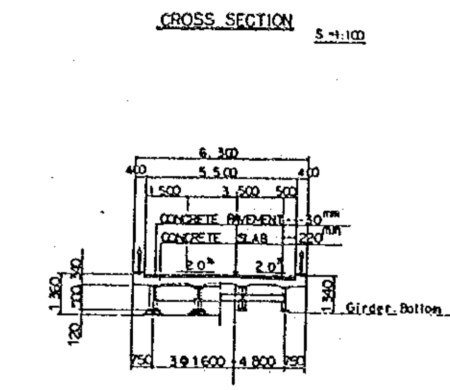
HIS MAJESTY'S GOVERNMENT OF NEPAL	
BASIC DESIGN STUDY ON RE-CONSTRUCTION OF KATHMANDU VALLEY BRIDGES	
DHOBIKHOLA BRIDGE No.7 BABAR MAHAL	SHEET NO 4
SCALE HOR. VER.	DATE
JAPAN INTERNATIONAL COOPERATION AGENCY	

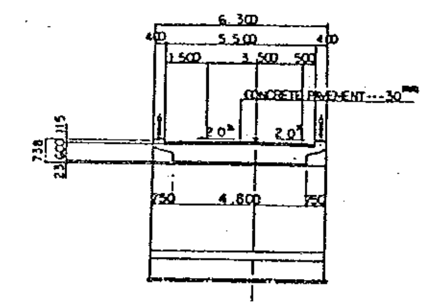
Fig. 5.10 GENERAL VIEW OF NO.7 DHOBI KHOLA BR.

GENERAL ELEVATION S=1:200

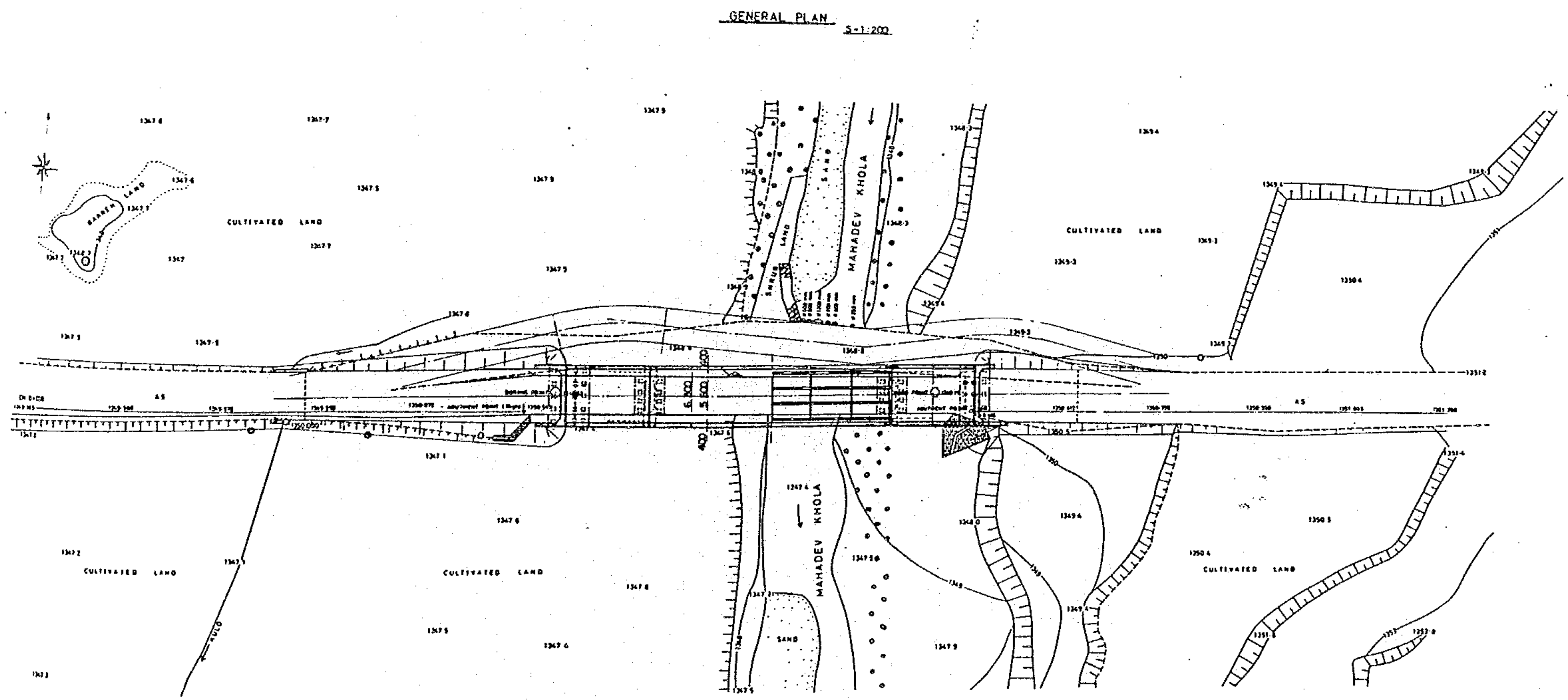


CROSS SECTION S=1:100





GENERAL PLAN S=1:200



SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER GIRDER	PER SPAN	PER BRIDGE	REMARKS
STEEL						
GIRDER	SM50	kg		42,495		
OTHERS		kg				
SHOE				8		
HANDRAIL				50		
CONCRETE	σck=300	m³		35.00		
FORM		m²		137.00		
CONCRETE PAVEMENT		m²		138.00		
EXPANSION JOINT		m		12.00		

REINFORCEMENT BAR ---220 kg/m³

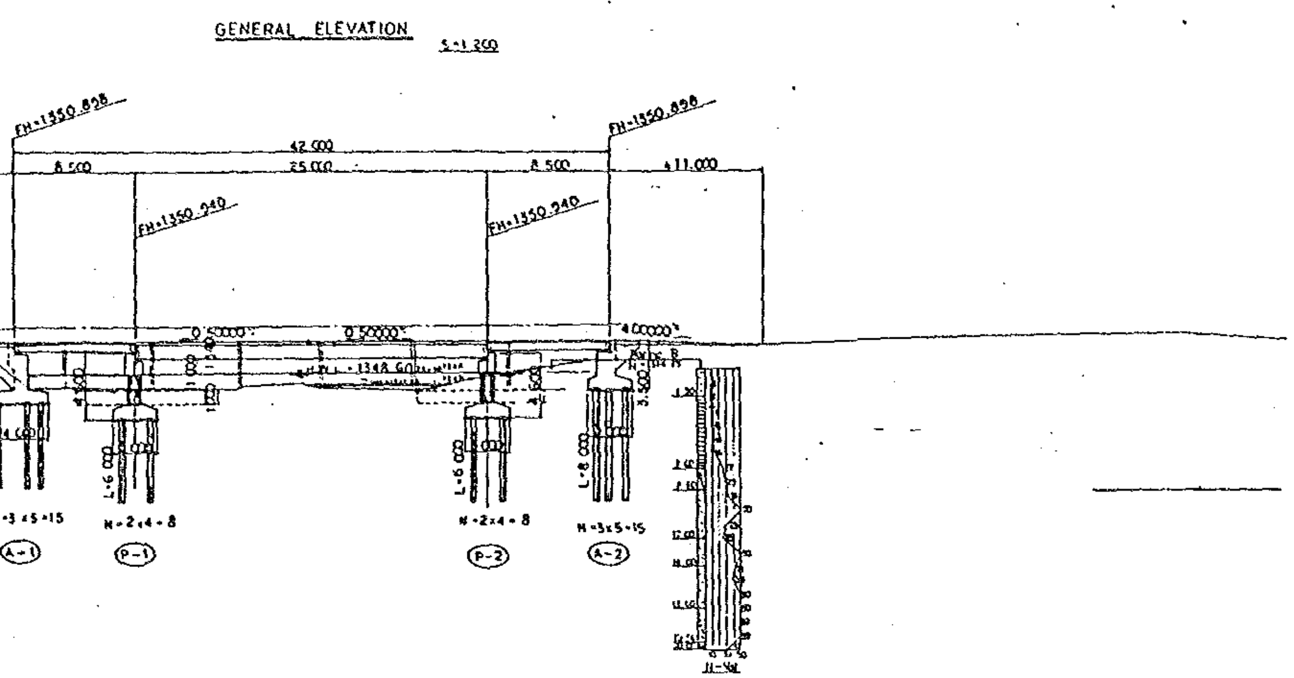
SUB-STRUCTURE

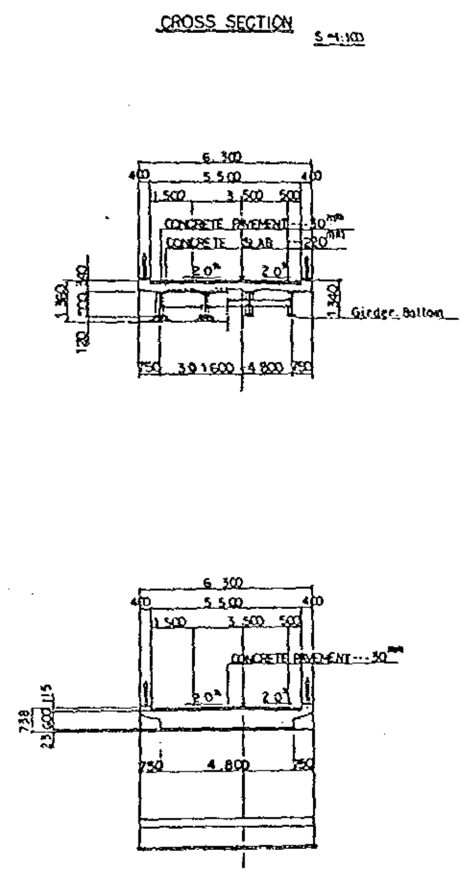
ITEM	CLASS	UNIT	A-1	P-1	P-2	A-2	QUANTITY	REMARKS
EXCAVATION		m³	174	63	96	146	481	
CONCRETE	σck=210 kg/cm²	m³	56	28	28	35	147	
FORM		m²	88	56	56	64	252	
REINFORCEMENT BAR		t	2.8	1.7	1.7	2.0	8.2	SD-30

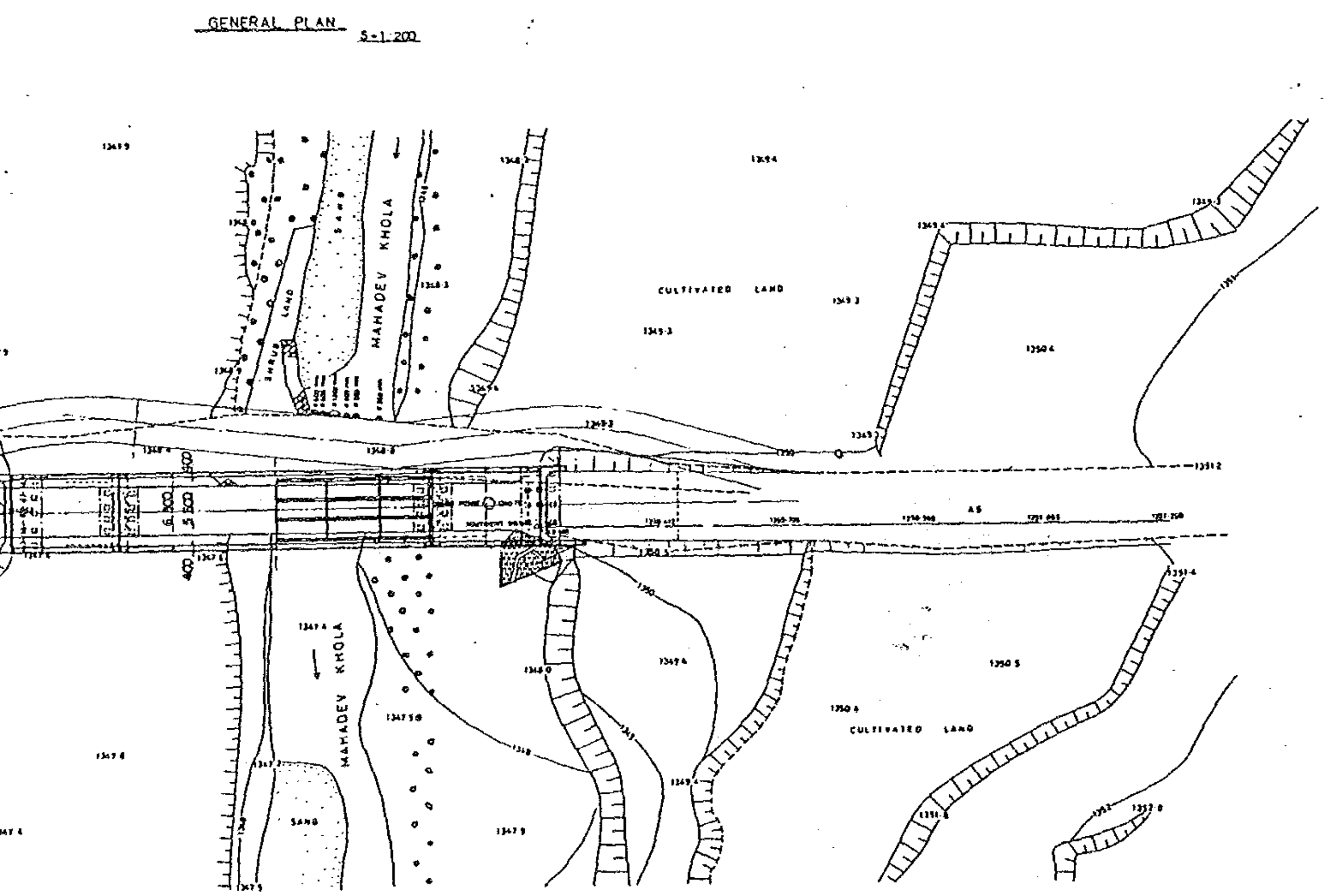
SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER
CONCRETE			
CONCRETE	σck=240 kg/cm²	m³	155
FORM		m²	204
REINFORCEMENT BAR	SD-30	t	11
SHOE			19
EXPANSION JOINT		m	12
HANDRAIL		m	24
CONCRETE PAVEMENT		m²	94

Fig. 5.11 G







SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER GIRDER	PER SPAN	PER BRIDGE	REMARKS
STEEL						
GIRDER	SM50M	kg		42,495		
OTHERS		kg				
SHOE				8		
HANDRAIL		m		50		
CONCRETE	Sn-300	m³		55.00		
FORM		m²		157.00		
CONCRETE PAVEMENT		m²		155.00		
EXPANSION JOINT		m		12.00		

※ REINFORCEMENT BAR ---220 kg/m³

SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER BRIDGE	REMARKS
CONCRETE				
CONCRETE	σck=240 kg/cm²	m³	135	
FORM		m²	306	
REINFORCEMENT BAR	SD-30	kg	11.80	
SHOE			19.20	
EXPANSION JOINT		m	12.60	
HANDRAIL		m	34.00	
CONCRETE PAVEMENT		m²	94.00	

SUB-STRUCTURE

ITEM	CLASS	UNIT	A-1	P-1	P-2	A-2	QUANTITY	REMARKS
EXCAVATION		m³	178	63	96	146	481	
CONCRETE	σck=210 kg/cm²	m³	46	28	28	35	137	
FORM		m²	86	56	66	54	262	SD-30
REINFORCEMENT BAR		t	2.8	1.7	1.7	3.0	8.2	

DESIGN CONDITION

TOTAL BRIDGE LENGTH	42.000 m
GIRDER LENGTH	
SPAN	
WIDTH	5.500 m
LIVE LOAD	TL-20
IMPACT COEFFICIENT	
SEISMIC COEFFICIENT	kh=0.10
ANGLE OF SKEW	θ=90°
RADIUS OF CURVATURE	R=—
LONGITUDINAL SLOPE	LEVEL

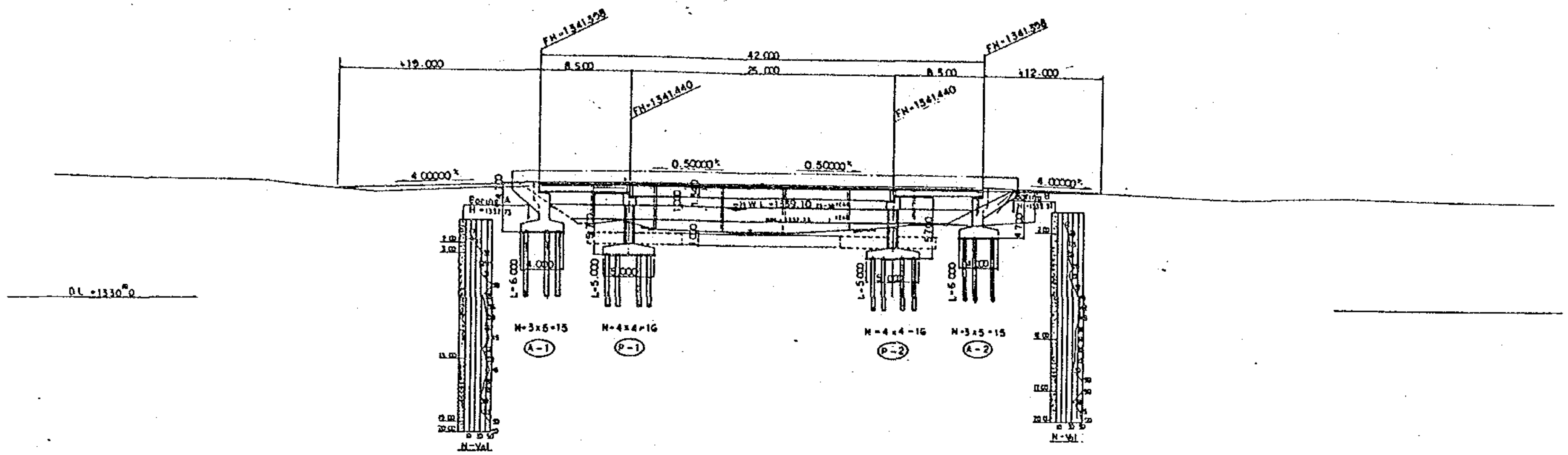
5 0 5 10 15 m

SCALE 1:200

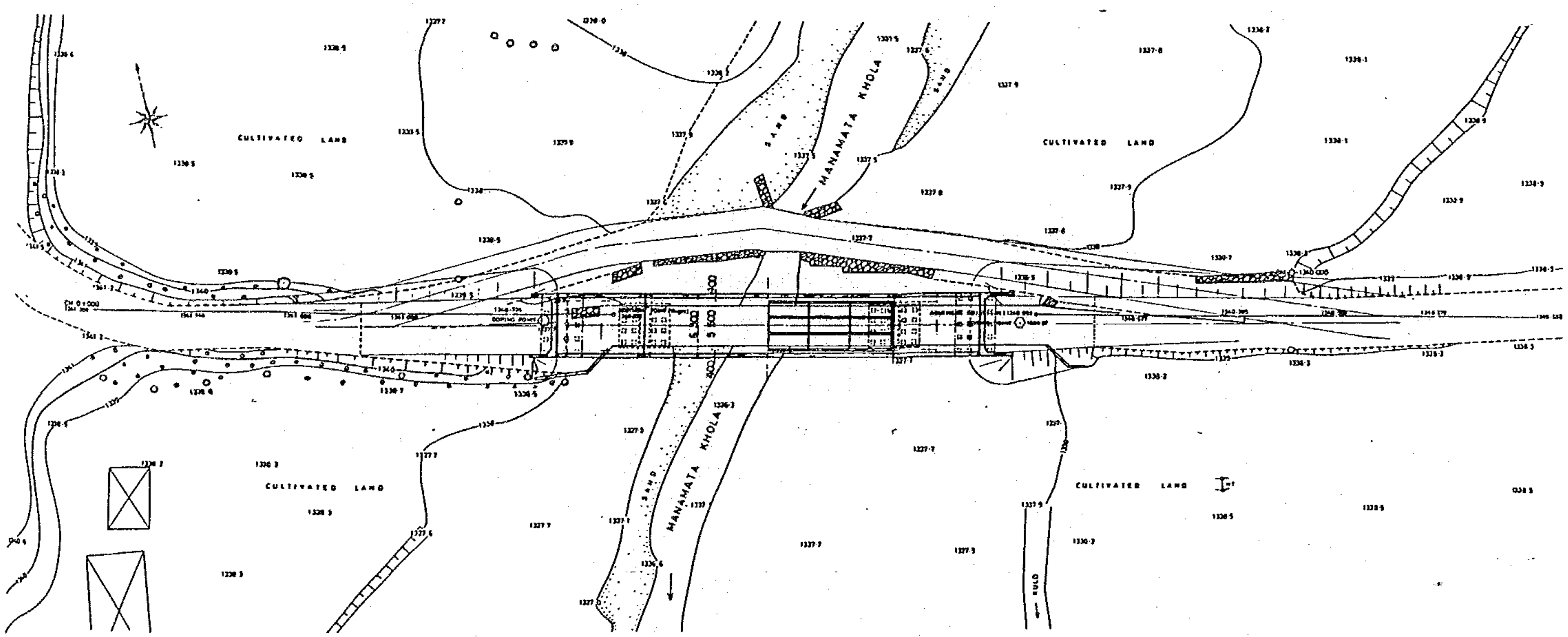
HIS MAJESTY'S GOVERNMENT OF NEPAL	
BASIC DESIGN STUDY ON RE-CONSTRUCTION OF KATHMANDU VALLEY BRIDGES	
MAHADEVKHOLA BRIDGE No. 8 PEWA DOL	SHEET NO 5
SCALE HOR VER	DATE
JAPAN INTERNATIONAL COOPERATION AGENCY	

Fig. 5.11 GENERAL VIEW OF NO.8 MAHADEV KHOLA BR.

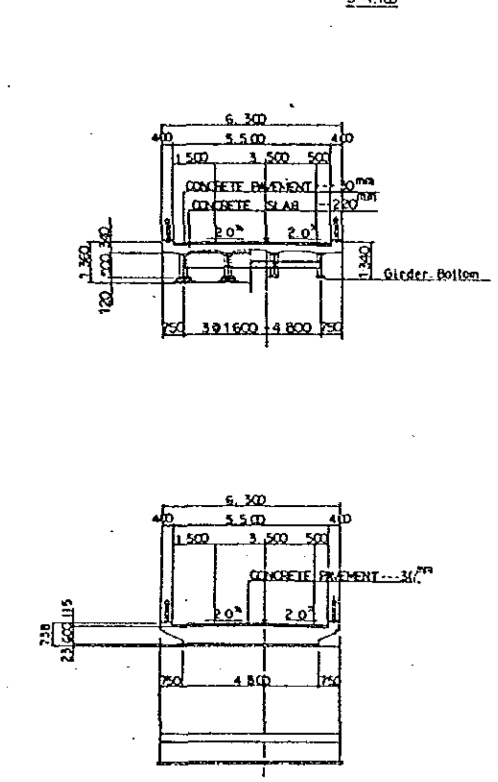
GENERAL ELEVATION S=1:200



GENERAL PLAN S=1:200



CROSS SECTION S=1:100



SUPER-STRUCTURE

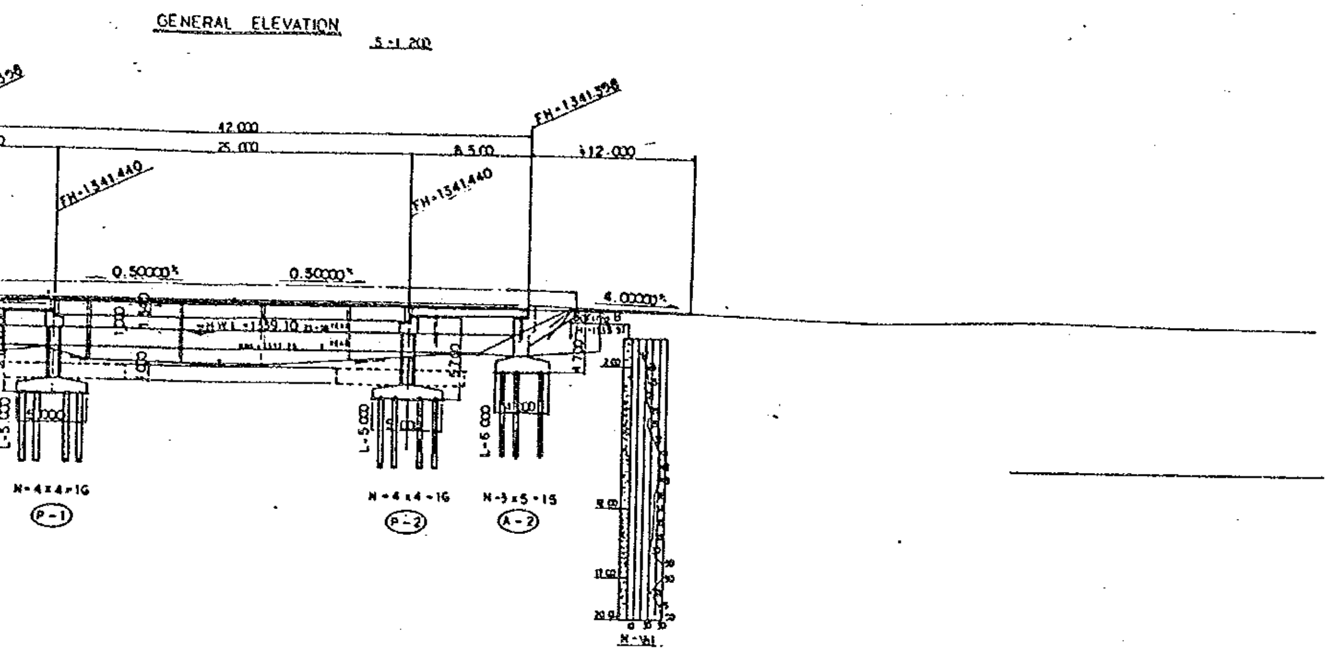
ITEM	CLASS	UNIT	PER GIRDER	PER SPAN	PER BRIDGE	REMARKS
STEEL						
GIRDER	[illegible]	kg		42.499		
OTHERS		kg				
SHOE		[illegible]		8		
HANDRAIL		m		50		
CONCRETE	σ=300	m³		35.00		
FORM		m²		137.00		
CONCRETE PAVEMENT		m²		138.00		
EXPANSION JOINT		m		12.00		

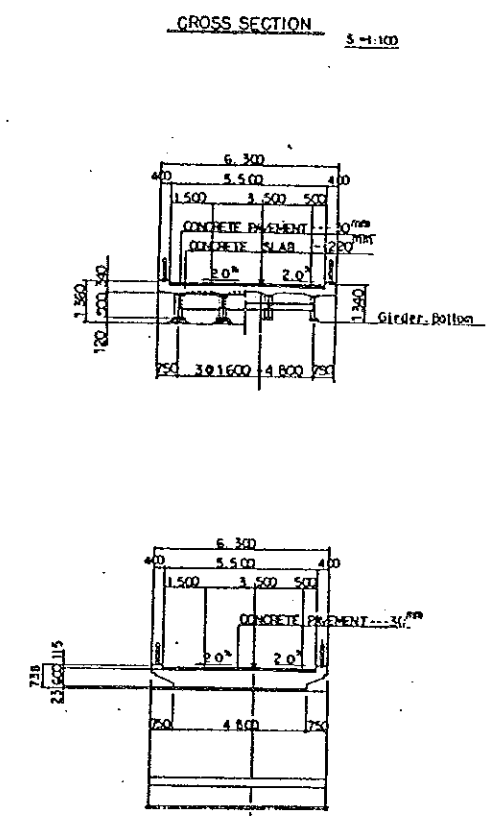
REINFORCEMENT BAR ---220kg

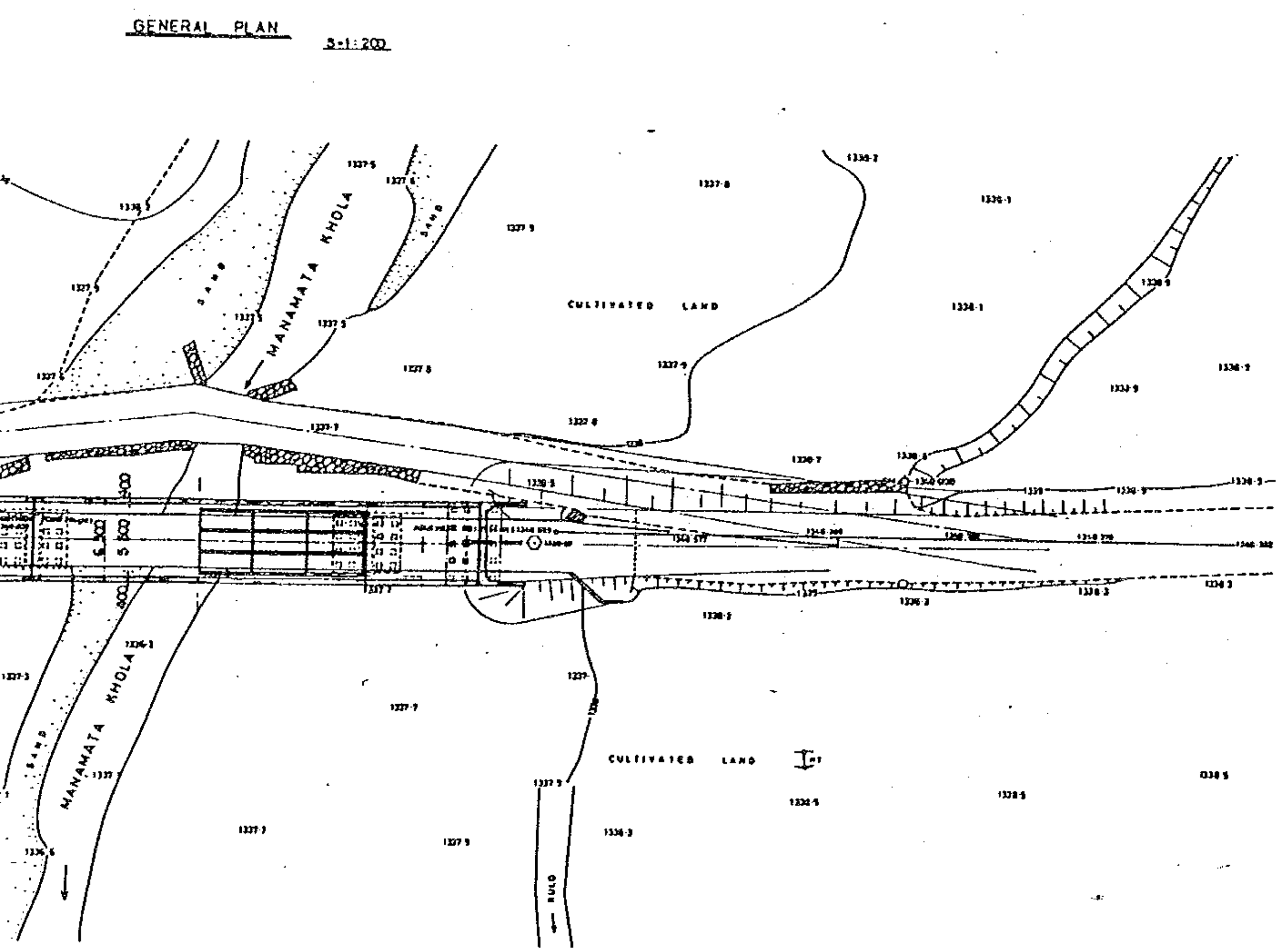
SUB-STRUCTURE

ITEM	CLASS	UNIT	A-1	P-1	P-2	A-2	QUANTI[TY]
EXCAVATION		m³	176	143	143	60	522
CONCRETE	σ=210kg	m³	47	39	39	56	172
FORM		m²	86	88	88	92	354
REINFORCEMENT BAR		t	2.9	2.3	2.3	3.3	10.[illegible]

Fig. 5.12







SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER GIRDER	PER SPAN	PER BRIDGE	REMARKS
STEEL						
GIRDER	SM50B	kg		42,495		
OTHERS		kg				
SHOE		#		8		
HANDRAIL		m		50		
CONCRETE	σck=300	m³		35.00		
FORM		m²		137.00		
CONCRETE PAVEMENT		m²		136.00		
EXPANSION JOINT		m		12.60		

& REINFORCEMENT BAR ---220 kg/m³

SUPER-STRUCTURE

ITEM	CLASS	UNIT	PER BRIDGE	REMARKS
CONCRETE				
CONCRETE	σck=240 kg/cm²	m³	66	
FORM		m²	306	
REINFORCEMENT BAR	SD-30	kg	11.80	
SHOE		#	19.20	
EXPANSION JOINT		#	12.60	
HANDRAIL		m	34.00	
CONCRETE PAVEMENT		m²	94.00	

SUB-STRUCTURE

ITEM	CLASS	UNIT	A-1	P-1	P-2	A-2	QUANTITY	REMARKS
EXCAVATION		m³	176	141	143	60	522	
CONCRETE	σck=210 kg/cm²	m³	47	32	33	54	179	
FORM		m²	86	88	88	92	354	
REINFORCEMENT BAR		t	2.5	2.3	2.5	3.5	10.8	SD-30

DESIGN CONDITION

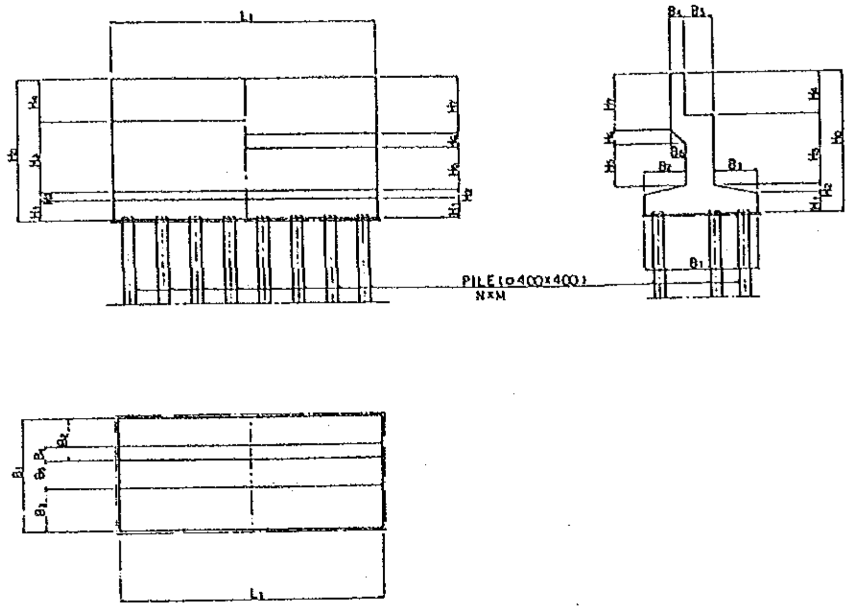
TOTAL BRIDGE LENGTH	42.000 m
GIRDER LENGTH	
SPAN	
WIDTH	5.500 m
LIVE LOAD	TL-20
IMPACT COEFFICIENT	
SEISMIC COEFFICIENT.	kh=0.10
ANGLE OF SKEW	θ=90°
RADIUS OF CURVATURE	R=—
LONGITUDINAL SLOPE	LEVEL

5 0 5 10 15 m
SCALE 1:200

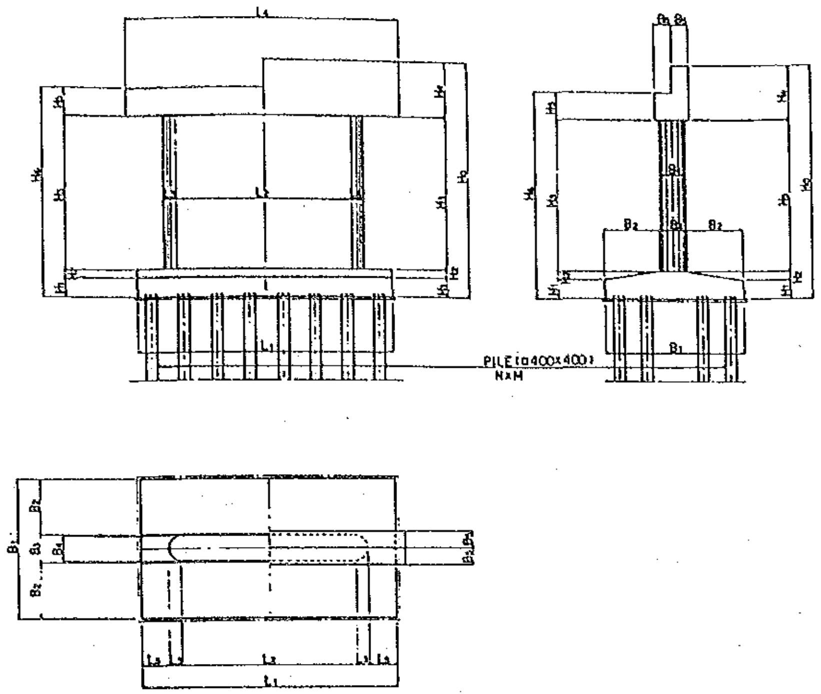
HIS MAJESTY'S GOVERNMENT OF NEPAL	
BASIC DESIGN STUDY ON RE-CONSTRUCTION OF KATHMANDU VALLEY BRIDGES	
MANAMATTAKHOLA BRIDGE No.9 KHULALTAR	SHEET NO 6
SCALE HOR VER	DATE
JAPAN INTERNATIONAL COOPERATION AGENCY	

Fig. 5.12 GENERAL VIEW OF NO.9 MANMATTA BR.

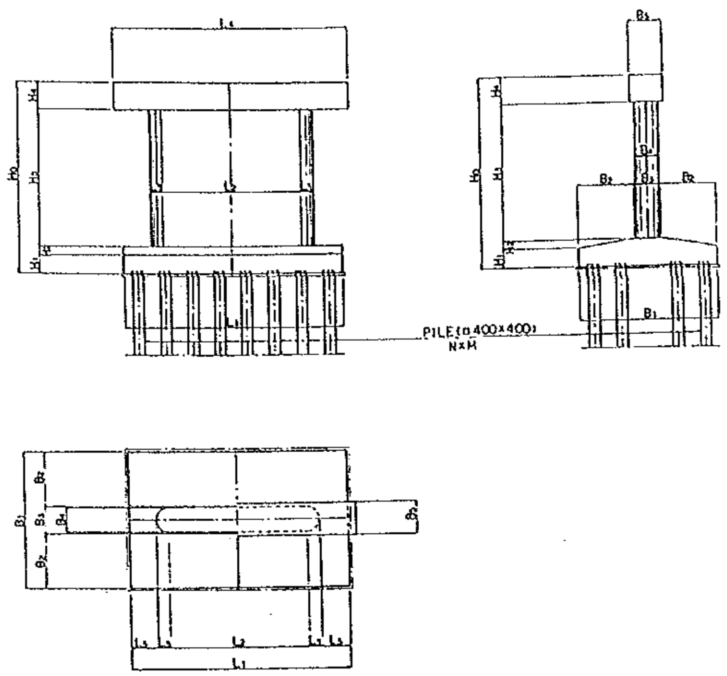
TYPE-1



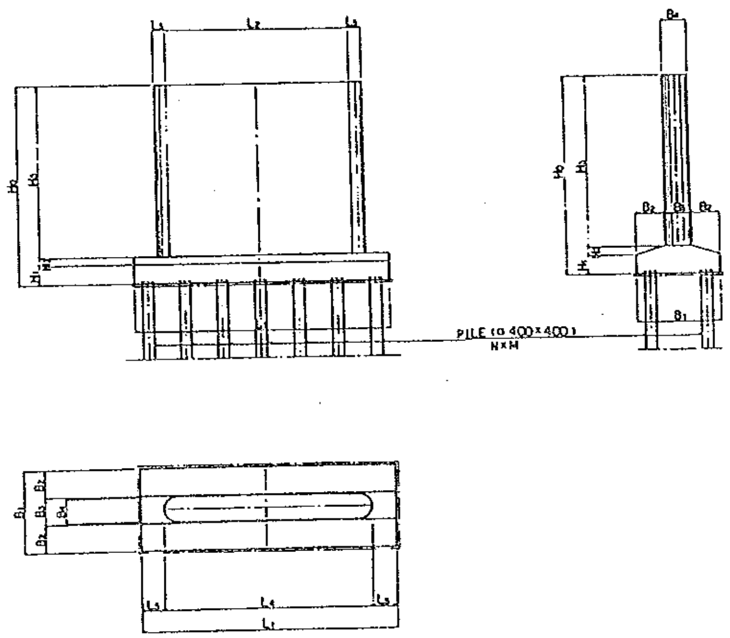
TYPE-2



TYPE-3



TYPE-4



SUB-STRUCTURES

BRIDGE NAME		BISHNUMATI BRIDGE No.2 DALLU				DHOBIKHOLA BRIDGE No.4 KALO PUL					DHOBIKHOLA BRIDGE No.6 HANDIGAON			
No.		A−1	P−1	P−2	A−2	A−1	P−1	P−2	P−3	A−2	A−1	P−1	P−2	A−2
TYPE		1	3	3	1	1	2	2	4	1	1	2	2	1
L	L1	7.300	6.000	6.000	7.300	9.300	8.000	8.000	7.500	9.300	7.300	6.000	6.000	7.300
	L2	—	3.600	3.600	—	—	5.600	5.600	6.300	—	—	4.100	4.100	—
	L3	—	0.450	0.450	—	—	0.450	0.450	0.450	—	—	0.450	0.450	—
	L4	—	6.500	6.500	—	—	8.500	8.500	7.200	—	—	7.000	7.000	—
	L5	—	0.750	0.750	—	—	0.750	0.750	0.150	—	—	0.500	0.500	—
H	H0	5.500	7.000	7.000	3.200	7.500	8.500	9.200	7.000	4.500	5.000	5.900	5.900	3.700
	H1	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700
	H2	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
	H3	3.070	5.000	5.000	0.770	4.260	5.650	5.608	6.000	2.662	2.710	4.130	4.130	1.410
	H4	1.430	1.000	1.000	1.430	2.240	1.810	1.592	—	0.838	1.290	0.770	0.770	1.250
	H5	1.570	—	—	—	2.760	1.000	1.000	—	1.162	1.210	0.700	0.700	—
	H6	0.500	—	—	—	0.500	7.650	8.608	—	0.500	0.500	5.830	5.830	—
	H7	2.430	—	—	—	3.240	—	—	—	1.838	2.290	—	—	—
B	B1	4.000	5.000	5.000	3.000	4.000	5.000	5.000	5.000	4.000	4.000	5.000	5.000	3.000
	B2	1.600	1.950	1.950	1.200	1.600	1.950	1.950	1.950	1.600	1.600	1.950	1.950	0.900
	B3	1.500	1.100	1.100	0.500	1.500	1.100	1.100	1.100	1.500	1.500	1.100	1.100	1.500
	B4	0.400	0.900	0.900	0.400	0.400	0.900	0.900	0.900	0.400	0.400	0.900	0.900	0.400
	B5	0.900	1.200	1.200	0.900	0.900	0.600	0.600	—	0.900	0.900	0.600	0.600	0.900
	B6	0.500	—	—	—	0.500	—	—	—	0.500	0.500	—	—	0.500
Number of Piles	N	3	4	4	2	4	4	4	2	3	3	4	4	3
	M	8	8	8	8	8	8	8	7	8	6	6	6	6
	Σn	24	32	32	16	32	32	32	14	24	18	24	24	18
	ℓ	800+600	600+500	600+500	800+600	8.00	600	600	800	600+500	800+500	600+500	600+500	800+600
	Σℓ1	144.0	144.0	144.0	96.0	256.0	192.0	192.0	112.0	144.0	144.0	144.0	144.0	144.0
	Σℓ2	108.0	120.0	120.0	72.0	—	—	—	—	120.0	900	120.0	120.0	108.0
	Σl	252.0	264.0	264.0	168.0	256.0	192.0	192.0	112.0	264.0	234.0	264.0	264.0	252.0

BRIDGE NAME		DHOBIKHOLA BRIDGE No.7 BABAR MAHAL						MAHADEVKHOLA BRIDGE No.8 PEWADOL				MANAMATTAKHOLA BRIDGE No.9 KHULALTAR			
No.		A−1	P−1	P−2	P−3	P−4	A−2	A−1	P−1	P−2	A−2	A−1	P−1	P−2	A−2
TYPE		1	4	2	2	4	1	1	2	2	1	1	2	2	1
L	L1	7.300	6.000	6.000	6.000	6.000	7.300	6.300	4.300	4.300	6.300	6.300	4.300	4.300	6.300
	L2	—	4.800	4.100	4.100	4.800	—	—	3.100	3.100	—	—	3.100	3.100	—
	L3	—	0.450	0.450	0.450	0.450	—	—	0.450	0.450	—	—	0.450	0.450	—
	L4	—	5.700	7.000	7.000	5.700	—	—	6.000	6.000	—	—	6.000	6.000	—
	L5	—	0.150	0.500	0.500	0.150	—	—	0.150	0.150	—	—	0.150	0.150	—
H	H0	3.200	3.600	7.500	7.500	4.800	4.000	4.300	4.600	4.600	3.500	4.700	5.700	5.700	4.700
	H1	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700
	H2	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
	H3	1.462	2.600	4.868	4.868	3.800	2.262	2.562	1.968	1.968	1.762	2.562	3.068	3.068	2.562
	H4	0.738	—	1.632	1.632	—	0.738	0.738	1.632	1.632	0.738	0.738	1.632	1.632	0.738
	H5	—	—	1.000	1.000	—	0.762	1.062	1.000	1.000	—	1.462	1.000	1.000	1.462
	H6	—	—	6.868	6.868	—	0.500	0.500	3.968	3.968	—	0.500	5.068	5.068	0.500
	H7	—	—	—	—	—	1.738	1.738	—	—	—	1.738	—	—	1.738
B	B1	3.000	3.000	5.000	5.000	3.000	3.000	4.000	3.000	3.000	3.000	4.000	5.000	5.000	4.000
	B2	1.200	0.950	1.950	1.950	0.950	0.600	1.600	0.950	0.950	1.200	1.600	1.950	1.950	1.600
	B3	0.500	1.100	1.100	1.100	1.100	1.500	1.500	1.100	1.100	0.500	1.500	1.100	1.100	1.500
	B4	0.400	0.900	0.900	0.900	0.900	0.400	0.400	0.900	0.900	0.400	0.400	0.900	0.900	0.400
	B5	0.900	—	0.600	0.600	—	0.900	0.900	0.600	0.600	0.900	0.900	0.600	0.600	0.900
	B6	—	—	—	—	—	0.500	0.500	—	—	—	0.500	—	—	0.500
Number of Piles	N	3	2	4	4	2	3	3	2	2	3	3	4	4	3
	M	6	5	6	6	5	6	5	4	4	5	5	4	4	5
	Σn	18	10	24	24	10	18	15	8	8	15	15	16	16	15
	ℓ	800+600	800+600	10.0	10.0	800+500	800+600	6.00	6.00	6.00	8.00	6.00	5.00	5.00	6.00
	Σℓ1	144.0	80.0	240.0	240.0	80.0	144.0	90.00	48.00	48.00	120.00	90.00	80.00	80.00	90.00
	Σℓ2	108.0	60.0	—	—	50.0	108.0	—	—	—	—	—	—	—	—
	Σl	252.0	140.0	240.0	240.0	130.0	252.0	90.00	48.00	48.00	120.00	90.00	80.00	80.00	90.00

HIS MAJESTY'S GOVERNMENT OF NEPAL
BASIC DESIGN STUDY ON RE-CONSTRUCTION OF KATHMANDU VALLEY BRIDGES
SUBSTRUCTURES | SHEET NO
SCALE HOR VER | DATE
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 5.13 CONFIGURATION OF SUBSTRUCTURES

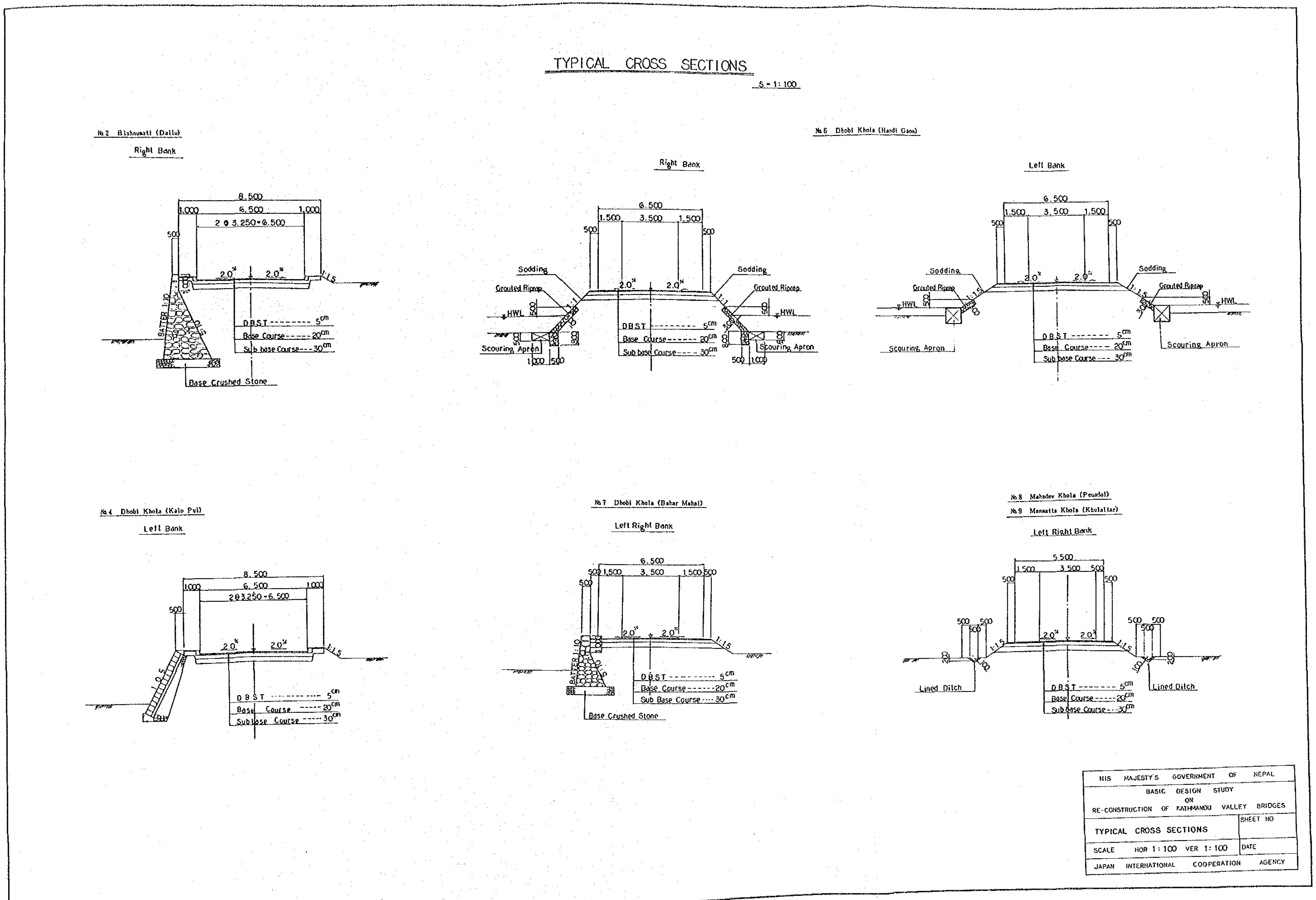


Fig. 5.14 TYPICAL CROSS SECTIONS OF APPROACHES