ROADS AND HIGHWAYS DEPARTMENT,MINISTRY OF COMMUNICATION
THE PEOPLE'S REPUBLIC OF BANGLADESH

NO.

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR IMPROVEMENT OF STEEL BRIDGES FOR ROADS IN RURAL AREAS IN THE PEOPLE'S REPUBLIC OF BANGLADESH

MARCH 2001

JAPAN INTERNATIONAL COOPERATION AGENCY
KATAHIRA & ENGINEERS INTERNATIONAL

PREFACE

In response to a request from the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Steel Bridges for Roads in Rural Areas and entrusted the study to the Japan International Cooperation Agency (JICA).

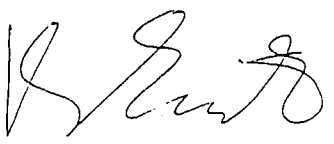
JICA sent to Bangladesh a study team from September 3 to October 10, 2000 and from November 19, 2000 to January 5, 2001.

The team held discussions with the officials concerned of the Government of the People's Republic of Bangladesh, and conducted field studies at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Bangladesh from March 10 to 14, 2001 in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the People's Republic of Bangladesh for their close cooperation extended to the team.

March, 2001



Kunihiko Saito
President
Japan International Cooperation Agency

March, 2001

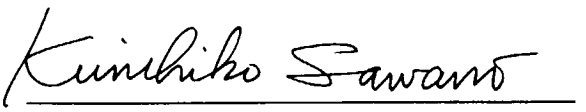
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of Steel Bridges for Roads in Rural Areas in the People's Republic of Bangladesh.

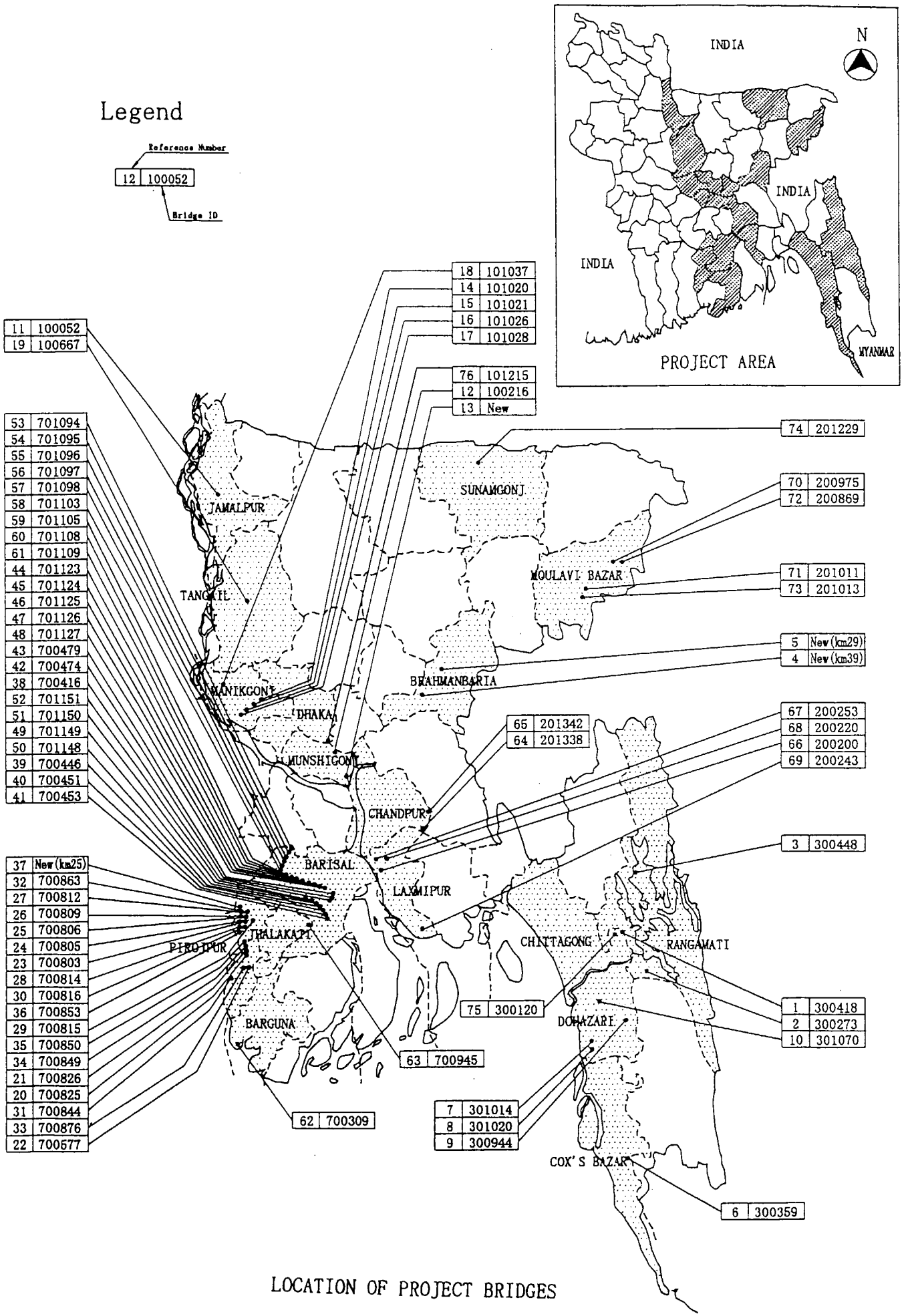
This study was conducted by Katahira & Engineers International, under a contract to JICA, during the period from August, 2000 to March, 2001. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Bangladesh, and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the Project.

Very truly yours,



Kunihiko Sawano
Project Manager,
Basic Design Study Team on the Project for
Improvement of Steel Bridges for Roads
in Rural Areas
Katahira & Engineers International



LOCATION OF PROJECT BRIDGES

PERSPECTIVE

Moulavi Bazar Div. Bridge ID 201011

Abbreviation

AASHTO	:	American Association of State Highway and Transportation Officials
A D B	:	Asian Development Bank
B W D B	:	Bangladesh Water Development Board
DANIDA	:	Danish International Development Agency
I D A	:	International Development Association
J B I C	:	Japan Bank for International Cooperation
J I C A	:	Japan International Cooperation Agency
J I S	:	Japanese Industrial Standard
L G E D	:	Local Government Engineering Department
N H W L	:	Normal High Water Level
R H D	:	Roads and Highways Department
S H W L	:	Standard High Water Level
S W M C	:	Surface Water Modeling Center

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CHAPTER 1 BACKGROUND OF THE PROJECT

The transport system of Bangladesh consists of roads, railways, inland waterways, sea transport and air transport. The modal share of roads in three surface transports – roads, railways and inland waterways in 1997 is 72% for passengers and 65% for freight. Thus, the road transport plays a dominant role in transport system in Bangladesh. The government has set out as one of the objectives of the Fifth Five Year Plan 1997-2002 the development of infrastructure needed to promote socio-economic growth particularly in the private sector. Road improvement is of vital importance as a basic infrastructure to sustain the socio-economic activities.

About 80% of the population lives in rural areas, where the generation of employment opportunities does not catch up the population growth, resulting in abject poverty and high rate of un- and under-employment rate accounting for about 40%. Furthermore, the flood causes extensive damage almost every year to road structures such as pavement, embankment, bridges, etc. and many road sections are impassable during rainy season, causing a constraint to rural development. Aiming at reduction of rural poverty, the government has been implementing various projects including rural infrastructure such as growth centers and roads, bridges and culverts connecting such centers, small irrigation and flood control related infrastructure, employment generation programs, etc. About 60% of financial outlay for rural development in the Fifth Five Year Plan is allocated to rural infrastructure development, as an important strategy for the reduction of rural poverty.

According to the Ministry of Disaster Management and Relief, 52 zillas out of 64 zillas were affected by the flood in 1998 and many roads and bridges were damaged. The road network of Bangladesh comprises national highway, regional highway, feeder road-A, feeder road-B and rural road. The first three categories of roads are constructed and maintained by the Roads and Highways Department (RHD) of the Ministry of Communication and the other roads are constructed by the Local Government Engineering Department (LGED) under the Local Government Division of the Ministry of Local Government, Rural Development and Co-operatives. Among the RHD administered roads, sections with a total length of 9,623 km were submerged and 4,329 km of road embankment, 4,244 km of pavement, 1,204 bridges/culverts, etc. were damaged by the 1998 flood. A part of the 114 requested bridges were washed away in the flood. Remaining bridges are also problematic being pedestrian bridges impassable for vehicles, superannuated bridges with insufficient capacity and so on and need to be reconstructed.

In view of the above, the Government of the People's Republic of Bangladesh made a request to the Government of Japan for grant aid for procurement of steel materials for 114 bridges with a total length of 3,160 m in four zones of Dhaka, Comilla, Chittagong and Barisal for the purpose of improvement of bridges for roads in rural areas as a basic infrastructure for rural development.

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 Objectives of the Project

Bangladesh is one of the most densely populated countries in the world and a vast majority of the population live in the rural areas. Poverty is widespread in the country and more so in the rural areas. It is estimated that around 50% of the population lives below poverty line and about half of them is considered to be the hard-core poor. Under such situation, the Government sets out in the Fifth Five Year Plan 1997-2002 its development strategies being poverty alleviation and rural development, acceleration of agricultural production, etc. and addresses the development of rural infrastructure such as roads, bridges and culverts as one of the strategies of the said Plan for rural development.

The road network of Bangladesh comprises national highway, regional highway, feeder road-A, feeder road-B and rural road. The first three categories of roads are administered by the Roads and Highways Development (RHD), Ministry of Communication.

National highways connect major rural cities with the capital and major rural cities each other. Regional highways complement the national highway network connecting zila centers thereto. National highways and regional highways form a trunk road network in Bangladesh. A part of middle and small sized bridges on national and regional highways have problems such as insufficient width, insufficient capacity, etc., being bottlenecks in coping with increasing transport demand.

Feeder roads-A connect thanas with the trunk road network. Many unions and mouzas are densely distributed along the roads. There is no alternative route in most cases and the road is the only means of movement of people and goods, serving as, so to speak, a life line for the inhabitants along the road. There are many waterways in Bangladesh because of its topographical particularity but the bridges are generally underdeveloped; some bridges not existing, some impassable for vehicles serving only for pedestrians, some insufficient in capacity due to superannuation or from the beginning of construction, etc. These problems on the bridges cause a hindrance to socio-economic activities.

The situation was further aggravated by the flood in 1998 which affected many roads and bridges.

Provision of adequate transport means for passage of people and transportation of local products and subsistence goods is vital for stabilizing the basis of life and improving the quality of life and thus contributes to the alleviation of poverty especially in rural areas which is one of the Government's development goals and objectives. The following are the main socio-economic effects expected by the improvement of transport means:

- Rise of producer's will to produce marketable products and resultant increase of agricultural products, accruing from provision of stable means of transportation of the products to the market and rise of their farmgate prices.
- Promotion of agro-industry like food processing and generation of employment opportunities (especially for women).
- Stabilization of prices due to stable supply of subsistence goods.
- Improvement of daily life of inhabitants in attending school, commuting, shopping, visiting mosque, etc.
- Improvement of emergent medical treatment due to improvement of accessibility to the hospital.

This project is to procure the steel materials for the bridges damaged by the 1998 flood on national highways, regional highways and feeder roads-A in 18 divisions within four zones, aiming to improve the transport infrastructure in rural areas by urgently restoring/improving the bridges and thus to promote the socio-economic development.

2.2 Basic Concept of the Project

2.2.1 Selection of the Project Bridges

The 114 requested bridges were evaluated on their engineering viability and socio-economic viability in accordance with the evaluation criteria shown in Table 2.2.1-1.

TABLE 2.2.1-1 EVALUATION CRITERIA FOR ENGINEERING AND SOCIO-ECONOMIC VIABILITIES

Evaluation Criteria for Engineering Viability
The bridge conforming to any of the following conditions is disqualified. • Necessity of Reconstruction Reconstruction of the bridge is not urgently needed, because ① the new bridge has been completed or is being constructed, ② the existing bridge is not so damaged that it can be still used, ③ the existing bridge is still usable with some reinforcement although its capacity is a little in question, or ④ because of a rerouting plan, the bridge is located outside of the rerouting route and therefore its reconstruction is not urgent. • Appropriateness to the Project for Procurement of Steel Materials for Superstructure Span length is out of the range of 10 to 30 m, e.g. more than 30 m of span is needed due to riverbed condition, navigation requirement, etc. or a box culvert with less than 10 m span is suitable because of the narrow width of waterway. • Constructability Difficulty is envisaged in the design/construction of the bridge, especially in the construction of pier foundation due to deep water for example. • Condition of Connecting Road Presently there is no connecting road or the condition of the connecting road is so bad that vehicles can hardly pass, and no road construction/improvement plan is proposed or there is a plan but difficulty is envisaged in its implementation. • Stability of River Channel The change of river channel is expected. • Condition of Equipment/Materials Delivery Route Delivery of equipment and materials to the bridge site is difficult due to the problem in the delivery route.
Evaluation Criteria for Socio-economic Viability
Adequate socio-economic effect is expected, satisfying all of the following conditions: • Number of Beneficiaries Number of beneficiaries is 5,000 persons or more for 50 m or less long bridge and 10,000 persons or more for more than 50 m long bridge. • Traffic Demand Daily vehicular traffic volume (car, bus, truck, motorcycle) is 100 or more or number of persons crossing the bridge (or river) is 1,000 or more per day. • Detour Route No detour route exists or length of detour route, if exists, is more than 30 km (travel time not less than one hour). • Peace and Order Situation No peace and order problem is expected in the bridge site and along the approach road. • Environmental Aspect Any environmental problem such as resettlement of affected inhabitants with difficulty to be resolved is not expected.

The bridges which pass both engineering and socio-economic evaluation criteria were selected as the project bridges. The result of the selection is shown in Figure 2.2.1-1.

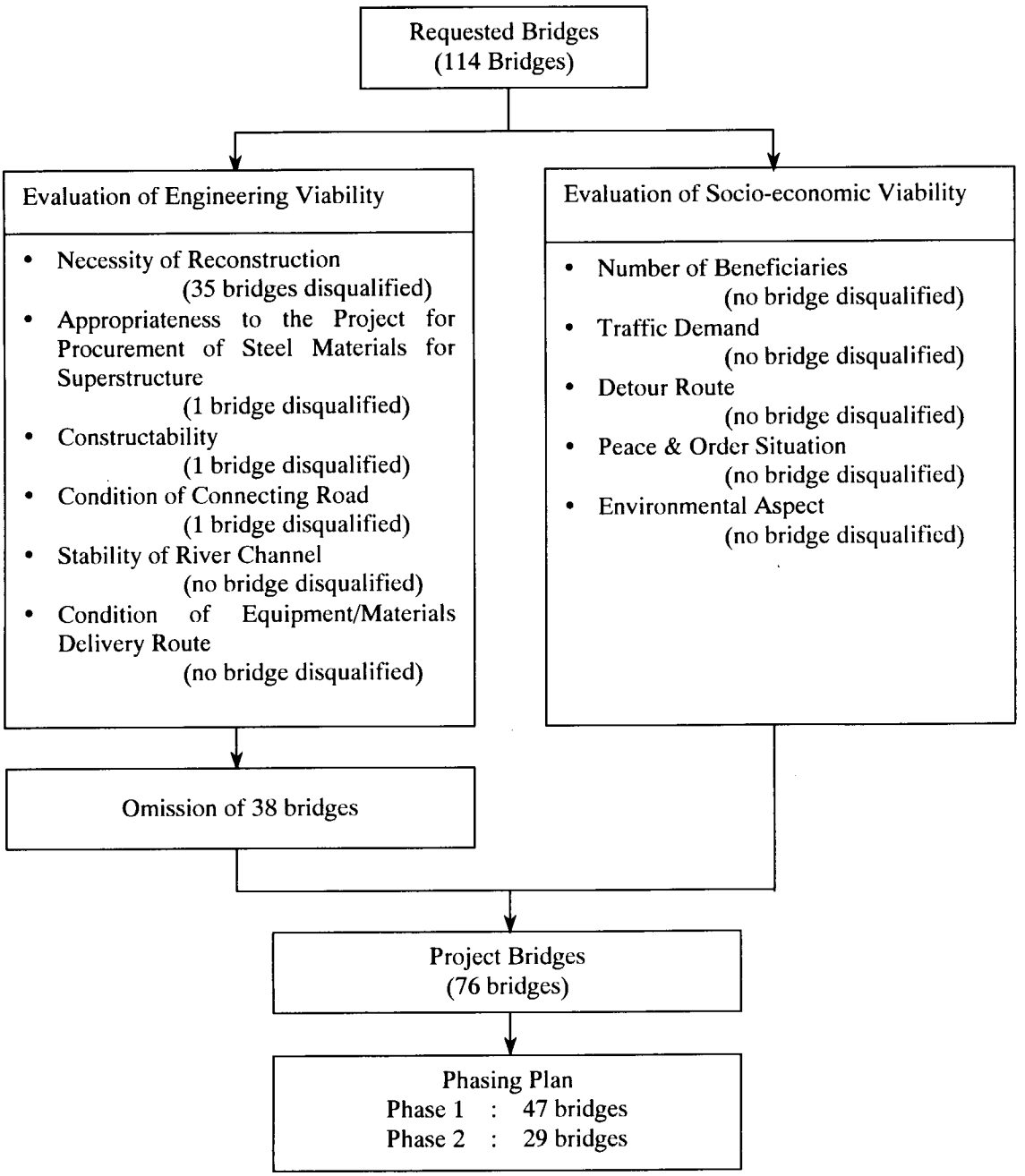


FIGURE 2.2.1-1 SELECTION OF PROJECT BRIDGES

The project bridges are listed in Table 2.2.1-2.

TABLE 2.2.1-2 LIST OF PROJECT BRIDGES (1/2)

No.	Division	Bridge ID	Route No.	No. of Lanes	Bridge Length (m)	Phase
1	RANGAMATI	300418	N16	2	15	1
2		300273	F1814	1	25	1
3		300448	F1613	1	45	1
4	BRAHMAN BARIA	New(km39)	F1207	1	30	1
5		New(km29)	F1206	1	65	2
6	COX'S BAZAR	300359	F1009	1	15	1
7	DOHAZARI	301014	F1018	1	15	1
8		301020	F1018	1	20	1
9		300944	F1037	1	20	1
10		301070	F1038	1	30	1
11	JAMALPUR	100052	F4021	1	30	1
12	MUNSHIGONJ	100216	F8001	1	20	1
13		New	F8122	1	40	1
14	MANIKGONJ	101020	F5064	1	30	1
15		101021	F5064	1	20	1
16		101026	F5064	1	40	1
17		101028	F5064	1	30	1
18		101037	F4014	1	70	2
19	TANGAIL	100667	F4024	1	15	1
20	PIROJPUR	700825	F7709	2	15	1
21		700826	F7709	2	15	1
22		700577	F8707	1	15	1
23		700803	F7706	1	15	1
24		700805	F7706	1	15	1
25		700806	F7706	1	10	1
26		700809	F7706	1	15	1
27		700812	F7706	1	15	1
28		700814	F7707	1	30	1
29		700815	F7707	1	15	1
30		700816	F7707	1	15	1
31		700844	F7711	1	30	2
32		700863	F7712	1	25	2
33		700876	F8712	1	25	2
34		700849	F8715	1	15	2
35		700850	F8715	1	15	2
36		700853	F8715	1	20	2
37		New(km25)	F7704	1	10	2
38	BARISAL	700416	F8034	1	20	1
39		700446	F8032	1	25	1
40		700451	F8032	1	15	1
41		700453	F8032	1	15	1
42		700474	F8036	1	40	1
43		700479	F8036	1	20	1
44		701123	F8018	1	25	1
45		701124	F8018	1	20	1
46		701125	F8018	1	20	2
47		701126	F8018	1	15	2
48		701127	F8018	1	25	2
49		701149	F8019	1	15	2
50		701148	F8019	1	20	2

TABLE 2.2.1-2 LIST OF PROJECT BRIDGES (2/2)

No.	Division	Bridge ID	Route No.	No. of Lanes	Bridge Length (m)	Phase
51	BARISAL	701150	F8019	1	20	2
52		701151	F8019	1	20	2
53		701094	F8020	1	30	2
54		701095	F8020	1	20	2
55		701096	F8020	1	20	2
56		701097	F8020	1	30	2
57		701098	F8020	1	25	2
58		701103	F8020	1	20	2
59		701105	F8407	1	25	2
60		701108	F8407	1	20	2
61		701109	F8407	1	20	2
62	BARGUNA	700309	F8805	1	70	2
63	JHALAKATI	700945	F8056	1	25	2
64	CHANDPUR	201338	F1407	1	20	1
65		201342	F1407	1	25	1
66	LAXMIPUR	200200	R140	2	30	1
67		200253	R140	2	25	1
68		200220	F1404	1	25	1
69		200243	F1405	1	25	1
70	MOULAVI BAZAR	200975	F2821	1	60	2
71		201011	F2003	1	130	2
72		200869	F2824	2	40	1
73		201013	F2003	1	20	1
74	SUNAMGONJ	201229	F2804	1	30	1
75	CHITTAGONG	300120	F1617	1	25	1
76	DHAKA	101215	R812	2	25	1
Total		Number of bridges = 76 (Phase-1: 47, Phase-2: 29)				
		Total length = 1,990m (Phase-1: 1,085m, Phase-2: 905m)				

2.2.2 Basic Concept of the Project

This project is to procure the steel materials for superstructure of 76 bridges with a total length of 1,990m on national highways, regional highways and feeder roads-A in 18 divisions within four zones of Dhaka, Comilla, Chittagong and Barisal and erection tools necessary for constructing the bridges with the above materials, and to promote the bridge construction to be done by the Government of Bangladesh through a technical assistance provided by the Government of Japan as a soft component of the project. The breakdown of the project bridges by number of lanes is as follows:

- 69 1-lane bridges with a total length of 1,825m
- 7 2-lane bridges with a total length of 165m

2.3 Basic Design

2.3.1 Design Concept

2.3.1.1 Principle Design Concept

1) Grade of Bridge

The project bridges are located on the three classes of roads: national highways, regional highways and feed roads-A. National highways connect major rural cities with the capital and major rural cities each other. Regional highways connect zila centers to the national highway network. National highways and regional highways form a trunk road network. Feeder roads-A connect thanas with the trunk road network.

In consideration of the functions of roads by class, the bridges on national highways and regional highways are two-lane bridges, while the bridges on feeder roads-A which have less traffic demand in general are one-lane bridges in principle. However, in case the connecting roads have two lanes and daily traffic volume is more than 500, the bridges may cause bottlenecks. In such cases, two-lane bridges are planned even for bridges on feeder roads-A. In accordance with the RHD Standards, the width of two-lane bridge is 10.0m for national highway, 9.5m for regional highway and 7.6m for feeder road-A including sidewalks on both sides.

Design live load is AASHTO HS 20-44 in accordance with the RHD Standards.

2) Hydrological Considerations

Due to the geographical particularity in Bangladesh where the alluvial river plains dominate 90% of the country and around 70% is under water during rainy season, boat is an important transport means during rainy season. The project bridges are hydrologically divided into two types: bridges on river and bridges in catchment.

The RHD's criteria to decide the bridge elevation are as follows:

- For the bridges on river, the elevation of girder bottom shall be the Standard High Water Level (SHWL) plus navigation clearance or higher. The SHWL is the water level for flood run-off of 10-year return period analyzed by the

Surface Water Modeling Center (SWMC). Navigation clearance is 1.0 to 3.0m depending on the size of boat passing.

- For the bridges in catchment, the elevation of deck surface is decided to be the same as the existing approach road surface elevation in principle.

For this project, the above criteria are basically followed and furthermore the following criterion is additionally applied for the bridges in catchment:

- The elevation of girder bottom shall be the Normal High Water Level (NHWL) plus navigation clearance or higher. The NHWL is the high water level which may occur every year. Navigation clearance is 1.0m in principle except where large-sized boats pass, and 0.6m in special case where necessary to avoid making the approach road elevation too high.

3) Constructability

Necessary conditions for this project with regard to constructability are as follows:

- Assembly and erection of girders shall be done by man power not using heavy equipment because of lack of equipment for erection.
- Assembly and erection of girders shall be done in a short time so that the whole work including setting of staging, erection of girders and removal of staging can be completed within a dry season when the water level is low.

To satisfy the said conditions, a truss type is selected for superstructure and the maximum length and weight of a member are limited to 3.5m and 300g respectively.

4) Durability

To sustain the effect of the project, bridges shall be durable as permanent structures.

5) Maintenance

Consideration is given to reduce maintenance requirements as much as possible. Steel materials, if painted for protection from rust, need to be periodically repainted. However, the repainting has difficulty in procurement of materials, technique and cost. To avoid it, galvanized coating is applied to steel materials taking advantage of semi-permanent resistance against rust and thus maintenance requirements are considerably reduced.

6) Vertical Profile

Deck surface is kept level and its elevation is made as low as possible. If deck elevation is high, the approach road elevation should also be high resulting in not only worse vertical profile but also more occasions of embankment damage, being disadvantageous in maintenance. For the elevation of deck surface to be low, the height from the bottom of girder to the deck surface should be as small as possible. For this reason, the through type structure is selected.

7) Substructure, Revetment and Approach Road

Standard types of substructure, revetment and approach road used in the RHD are applied in principle.

8) Construction Period

For early realization of the effect of the project, construction of bridges shall be completed by the Government of Bangladesh within two years from the date of handing-over the steel materials for superstructure.

To spread the annual workload under the above condition, the project is planned to be implemented in two phases. The basic considerations in division of bridges into two phases are as follows:

- The bridges are divided into two phases keeping the total weight of steel materials in each phase within 60% of overall weight.
- 2-lane bridges, which have higher traffic demand and therefore higher priority, are selected for Phase-1.
- The bridges which are easier in construction especially in erection are selected for Phase-1, so as to construct the more difficult bridges after being skilled and thus to smoothly complete the project as a whole. Following this principle, 3 or more-span bridges are put in Phase-2.
- The bridges requiring the improvement of connecting roads are put in Phase-2 to give time to the improvement works.

The division of bridges into two phases is shown in Table 2.2.1-2.

2.3.1.2 Design Conditions

1) Design Specifications

AASHTO Standard Specifications for Highway Bridges, 1996 is applied.

2) Bridge Width

Two-lane bridges	:	7.50m carriageway + 2 x 1.25m sidewalk = 10.00m for national highways 7.50m carriageway + 2 x 1.00m sidewalk = 9.50m for regional highways 6.10m carriageway + 2 x 0.75m sidewalk = 7.60m for feeder roads-A
One-lane bridges	:	3.35m (carriageway and sidewalk unsegregated)

3) Design Loads

Live load	:	AASHTO HS 20-44 is applied.
Impact load	:	AASHTO Section 3.8 is applied.
Thermal force	:	± 10℃ is assumed based on actual condition of temperature changes.
Wind load	:	AASHTO Section 3.15 is applied.
Earthquake load	:	Horizontal seismic coefficient Kh = 0.05 is assumed.

4) Design Strength of Materials

- Design strength of concrete for substructure : 210 kgf/cm^2
- Design strength of concrete for deck slab : 240 kgf/cm^2
- Yield stress of reinforcing bars : 2,100 kgf/cm^2
- Mechanical property of steel materials for superstructure

Mark	Standard	Category	Yield Point Stress (kgf/mm^2)			Tensile Strength (kgf/mm^2)
			t ≦ 16	16 < t < 40	t ≧ 40	
SS400	JIS G 3101	2	25 or more	24 or more	22 or more	41 - 52
SM490YA/ SM490YB	JIS G 3106	3	37 or more	36 or more	34 or more	50 - 62
Bolt	JIS B 1186	Hexagonal High Strength Bolt of Friction Type Connection, M22 (F8T)				

t = thickness in mm

5) Specification for Galvanized Coating

- Standard process of plating : JIS H 9124
- Quality of galvanized coating : JIS H 8641, Category 2, HDZ 55 (bond quantity 550 g/m^2 or more for the steel material under severe environment of rusting)
- Slide surface ratio of plate surface to be connected : 0.4 or more

6) Geometric Design Standard of Approach Road

- Cross section elements : same as the existing road in principle.

- Minimum radius : 350m for national highways, 200m for regional highways and 120m for feeder roads-A.
- Maximum grade : 6%

2.3.1.3 Type of Superstructure

1) Factors to be Considered in Selection of Superstructure Type

In view of the particularity of the project, i.e. construction of bridges by the Government of Bangladesh with steel materials for superstructure to be provided by the Government of Japan, the factors to be considered in selection of superstructure type are as follows:

Constructability	:	Assembly and erection of girders shall be able to be done by man power not using heavy equipment.
Durability	:	Bridges shall be durable as permanent bridges and easily maintainable.
Economical Factor	:	Construction cost of bridges including fabrication cost of girders and improvement cost of approach roads shall be as inexpensive as possible.
Vertical Profile	:	Elevation of deck surface shall be as low as possible.

2) Applied Type

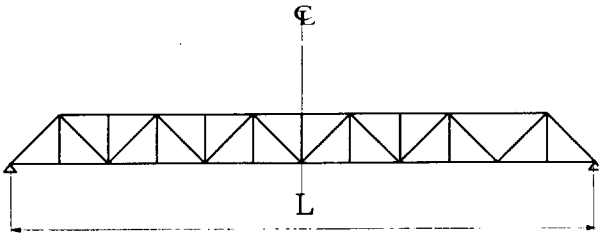
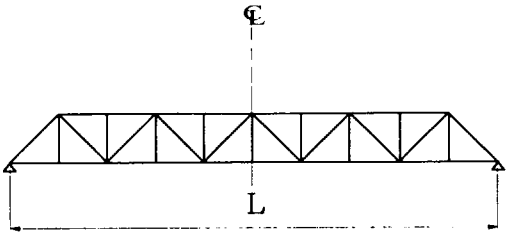
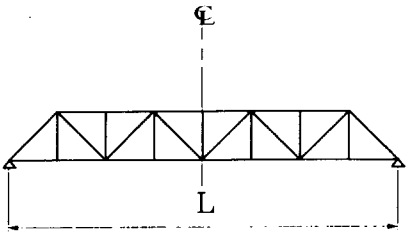
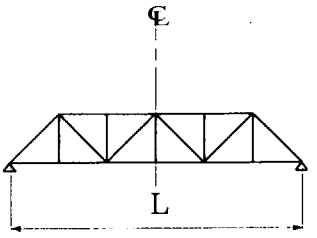
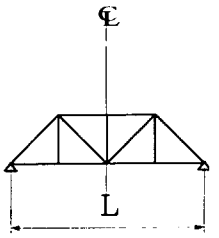
Based on the above considerations, pony truss is selected. For connection of members, hexagonal high strength bolts, which are reliable and commonly used, are applied.

3) Span Length

To facilitate the detailed design and fabrication and erection of girders, superstructures are standardized. In conforming with panel length, applicable span length varies from 10m to 30m at 5m intervals.

Structure for each span length is shown in Table 2.3.1-1.

TABLE 2.3.1-1 STANDARD SPANS

Span Length	Side View
L = 30 m	 L = 12 x 2.438m = 29.256m
L = 25 m	 L = 10 x 2.438m = 24.380m
L = 20 m	 L = 8 x 2.438m = 19.504m
L = 15 m	 L = 6 x 2.438m = 14.628m
L = 10 m	 L = 4 x 2.438m = 9.752m

4) Selection of Span Length

For the required bridge length, appropriate spans are selected from 10 m, 15 m, 20 m, 25 m and 30 m and combined to compose the bridge length.

In case of even number of spans, asymmetric composition of spans is applied not so as to locate a pier in the center of the river for the convenience of navigation.

Proposed composition of spans is as follows:

Bridge Length (m)	Composition of Spans (m)
10	10
15	15
20	20
25	25
30	30
40	15 + 25 (asymmetric)
45	15 + 30 (asymmetric)
60	20 + 20 + 20
65	20 + 25 + 20
70	20 + 30 + 20
130	25 + 25 + 30 + 25 + 25

5) Type of Deck Slab

For one-lane bridges, steel deck slab is applied taking advantage of lightness of dead load and easiness in construction, while for two-lane bridges, reinforced concrete deck slab is applied making a point of running quality.

2.3.1.4 Type of Substructure, Revetment and Approach Road

1) Type of Substructure

Standard types of substructures used in the RHD are applied, which are as follows:

Abutment	:	U-type
Pier	:	Reversed T-shape two-column type
Foundation Pile	:	Cast-in-place concrete pile

2) Revetment

For the bridges on river where water velocity is high and scouring of slope at abutment is anticipated, revetment with brick pitching is planned to be provided.

3) Approach Road

Cross section of approach road is designed conforming to that of the existing road. Asphalt concrete is applied as a standard pavement type. The maximum grade is not more than 6% and the gradient of embankment slope is 1 : 2.

2.3.2 Basic Design

2.3.2.1 Bridge Planning

1) Location of Bridge

Bridge locations should be in accordance with the RHD's road plan and reasonable from the engineering point of view. They were decided as agreed between the Basic Design Study Team and the RHD with confirmation at the sites. Most bridges are located at the same locations as the existing bridges. In case the existing bridge is perpendicular to the connecting road and vehicles cannot turn, the bridge location is changed.

2) Bridge Length

The bridge length was decided so as to be minimum on condition that abutments are placed behind the intersections of design high water level and river banks and that the bridge length is a multiple of 5m for the convenience of standardization of superstructure.

3) Bridge Height

The elevation of girder bottom was decided based on the hydrological analysis. The procedure for determination of the elevation of girder bottom is shown in Figure 2.3.2-1.

The Study area is divided into five hydrological regions: Northeast Region (NE), Southeast Region (SE), North Central Region (NC), Southwest Region (SW/SC) and Eastern Hill Region (EH/CA) as shown in Figure 2.3.2-2.

According to the flood pattern of the waterway, bridges are divided into two categories: bridges on river and bridges in catchment (Figure 2.3.2-3). The elevation of girder bottom of the bridge of each category is decided as follows:

- Bridge on river : Elevation of girder bottom $\geqq$ SHWL + Navigation clearance
  where,
  SHWL (Standard High Water Level) = water level for flood run-off of 10-year return period,
  Navigation clearance = 1.0-3.0m depending on the size of boat passing (mostly 1.0m)

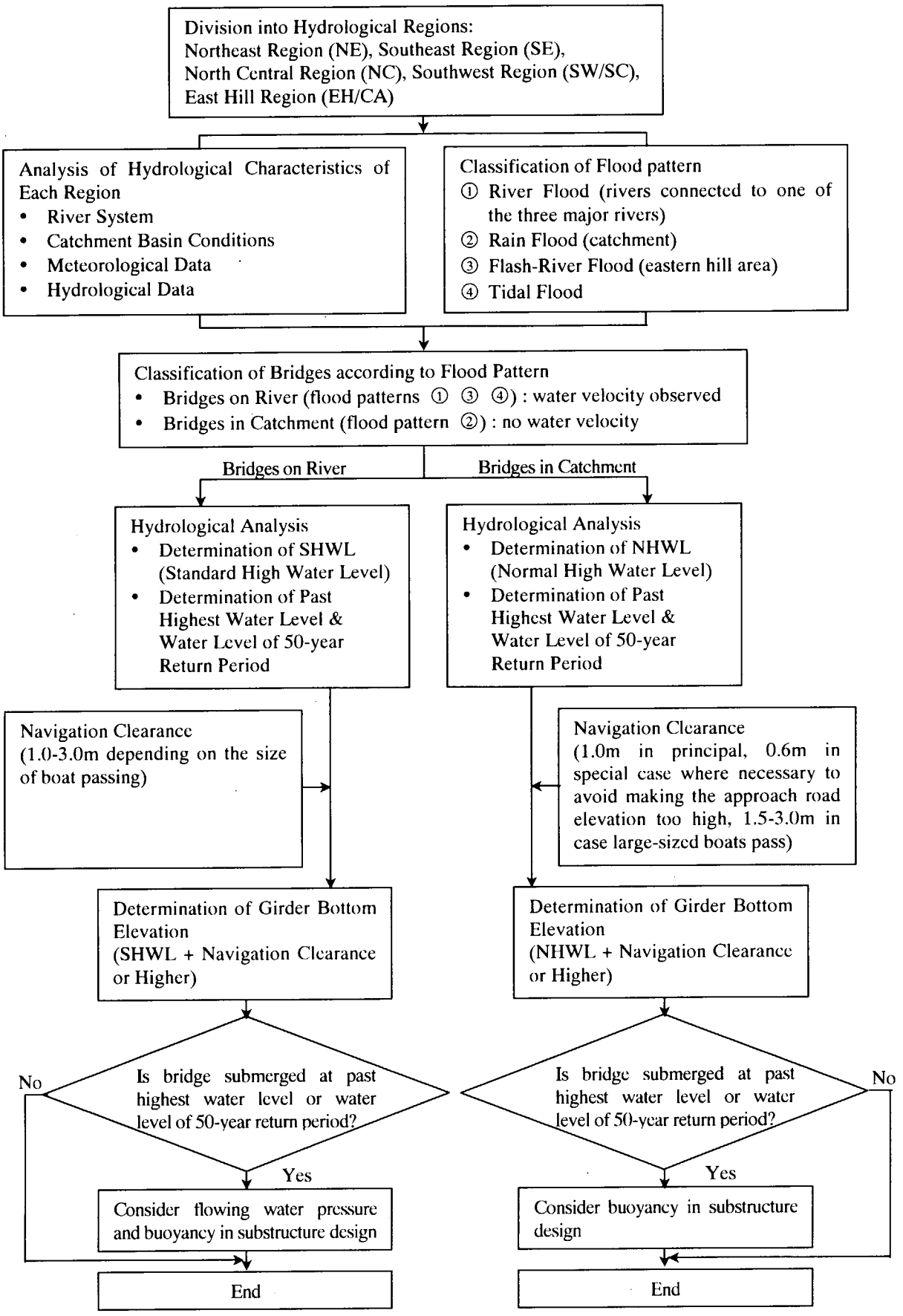


FIGURE 2.3.2-1 PROCEDURE FOR DETERMINATION OF ELEVATION OF GIRDER BOTTOM

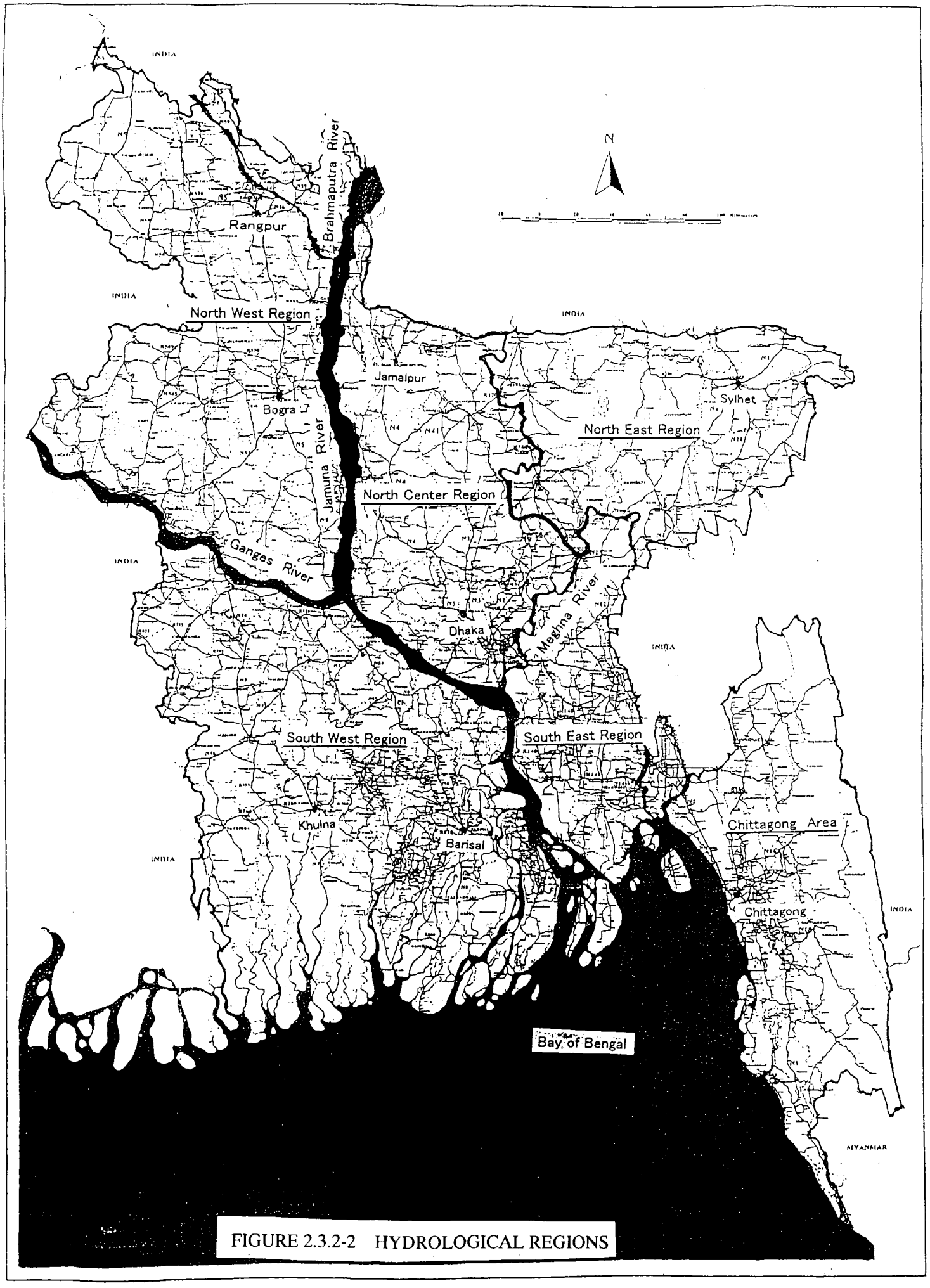


FIGURE 2.3.2-2 HYDROLOGICAL REGIONS

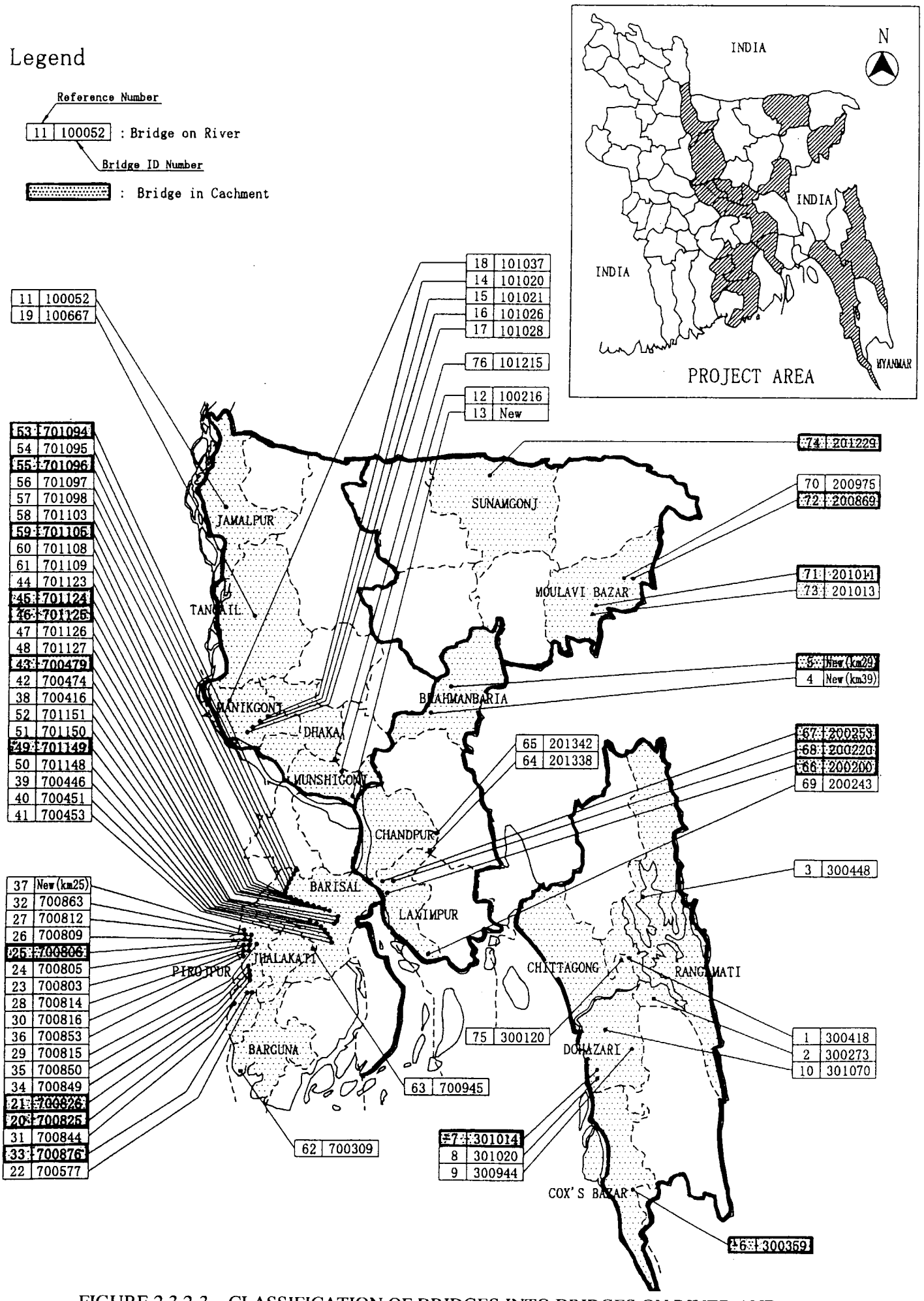


FIGURE 2.3.2-3 CLASSIFICATION OF BRIDGES INTO BRIDGES ON RIVER AND BRIDGES IN CATCHMENT

- Bridge in catchment: Elevation of girder bottom≧NHWL + Navigation clearance
  where,
  NHWL (Normal High Water Level) = high water level which may occur every year,
  Navigation clearance = 1.0m in principle, 0.6m in special case where necessary to avoid making the approach road elevation too high, and 1.5-3.0m in case large-sized boats pass

For both categories, considerations for past highest water level and water level for flood run-off of 50-year return period are paid in the design as shown in Figure 2.3.2-1.

The various water levels are estimated as follows:

SHWL and water level of 50-year return period for bridges on river

① Water level – flow rate curve (H-Q curve) is drawn based on the water velocity measured during the site survey and the river cross section prepared by the topographic survey.

② By SWMC (Surface Water Modeling Center), the whole country is divided into 48 catchment basins as shown in Appendix 7 and the flood frequency analysis is made for each basin. Based on the analysis results, the probability flood run-off (Qp) at the bridge site is obtained from the following equation:

$$Q_p = C \times Q_{SWMC}$$

Where, Q_p = probability flood run-off at the bridge site
Q_{SWMC} = probability flood run-off prepared by SWMC in the basin covering the bridge site
C = adjustment factor for the bridge site, obtained from the following equation:

$$C = \sqrt{Q_{00}} / \sqrt{Q_{1.1}}$$

Q_{00} = flow rate at the bridge site, surveyed in September 2000
$Q_{1.1}$ = flood run-off of 1.1-year return period by SWMC in the corresponding basin

③ SHWL and water level of 50-year return period are estimated applying Q_p's of 10-year and 50-year return periods obtained in ② to the H-Q curve obtained in ①, respectively.

NHWL for bridges in catchment

NHWL is obtained from hearing at site.

Water level of 50-year return period for bridges in catchment

When water level reaches the NHWL in the catchment area, the area is inundated all around and ground surface is saturated. There is no place where water is drained. Under such situation, excess rainfall after reaching the NHWL is assumed to be added to the NHWL. On this assumption, water level of 50-year return period is estimated from the following equation:

$$HWL_{50} = NHWL + (R_{50} - R_{1.1})$$

Where, HWL_{50} = water level of 50-year return period
NHWL = normal high water level
R_{50} = rainfall of 50-year return period in the corresponding hydrological region
$R_{1.1}$ = rainfall of 1.1-year return period in the corresponding hydrological region

Past highest water level for both bridges on river and bridges in catchment

They are obtained from hearing at site.

Hydrological analysis results are shown in Tables 2.3.2-1 and 2.3.2-2 for bridges on river and bridges in catchment respectively.

TABLE 2.3.2-1 HYDROLOGICAL ANALYSIS FOR BRIDGES ON RIVER (1/2)

Number	Division	Bridge ID	Hydrological Region -Catchment Basin No.	Probability Flood Run-off (m3/s)			Water Level (m)*			Naviga-tion Clear-ance	SHWL + NC	Girder Bottom Elevation	Deck Surface Elevation	Water Velocity Surveyed in Sept. 2000
				1.1-year Return Period	10-year Return Period	50-year Return Period	10-year Return Period SHWL	50-year Return Period	Past Highest Water Level	NC(m)	(m)*	(m)*	(m)*	(m/s)
1	Rangamati	300418	CA-14	5	67	75	8.1	-	8.3	1.0	9.1	9.1	10.310	0.30
2	Rangamati	300273	CA-10	6	81	101	7.4	9.7	7.5	1.0	8.4	8.4	8.954	0.91
3	Rangamati	300448	CA-10	153	351	436	7.5	5.8	8.2	1.0	8.5	8.5	9.054	0.83
4	Brahman B.	New(km39)	SE-21	5	37	72	9.1	12.6	9.5	1.0	10.1	10.1	10.654	0.15
8	Dohazari	301020	CA-5&6	1	39	46	10.5	10.1	10.5	1.0	11.5	11.5	12.054	0.40
9	Dohazari	300944	CA-5	6	143	167	10.0	13.0	10.1	1.0	11.0	11.0	11.554	0.63
10	Dohazari	301070	CA-3	102	451	560	10.0	-	10.4	1.0	11.0	11.0	11.554	0.91
11	Jamalpur	100052	NC-2	47	178	236	9.9	12.2	10.1	1.0	10.9	10.9	11.454	0.50
12	Munshigonj	100216	NC-6	72	243	301	9.5	7.3	9.8	1.0	10.5	10.5	11.054	0.50
13	Munshigonj	New	NC-6	99	282	350	10.6	11.3	10.9	1.0	11.6	11.6	12.154	0.50
14	Manikgonj	101020	NC-16	60	179	210	8.6	9.9	9.0	1.0	9.6	9.6	10.154	0.50
15	Manikgonj	101021	NC-16	15	89	105	9.2	-	9.4	1.0	10.2	10.2	10.754	0.40
16	Manikgonj	101026	NC-16	22	110	129	9.1	13.4	9.3	1.0	10.1	10.1	10.654	0.20
17	Manikgonj	101028	NC-16	21	108	126	9.0	12.9	9.1	1.0	10.0	10.0	10.554	0.30
18	Manikgonj	101037	NC-13	430	437	552	11.0	11.1	11.3	3.0	14.0	14.0	14.554	0.90
19	Tangail	100667	NC-6	9	86	107	11.1	-	11.3	1.0	12.1	12.1	12.654	0.20
22	Pirojpur	700577	SC-11	6	35	44	10.1	12.8	10.6	1.0	11.1	11.1	11.654	0.40
23	Pirojpur	700803	SC-7	3	23	30	10.8	12.0	11.2	1.0	11.8	11.8	12.354	0.40
24	Pirojpur	700805	SC-7	7	37	47	10.0	13.5	10.5	1.0	11.0	11.0	11.554	0.40
26	Pirojpur	700809	SC-7	7	37	47	10.2	11.4	10.6	1.0	11.2	11.2	11.754	0.40
27	Pirojpur	700812	SC-7	7	37	47	9.2	-	9.4	1.0	10.2	10.2	10.754	0.30
28	Pirojpur	700814	SC-7	204	226	247	10.9	11.6	10.9	1.0	11.9	11.9	12.454	0.80
29	Pirojpur	700815	SC-7	3	23	30	9.4	13.7	10.0	1.0	10.4	10.4	10.954	0.50
30	Pirojpur	700816	SC-7	1	14	17	10.1	13.7	10.5	1.0	11.1	11.1	11.654	0.10
31	Pirojpur	700844	SW-24	18	94	111	9.8	14.0	10.1	1.0	10.8	10.8	11.354	0.40
32	Pirojpur	700863	SC-7	17	55	71	9.7	10.9	9.9	1.0	10.7	10.7	11.254	0.60
34	Pirojpur	700849	SW-25	1	12	14	10.4	-	10.7	1.0	11.4	11.4	11.954	0.10
35	Pirojpur	700850	SW-25	11	71	83	9.8	14.5	10.3	1.0	10.8	10.8	11.354	0.70
36	Pirojpur	700853	SW-25	35	127	194	10.1	-	10.2	1.0	11.1	11.1	11.654	0.70
37	Pirojpur	New(km25)	SC-7	2	19	24	10.5	-	11.0	1.0	11.5	11.5	12.054	0.30

* Height from temporary bench mark

TABLE 2.3.2-1 HYDROLOGICAL ANALYSIS FOR BRIDGES ON RIVER (2/2)

Number	Division	Bridge ID	Hydrological Region -Catchment Basin No.	Probability Flood Run-off (m3/s)			Water Level (m)*			Naviga-tion Clear-ance	SHWL + NC	Girder Bottom Elevation	Deck Surface Elevation	Water Velocity Surveyed in Sept. 2000
				1.1-year Return Period	10-year Return Period	50-year Return Period	10-year Return Period SHWL	50-year Return Period	Past Highest Water Level	NC(m)	(m)*	(m)*	(m)*	(m/s)
38	Barisal	700416	SC-17	6	27	40	9.1	9.6	9.7	1.0	10.1	10.1	10.654	0.50
39	Barisal	700446	SC-17	11	42	52	9.0	9.0	10.3	1.0	10.0	10.0	10.554	0.50
40	Barisal	700451	SC-17	5	28	34	9.3	11.1	9.5	1.0	10.3	10.3	10.854	0.30
41	Barisal	700453	SC-17	3	22	27	8.7	14.0	8.9	1.0	9.7	9.7	10.254	0.30
42	Barisal	700474	SC-17	7	33	40	8.8	11.2	9.1	1.0	9.8	9.8	10.354	0.10
44	Barisal	701123	SC-17	7	33	40	10.3	12.4	10.9	2.0	12.3	12.3	12.854	0.20
47	Barisal	701126	SC-17	19	59	71	10.0	10.6	10.5	1.0	11.0	11.0	11.554	1.00
48	Barisal	701127	SC-17	53	93	113	11.0	10.8	11.8	1.0	12.0	12.0	12.554	1.00
50	Barisal	701148	SC-17	3	22	27	9.9	11.8	10.4	1.0	10.9	10.9	11.454	0.15
51	Barisal	701150	SC-17	1	13	15	9.8	11.8	11.0	1.0	10.8	10.8	11.354	0.10
52	Barisal	701151	SC-17	3	18	22	10.3	12.5	11.1	1.0	11.3	11.3	11.854	0.10
54	Barisal	701095	SC-17	7	39	46	10.1	11.2	11.1	1.0	11.1	11.1	11.654	0.40
56	Barisal	701097	SC-17	7	29	35	9.1	10.9	10.2	1.0	10.1	10.1	10.654	0.15
57	Barisal	701098	SC-17	6	32	39	9.8	11.8	10.6	1.0	10.8	10.8	11.354	0.20
58	Barisal	701103	SC-17	12	44	54	11.1	14.2	11.7	1.0	12.1	12.1	12.654	0.40
60	Barisal	701108	SC-17	2	18	22	10.7	12.4	10.9	1.0	11.7	11.7	12.254	0.20
61	Barisal	701109	SC-17	5	29	35	10.4	12.3	11.1	1.0	11.4	11.4	11.954	0.20
62	Barguna	700309	SC-12	90	171	200	9.0	7.4	9.1	2.0	11.0	11.0	11.554	0.70
63	Jhalakati	700945	SC-12	6	45	52	8.7	10.7	9.3	1.0	9.7	9.7	10.254	0.40
64	Chandpur	201338	SE-11	136	149	170	9.4	9.6	9.6	1.0	10.4	10.4	10.954	1.00
65	Chandpur	201342	SE-11	33	71	83	9.0	9.0	9.4	1.0	10.0	10.0	10.554	0.50
69	Laxmipur	200243	SE-19	27	87	169	9.9	9.8	10.5	1.5	11.4	11.4	11.954	1.70
70	Moulavi B.	200975	NE-35	116	243	304	9.8	10.5	10.2	2.0	11.8	11.8	12.354	0.70
73	Moulavi B.	201013	NE-35	5	50	78	11.6	14.3	11.8	1.0	12.6	12.6	13.154	0.30
75	Chitttagong	300120	CA-14	20	134	157	11.9	13.3	12.3	1.0	12.9	12.9	13.454	0.65
76	Dhaka	101215	SC-17	13	46	55	9.4	-	9.7	1.0	10.4	10.4	11.610	0.21

* Height from temporary bench mark

TABLE 2.3.2-2 HYDROLOGICAL ANALYSIS FOR BRIDGES IN CATCHMENT

Number	Division	Bridge ID	Hydrological Region -Catchment Basin No.	Probability Rainfall (April-September) (mm)		Water Level (m)*			Naviga-tion Clear-ance	NHWL + NC	Girder Bottom Elevation	Deck Surface Elevation
				1.1-year Return Period	50-year Return Period	Normal High Water Level NHWL	50-year Return Period	Past Highest Water Level	NC(m)	(m)*	(m)*	(m)*
5	Brahman B.	New(km29)	SE-22	1,464	3,196	12.3	14.0	12.4	1.0	13.3	13.3	13.854
6	Cox's Bazar	300359	CA-12	2,867	5,737	9.4	12.3	10.0	0.6	10.0	10.0	10.554
7	Dohazari	301014	CA-5&6	2,867	5,737	10.3	13.2	10.8	0.6	10.9	10.9	11.454
20	Pirojpur	700825	SW-25	1,316	2,360	8.4	9.4	9.6	1.0	9.4	9.4	10.610
21	Pirojpur	700826	SW-25	1,316	2,360	8.2	9.2	9.8	1.0	9.2	9.9	11.110
25	Pirojpur	700806	SC-7	1,219	2,783	8.6	10.1	9.4	1.0	9.6	9.6	10.154
33	Pirojpur	700876	SC-11	1,219	2,783	8.8	10.4	10.4	1.0	9.8	9.8	10.354
43	Barisal	700479	SC-17	1,219	2,783	9.8	11.4	10.4	1.0	10.8	10.8	11.354
45	Barisal	701124	SC-17	1,219	2,783	9.5	11.1	11.0	0.6	10.1	10.1	10.654
46	Barisal	701125	SC-17	1,219	2,783	9.5	11.1	11.0	1.0	10.5	10.5	11.054
49	Barisal	701149	SC-17	1,219	2,783	8.6	10.2	10.5	1.0	9.6	9.6	10.154
53	Barisal	701094	SC-4	1,219	2,783	9.4	11.0	11.0	0.6	10.0	10.0	10.554
55	Barisal	701096	SC-4	1,219	2,783	7.8	9.4	10.3	1.0	8.8	8.8	9.354
59	Barisal	701105	SC-17	1,219	2,783	8.3	10.0	9.7	1.0	9.3	9.3	9.854
66	Laxmipur	200200	SE-19	1,464	3,196	7.4	9.1	8.1	1.5	8.9	9.4	10.610
67	Laxmipur	200253	SE-18	1,464	3,196	7.2	8.9	8.6	1.0	8.2	9.2	10.410
68	Laxmipur	200220	SE-18	1,464	3,196	9.8	11.5	10.6	1.0	10.8	10.8	11.354
71	Moulavi B.	201011	NE-35	2,867	5,737	11.0	13.9	11.4	2.0	13.0	13.0	13.554
72	Moulavi B.	200869	NE-35	2,867	5,737	9.1	12.0	10.1	1.0	10.1	10.6	11.810
74	Sunamgonj	201229	NE-11	2,867	5,737	10.4	13.3	11.0	1.0	11.4	11.4	11.954

* Height from temporary bench mark

4) Bridge Planning

The bridge planning was made for the 76 project bridges. The basic dimensions thereof are shown in Table 2.3.2-4. Number of bridges by bridge length is summarized in Table 2.3.2-3.

TABLE 2.3.2-3 NUMBER OF BRIDGES BY BRIDGE LENGTH

Bridge Length (m)	Span Length (m)	Number of Bridges		
		1-lane	2-lane	Total
10	10	2	-	2
15	15	16	3	19
20	20	19	-	19
25	25	13	2	15
30	30	10	1	11
40	15 + 25	3	1	4
45	15 + 30	1	-	1
60	20 + 20 + 20	1	-	1
65	20 + 25 + 20	1	-	1
70	20 + 30 + 20	2	-	2
130	25 + 25 + 30 + 25 + 25	1	-	1
Total		69	7	76
Total Length		1,825m	165m	1,990m

TABLE 2.3.2-4 BASIC DIMENSIONS OF THE PROJECT BRIDGES (1/8)

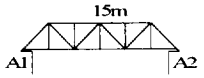
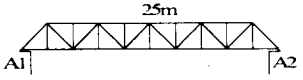
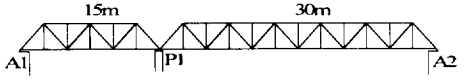
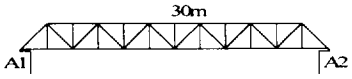
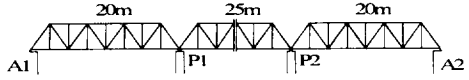
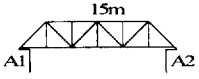
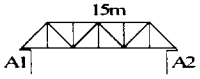
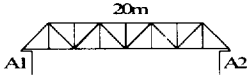
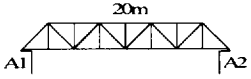
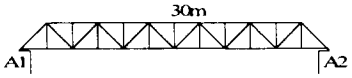
Number	RHD Division	Road No. & Bridge ID	Side View	Super-structure	Sub-structure		Approach Road (m)	Revetment (m^2)	Phase	Remarks
					Abutment/Pier	Foundation Pile Diameter 600mm				
1	Rangamati	N16 300418		L = 15 m W = 27.926 ton	A1 : H = 5.50m A2 : H = 5.50m	A1 : 15.50 x 20 A2 : 15.50 x 20	R: 20.0 L: 20.0	R: 100 L: 100	1	2-Lane (W = 7.5m + 2 x 1.25m) Staging Erection
2	Rangamati	F1814 300273		L = 25 m W = 22.356 ton	A1 : H = 4.30m A2 : H = 5.00m	A1 : 6.00 x 12 A2 : 6.00 x 12	R: 20.0 L: 20.0	R: 90 L: 90	1	Draw Erection
3	Rangamati	F1613 300448		L = 45 m W = 41.692 ton	A1 : H = 4.90m P1 : H = 7.80m A2 : H = 4.90m	A1 : 5.30 x 12 P1 : 6.00 x 9 A2 : 6.20 x 12	R: 20.0 L: 20.0	R: 120 L: 210	1	Draw Erection
4	Brahman B.	F1207 New(km39)		L = 30 m W = 28.867 ton	A1 : H = 4.30m A2 : H = 5.00m	A1 : 16.00 x 12 A2 : 16.00 x 12	R: 20.0 L: 20.0	R: 125 L: 125	1	Staging Erection
5	Brahman B.	F1206 New(km29)		L = 65 m W = 56.370 ton	A1 : H = 7.10m P1 : H = 4.00m P2 : H = 4.00m A2 : H = 7.80m	A1 : 16.00 x 12 P1 : 18.50 x 9 P2 : 18.50 x 9 A2 : 16.00 x 12	R: 20.0 L: 20.0	R: 175 L: 175	2	Draw Erection
6	Cox's Bazar	F1009 300359		L = 15 m W = 12.825 ton	A1 : H = 4.60m A2 : H = 4.60m	A1 : 10.50 x 12 A2 : 10.50 x 12	R: 20.0 L: 20.0	R: --- L: ---	1	Draw Erection
7	Dohazari	F1018 301014		L = 15 m W = 12.825 ton	A1 : H = 4.80m A2 : H = 4.60m	A1 : 10.50 x 12 A2 : 10.50 x 12	R: 20.0 L: 20.0	R: --- L: ---	1	Draw Erection
8	Dohazari	F1018 301020		L = 20 m W = 17.007 ton	A1 : H = 5.30m A2 : H = 5.20 m	A1 : 10.50 x 12 A2 : 10.50 x 12	R: 20.0 L: 20.0	R: 125 L: 125	1	Staging Erection
9	Dohazari	F1037 300944		L = 20 m W = 17.007 ton	A1 : H = 5.00m A2 : H = 6.00m	A1 : 10.50 x 12 A2 : 10.50 x 12	R: 20.0 L: 20.0	R: 150 L: 150	1	Draw Erection
10	Dohazari	F1038 301070		L = 30 m W = 28.867 ton	A1 : H = 6.10m A2 : H = 7.10m	A1 : 30.00 x 12 A2 : 10.50 x 12	R: 20.0 L: 20.0	R: 200 L: 125	1	Draw Erection

TABLE 2.3.2-4 BASIC DIMENSIONS OF THE PROJECT BRIDGES (2/8)

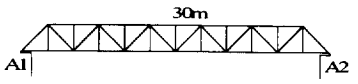
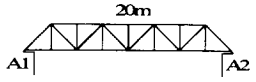
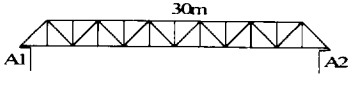
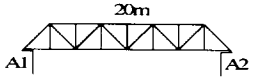
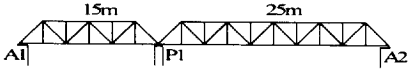
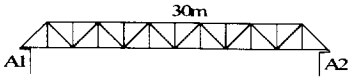
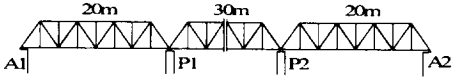
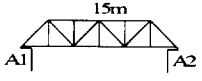
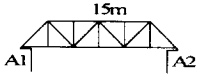
Number	RHD Division	Road No. & Bridge ID	Side View	Super-structure	Sub-structure		Approach Road (m)	Revetment (m^2)	Phase	Remarks
					Abutment/Pier	Foundation Pile Diameter 600mm				
11	Jamalpur	F4021 100052		L = 30 m W = 28.867 ton	A1 : H = 9.20m A2 : H = 10.50m	A1 : 7.00 x 12 A2 : 8.50 x 12	R: 20.0 L: 20.0	R: 175 L: 175	1	Draw Erection
12	Munshigonj	F8001 100216		L = 20 m W = 17.007 ton	A1 : H = 6.20m A2 : H = 4.50m	A1 : 13.00 x 12 A2 : 17.00 x 12	R: 20.0 L: 20.0	R: 120 L: 120	1	Draw Erection
13	Munshigonj	F8122 New		L = 40 m W = 35.181 ton	A1 : H = 5.70m P1 : H = 4.80m A2 : H = 5.70m	A1 : 13.00 x 12 P1 : 15.00 x 9 A2 : 17.00 x 12	R: 20.0 L: 20.0	R: 250 L: 150	1	Draw Erection
14	Manikgonj	F5064 101020		L = 30 m W = 28.867 ton	A1 : H = 6.70m A2 : H = 6.40m	A1 : 9.00 x 12 A2 : 9.00 x 12	R: 20.0 L: 20.0	R: 125 L: 100	1	Staging Erection
15	Manikgonj	F5064 101021		L = 20 m W = 17.007 ton	A1 : H = 6.10m A2 : H = 5.40m	A1 : 9.00 x 12 A2 : 9.00 x 12	R: 20.0 L: 20.0	R: 175 L: 175	1	Draw Erection
16	Manikgonj	F5064 101026		L = 40 m W = 35.181 ton	A1 : H = 7.20m P1 : H = 4.50m A2 : H = 6.00m	A1 : 9.00 x 12 P1 : 11.00 x 9 A2 : 9.00 x 12	R: 20.0 L: 20.0	R: 225 L: 225	1	Draw Erection
17	Manikgonj	F5064 101028		L = 30 m W = 28.867 ton	A1 : H = 5.50m A2 : H = 6.80m	A1 : 9.00 x 12 A2 : 9.00 x 12	R: 20.0 L: 20.0	R: 125 L: 175	1	Draw Erection
18	Manikgonj	F4014 101037		L = 70 m W = 62.881 ton	A1 : H = 9.70m P1 : H = 9.00m P2 : H = 9.00m A2 : H = 8.20m	A1 : 8.00 x 12 P1 : 10.00 x 9 P2 : 10.00 x 9 A2 : 11.00 x 12	R: 20.0 L: 20.0	R: 600 L: 750	2	Draw Erection
19	Tangail	F4024 100667		L = 15 m W = 12.825 ton	A1 : H = 9.60m A2 : H = 8.20m	A1 : 16.00 x 12 A2 : 17.00 x 12	R: 20.0 L: 20.0	R: 300 L: 300	1	Draw Erection
20	Pirojpur	F7709 700825		L = 15 m W = 25.346 ton	A1 : H = 5.00m A2 : H = 4.50m	A1 : 26.00 x 20 A2 : 26.00 x 20	R: 20.0 L: 20.0	R: 100 L: 100	1	2-Lane (W = 6.1m + 2 x 0.75m) Staging Erection

TABLE 2.3.2-4 BASIC DIMENSIONS OF THE PROJECT BRIDGES (3/8)

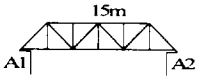
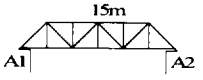
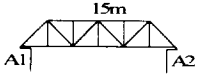
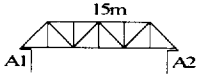
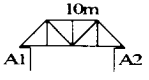
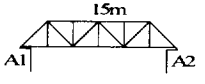
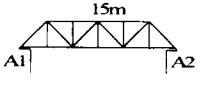
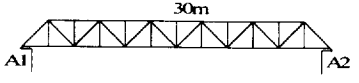
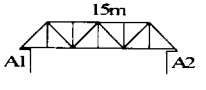
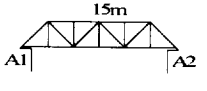
Number	RHD Division	Road No. & Bridge ID	Side View	Super-structure	Sub-structure		Approach Road (m)	Revetment (m^2)	Phase	Remarks
					Abutment/Pier	Foundation Pile Diameter 600mm				
21	Pirojpur	F7709 700826		L = 15 m W = 25.346 ton	A1 : H = 4.40m A2 : H = 4.40m	A1 : 26.00 x 20 A2 : 26.00 x 20	R: 20.0 L: 20.0	R: 100 L: 100	1	2-Lane (W = 6.1m + 2 x 0.75m) Staging Erection
22	Pirojpur	F8707 700577		L = 15 m W = 12.825 ton	A1 : H = 4.60m A2 : H = 5.10m	A1 : 16.00 x 12 A2 : 16.00 x 12	R: 20.0 L: 20.0	R: 100 L: 100	1	Draw Erection
23	Pirojpur	F7706 700803		L = 15 m W = 12.825 ton	A1 : H = 6.00m A2 : H = 6.00m	A1 : 9.00 x 12 A2 : 9.50 x 12	R: 20.0 L: 20.0	R: 150 L: 150	1	Draw Erection
24	Pirojpur	F7706 700805		L = 15 m W = 12.825 ton	A1 : H = 6.10m A2 : H = 5.40m	A1 : 9.00 x 12 A2 : 9.50 x 12	R: 20.0 L: 20.0	R: 150 L: 150	1	Staging Erection
25	Pirojpur	F7706 700806		L = 10 m W = 8.643 ton	A1 : H = 3.70m A2 : H = 4.00m	A1 : 9.00 x 12 A2 : 9.50 x 12	R: 20.0 L: 20.0	R: --- L: ---	1	Staging Erection
26	Pirojpur	F7706 700809		L = 15 m W = 12.825 ton	A1 : H = 4.10m A2 : H = 4.10m	A1 : 9.00 x 12 A2 : 9.50 x 12	R: 20.0 L: 20.0	R: 150 L: 150	1	Staging Erection
27	Pirojpur	F7706 700812		L = 15 m W = 12.825 ton	A1 : H = 4.00m A2 : H = 4.00m	A1 : 9.00 x 12 A2 : 9.50 x 12	R: 20.0 L: 20.0	R: 150 L: 150	1	Draw Erection
28	Pirojpur	F7707 700814		L = 30 m W = 28.867 ton	A1 : H = 6.70m A2 : H = 6.70m	A1 : 9.00 x 12 A2 : 9.50 x 12	R: 20.0 L: 20.0	R: 320 L: 320	1	Staging Erection
29	Pirojpur	F7707 700815		L = 15 m W = 12.825 ton	A1 : H = 3.50m A2 : H = 3.50m	A1 : 9.00 x 12 A2 : 9.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	1	Staging Erection
30	Pirojpur	F7707 700816		L = 15 m W = 12.825 ton	A1 : H = 4.50m A2 : H = 4.50m	A1 : 9.00 x 12 A2 : 9.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	1	Draw Erection

TABLE 2.3.2-4 BASIC DIMENSIONS OF THE PROJECT BRIDGES (4/8)

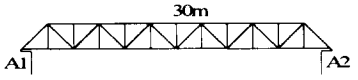
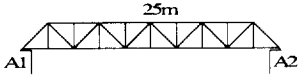
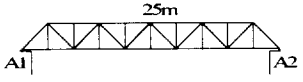
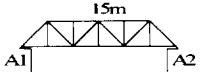
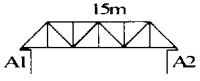
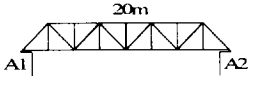
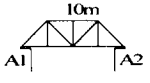
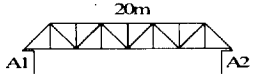
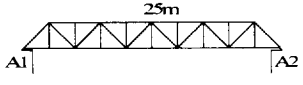
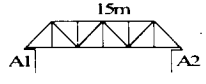
Number	RHD Division	Road No. & Bridge ID	Side View	Super-structure	Sub-structure		Approach Road (m)	Revetment (m^2)	Phase	Remarks
					Abutment/Pier	Foundation Pile Diameter 600mm				
31	Pirojpur	F7711 700844		L = 30 m W = 28.867 ton	A1 : H = 5.70m A2 : H = 6.00m	A1 : 24.50 x 12 A2 : 24.00 x 12	R: 20.0 L: 20.0	R: 320 L: 320	2	Staging Erection
32	Pirojpur	F7712 700863		L = 25 m W = 22.356 ton	A1 : H = 4.70m A2 : H = 4.70m	A1 : 10.00 x 12 A2 : 11.00 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Draw Erection
33	Pirojpur	F8712 700876		L = 25 m W = 22.356 ton	A1 : H = 4.00m A2 : H = 5.00m	A1 : 16.00 x 12 A2 : 15.00 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Staging Erection
34	Pirojpur	F8715 700849		L = 15 m W = 12.825 ton	A1 : H = 4.30m A2 : H = 4.30m	A1 : 19.00 x 12 A2 : 18.00 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Draw Erection
35	Pirojpur	F8715 700850		L = 15 m W = 12.825 ton	A1 : H = 5.00m A2 : H = 5.00m	A1 : 19.00 x 12 A2 : 18.00 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Staging Erection
36	Pirojpur	F8715 700853		L = 20 m W = 17.007 ton	A1 : H = 5.40m A2 : H = 6.70m	A1 : 19.00 x 12 A2 : 18.00 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Draw Erection
37	Pirojpur	F7704 New(km25)		L = 10 m W = 8.643 ton	A1 : H = 5.20m A2 : H = 4.40m	A1 : 9.00 x 12 A2 : 9.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Staging Erection
38	Barisal	F8034 700416		L = 20 m W = 17.007 ton	A1 : H = 5.40m A2 : H = 5.70m	A1 : 10.00 x 12 A2 : 10.00 x 12	R: 20.0 L: 20.0	R: 100 L: 100	1	Draw Erection
39	Barisal	F8032 /700446		L = 25 m W = 22.356 ton	A1 : H = 5.70m A2 : H = 5.70m	A1 : 17.00 x 12 A2 : 14.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	1	Draw Erection
40	Barisal	F8032 700451		L = 15 m W = 12.825 ton	A1 : H = 4.80m A2 : H = 5.00m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	1	Draw Erection

TABLE 2.3.2-4 BASIC DIMENSIONS OF THE PROJECT BRIDGES (5/8)

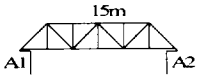
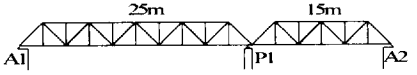
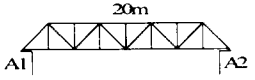
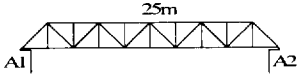
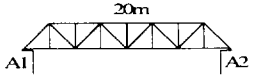
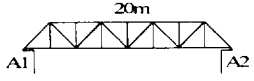
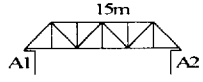
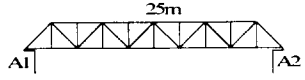
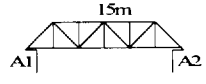
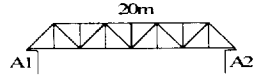
Number	RHD Division	Road No. & Bridge ID	Side View	Super-structure	Sub-structure		Approach Road (m)	Revetment (m^2)	Phase	Remarks
					Abutment/Pier	Foundation Pile Diameter 600mm				
41	Barisal	F8032 700453		L = 15 m W = 12.825 ton	A1 : H = 3.60m A2 : H = 4.60m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	1	Draw Erection
42	Barisal	F8036 700474		L = 40 m W = 35.181 ton	A1 : H = 4.80m P1 : H = 5.00m A2 : H = 5.20 m	A1 : 18.00 x 12 P1 : 10.00 x 9 A2 : 7.50 x 12	R: 20.0 L: 20.0	R: 480 L: 480	1	Draw Erection
43	Barisal	F8036 700479		L = 20 m W = 17.007 ton	A1 : H = 6.10m A2 : H = 5.40m	A1 : 18.00 x 12 A2 : 7.50 x 12	R: 20.0 L: 20.0	R: 125 L: 125	1	Draw Erection
44	Barisal	F8018 701123		L = 25 m W = 22.356 ton	A1 : H = 4.60m A2 : H = 6.80m	A1 : 14.50 x 12 A2 : 17.00 x 12	R: 20.0 L: 20.0	R: 150 L: 150	1	Staging Erection
45	Barisal	F8018 701124		L = 20 m W = 17.007 ton	A1 : H = 4.60m A2 : H = 4.60m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: 180 L: 180	1	Staging Erection
46	Barisal	F8018 701125		L = 20 m W = 17.007 ton	A1 : H = 5.60m A2 : H = 4.60m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: --- L: ---	2	Staging Erection
47	Barisal	F8018 701126		L = 15 m W = 12.825 ton	A1 : H = 5.50m A2 : H = 5.40m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: 120 L: 120	2	Staging Erection
48	Barisal	F8018 701127		L = 25 m W = 22.356 ton	A1 : H = 6.00m A2 : H = 7.20m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: 120 L: 120	2	Staging Erection
49	Barisal	F8019 701149		L = 15 m W = 12.825 ton	A1 : H = 5.20m A2 : H = 4.40m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: --- L: ---	2	Staging Erection
50	Barisal	F8019 701148		L = 20 m W = 17.007 ton	A1 : H = 5.20m A2 : H = 5.10m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Draw Erection

TABLE 2.3.2-4 BASIC DIMENSIONS OF THE PROJECT BRIDGES (6/8)

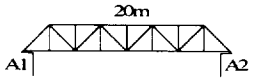
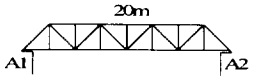
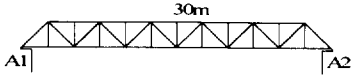
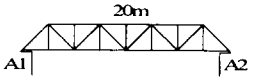
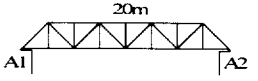
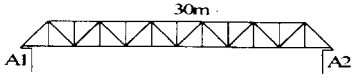
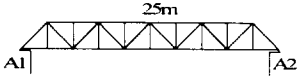
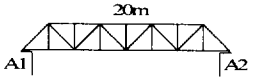
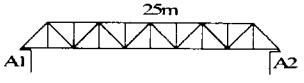
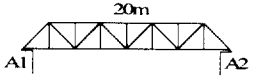
Number	RHD Division	Road No. & Bridge ID	Side View	Super-structure	Sub-structure		Approach Road (m)	Revetment (m^2)	Phase	Remarks
					Abutment/Pier	Foundation Pile Diameter 600mm				
51	Barisal	F8019 701150		L = 20 m W = 17.007 ton	A1 : H = 4.70m A2 : H = 4.60m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Staging Erection
52	Barisal	F8019 701151		L = 20 m W = 17.007 ton	A1 : H = 5.60m A2 : H = 5.50m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Staging Erection
53	Barisal	F8020 701094		L = 30 m W = 28.867 ton	A1 : H = 5.00m A2 : H = 5.10m	A1 : 14.50 x 12 A2 : 15.00 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Staging Erection
54	Barisal	F8020 701095		L = 20 m W = 17.007 ton	A1 : H = 4.80m A2 : H = 5.50m	A1 : 14.50 x 12 A2 : 15.00 x 12	R: 20.0 L: 20.0	R: --- L: ---	2	Draw Erection
55	Barisal	F8020 701096		L = 20 m W = 17.007 ton	A1 : H = 3.80m A2 : H = 3.90m	A1 : 14.50 x 12 A2 : 15.00 x 12	R: 20.0 L: 20.0	R: --- L: ---	2	Staging Erection
56	Barisal	F8020 701097		L = 30 m W = 28.867 ton	A1 : H = 6.00m A2 : H = 6.70m	A1 : 15.00 x 12 A2 : 20.00 x 12	R: 20.0 L: 20.0	R: 125 L: 125	2	Staging Erection
57	Barisal	F8020 701098		L = 25 m W = 22.356 ton	A1 : H = 5.00m A2 : H = 5.10m	A1 : 17.00 x 12 A2 : 14.00 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Staging Erection
58	Barisal	F8020 701103		L = 20 m W = 17.007 ton	A1 : H = 6.10m A2 : H = 5.40m	A1 : 15.00 x 12 A2 : 20.00 x 12	R: 20.0 L: 20.0	R: 175 L: 140	2	Staging Erection
59	Barisal	F8407 701105		L = 25 m W = 22.356 ton	A1 : H = 4.20m A2 : H = 4.30m	A1 : 14.50 x 12 A2 : 17.00 x 12	R: 20.0 L: 20.0	R: --- L: ---	2	Staging Erection
60	Barisal	F8407 701108		L = 20 m W = 17.007 ton	A1 : H = 5.10m A2 : H = 5.40m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	2	Staging Erection

TABLE 2.3.2-4 BASIC DIMENSIONS OF THE PROJECT BRIDGES (7/8)

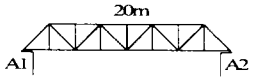
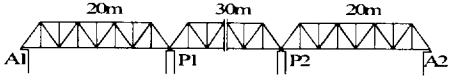
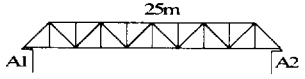
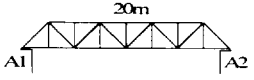
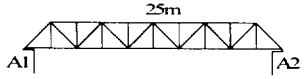
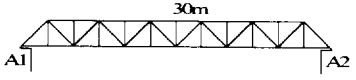
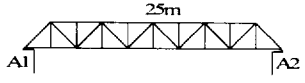
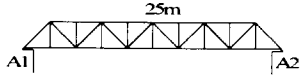
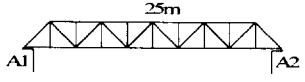
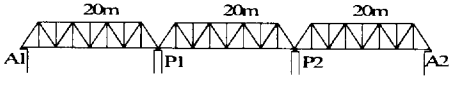
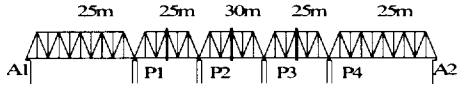
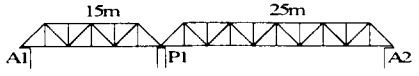
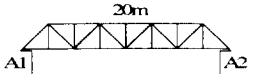
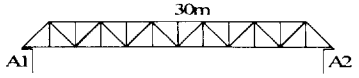
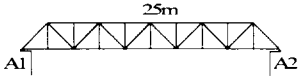
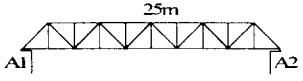
Number	RHD Division	Road No. & Bridge ID	Side View	Super-structure	Sub-structure		Approach Road (m)	Revetment (m^2)	Phase	Remarks
					Abutment/Pier	Foundation Pile Diameter 600mm				
61	Barisal	F8407 701109		L = 20 m W = 17.007 ton	A1 : H = 6.10m A2 : H = 5.40m	A1 : 16.00 x 12 A2 : 17.50 x 12	R: 20.0 L: 20.0	R: 175 L: 175	2	Draw Erection
62	Barguna	F8805 700309		L = 70 m W = 62.881 ton	A1 : H = 4.90m P1 : H = 6.00m P2 : H = 6.00m A2 : H = 5.00m	A1 : 19.00 x 12 P1 : 17.00 x 9 P2 : 16.00 x 9 A2 : 15.00 x 12	R: 20.0 L: 20.0	R: 450 L: 450	2	Draw Erection
63	Jhalakati	F8056 700945		L = 25 m W = 22.356 ton	A1 : H = 4.10m A2 : H = 4.60m	A1 : 10.50 x 12 A2 : 11.00 x 12	R: 20.0 L: 20.0	R: 150 L: 150	2	Draw Erection
64	Chandpur	F1407 201338		L = 20 m W = 17.007 ton	A1 : H = 5.50m A2 : H = 5.40m	A1 : 7.00 x 12 A2 : 8.00 x 12	R: 20.0 L: 20.0	R: 150 L: 150	1	Draw Erection
65	Chandpur	F1407 201342		L = 25 m W = 22.356 ton	A1 : H = 8.10m A2 : H = 7.10m	A1 : 7.00 x 12 A2 : 8.00 x 12	R: 20.0 L: 20.0	R: 175 L: 175	1	Staging Erection
66	Laxmipur	R140 200200		L = 30 m W = 72.820 ton	A1 : H = 5.00m A2 : H = 5.00m	A1 : 19.00 x 20 A2 : 19.00 x 20	R: 20.0 L: 20.0	R: 175 L: 175	1	2-Lane (W = 7.5m + 2 x 1.00m) Staging Erection
67	Laxmipur	R140 200253		L = 25 m W = 54.383 ton	A1 : H = 4.80m A2 : H = 4.80m	A1 : 19.00 x 20 A2 : 19.00 x 20	R: 20.0 L: 20.0	R: 175 L: 175	1	2-Lane (W = 7.5m + 2 x 1.00m) Staging Erection
68	Laxmipur	F1404 200220		L = 25 m W = 22.356 ton	A1 : H = 4.80m A2 : H = 5.80m	A1 : 7.00 x 12 A2 : 8.00 x 12	R: 20.0 L: 20.0	R: --- L: ---	1	Draw Erection
69	Laxmipur	F1405 200243		L = 25 m W = 22.356 ton	A1 : H = 5.50m A2 : H = 5.20 m	A1 : 16.00 x 12 A2 : 16.50 x 12	R: 20.0 L: 20.0	R: 175 L: 175	1	Draw Erection
70	Moulavi B.	F2821 200975		L = 60 m W = 51.021 ton	A1 : H = 5.70m P1 : H = 4.50m P2 : H = 4.50m A2 : H = 6.00m	A1 : 17.00 x 12 P1 : 18.00 x 9 P2 : 17.00 x 9 A2 : 15.00 x 12	R: 20.0 L: 20.0	R: 400 L: 400	2	Draw Erection

TABLE 2.3.2-4 BASIC DIMENSIONS OF THE PROJECT BRIDGES (8/8)

Number	RHD Division	Road No. & Bridge ID	Side View	Super-structure	Sub-structure		Approach Road (m)	Revetment (m^2)	Phase	Remarks
					Abutment/Pier	Foundation Pile Diameter 600mm				
71	Moulavi B.	F2003 201011		L = 130 m W = 118.291 ton	A1 : H = 6.00m P1 : H = 6.50m P2 : H = 6.50m P3 : H = 6.50m P4 : H = 6.50m A2 : H = 6.50m	A1 : 37.00 x 12 P1 : 36.00 x 9 P2 : 36.00 x 9 P3 : 36.00 x 9 P2 : 36.00 x 9 A2 : 38.00 x 12	R: 20.0 L: 20.0	R: 400 L: 400	2	Draw Erection
72	Moulavi B.	F2824 200869		L = 40 m W = 76.426 ton	A1 : H = 5.30m P1 : H = 5.00m A2 : H = 5.50m	A1 : 17.50 x 20 P1 : 16.00 x 20 A2 : 15.00 x 20	R: 20.0 L: 20.0	R: 125 L: 125	1	2-Lane (W = 6.1m + 2 x 0.75m) Staging Erection
73	Moulavi B.	F2003 201013		L = 20 m W = 17.007 ton	A1 : H = 7.00m A2 : H = 7.20m	A1 : 18.50 x 12 A2 : 19.00 x 12	R: 20.0 L: 20.0	R: --- L: ---	1	Draw Erection
74	Sunamgonj	F2804 201229		L = 30 m W = 28.867 ton	A1 : H = 6.00m A2 : H = 5.80m	A1 : 13.00 x 12 A2 : 13.50 x 12	R: 20.0 L: 20.0	R: 150 L: 150	1	Draw Erection
75	Chittagong	F1617 300120		L = 25 m W = 22.356 ton	A1 : H = 6.20m A2 : H = 5.30m	A1 : 24.00 x 12 A2 : 23.50 x 12	R: 20.0 L: 20.0	R: 100 L: 100	1	Draw Erection
76	Dhaka	R812 101215		L = 25 m W = 54.383 ton	A1 : H = 5.10m A2 : H = 5.50m	A1 : 23.50 x 20 A2 : 23.50 x 20	R: 20.0 L: 20.0	R: 125 L: 125	1	2-Lane (W = 7.5m + 2 x 1.00m) Staging Erection

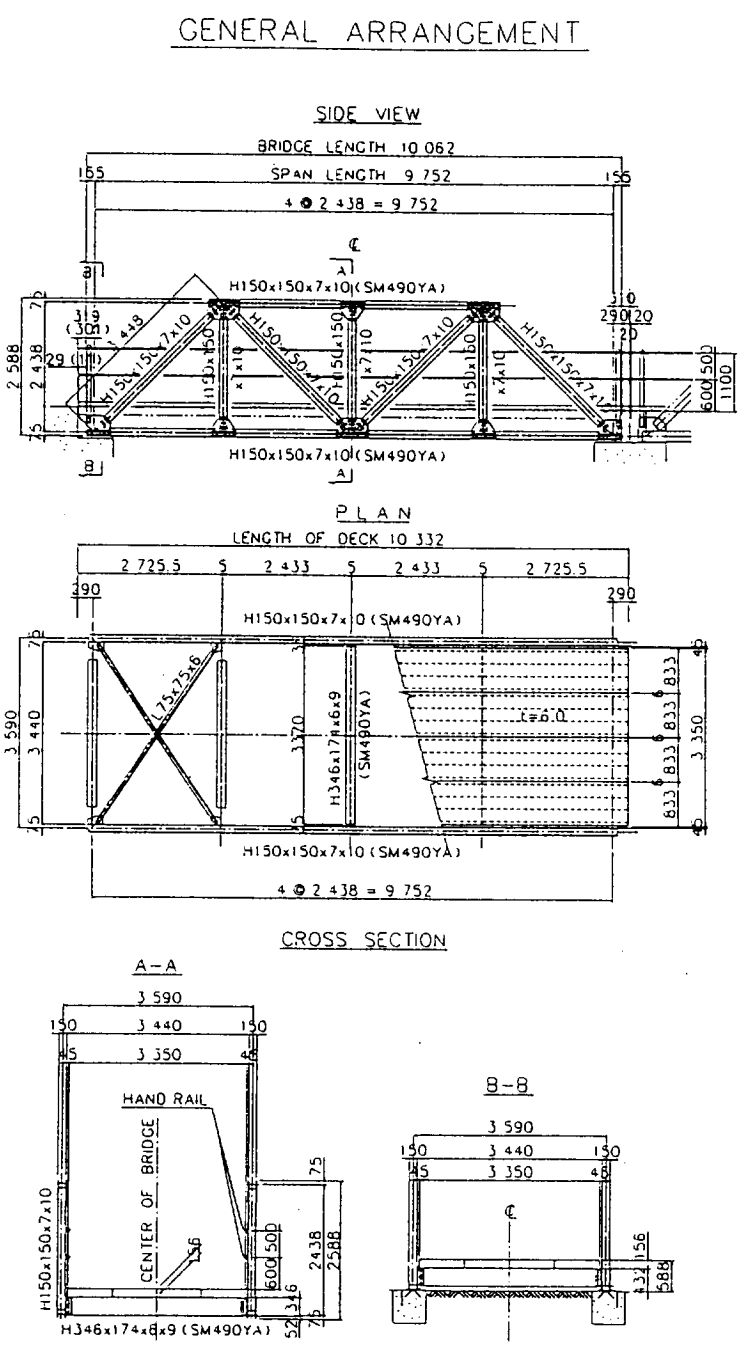
2.3.2.2 Design of Superstructure

The superstructure design was prepared in accordance with the design conditions shown in 2.3.1.2.

The following ancillaries were planned to be provided:

- Handrails to prevent from falling.
- Curb angles to prevent a wheel from running off on both sides of the deck of 1-lane bridges. In case of 2-lane bridges, concrete curbs are provided on the boundaries between carriageway and sidewalks.
- Inscription plates on two places per bridge.

Structural drawings of superstructure are shown in Figure 2.3.2-4. Details of ancillaries are shown in Figure 2.3.2-5. The results of design analysis are shown in Table 2.3.2-5.



NOTE
1.MATERIAL STANDARD NOT DESCRIBED IS JIS G3101 SS400 .

FIGURE 2.3.2-4 (1) STRUCTURAL DRAWINGS FOR SUPERSTRUCTURE (1-LANE, 3.35m WIDTH, 10m SPAN)

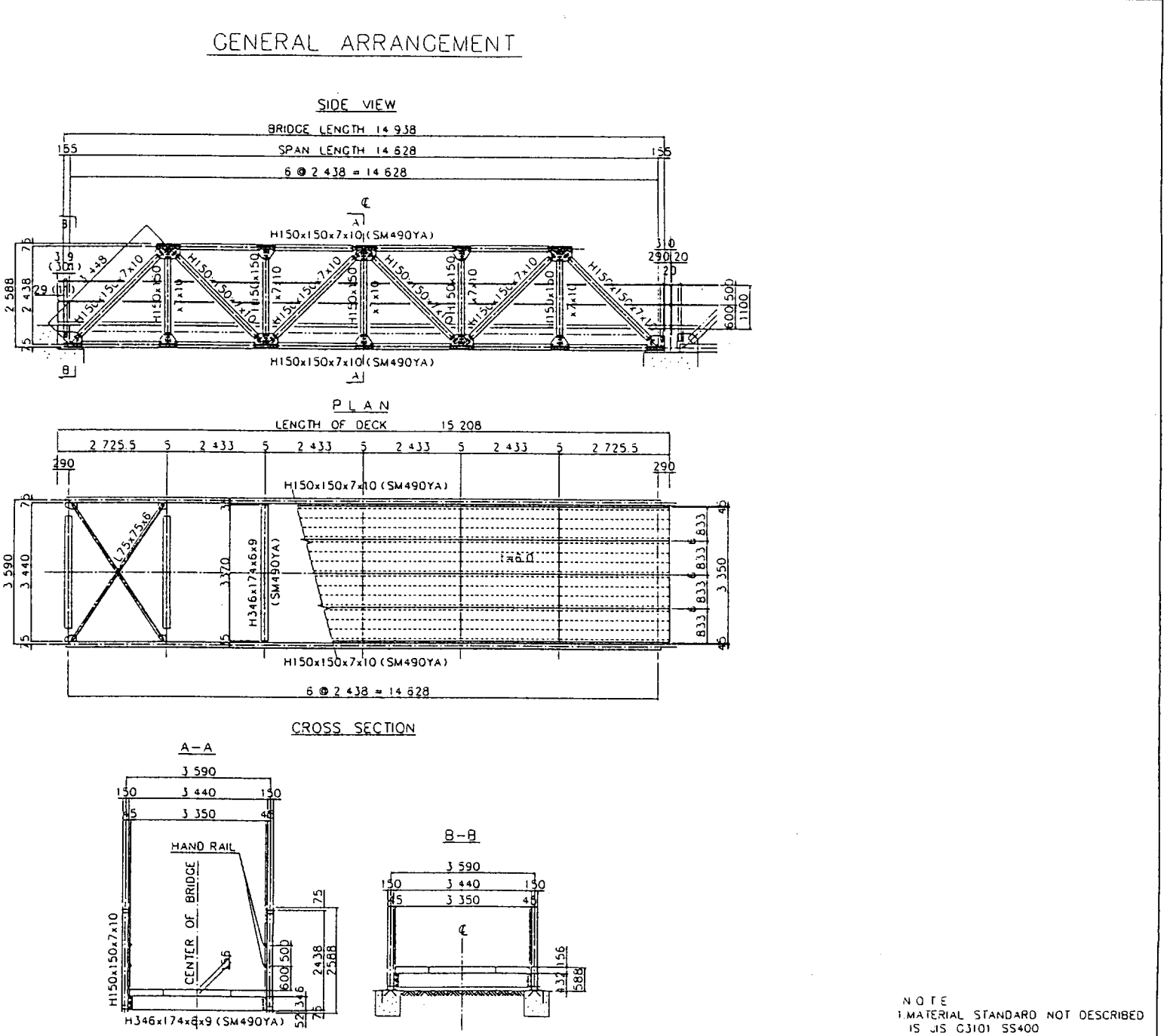


FIGURE 2.3.2-4 (2) STRUCTURAL DRAWINGS FOR SUPERSTRUCTURE (1-LANE, 3.35m WIDTH, 15m SPAN)

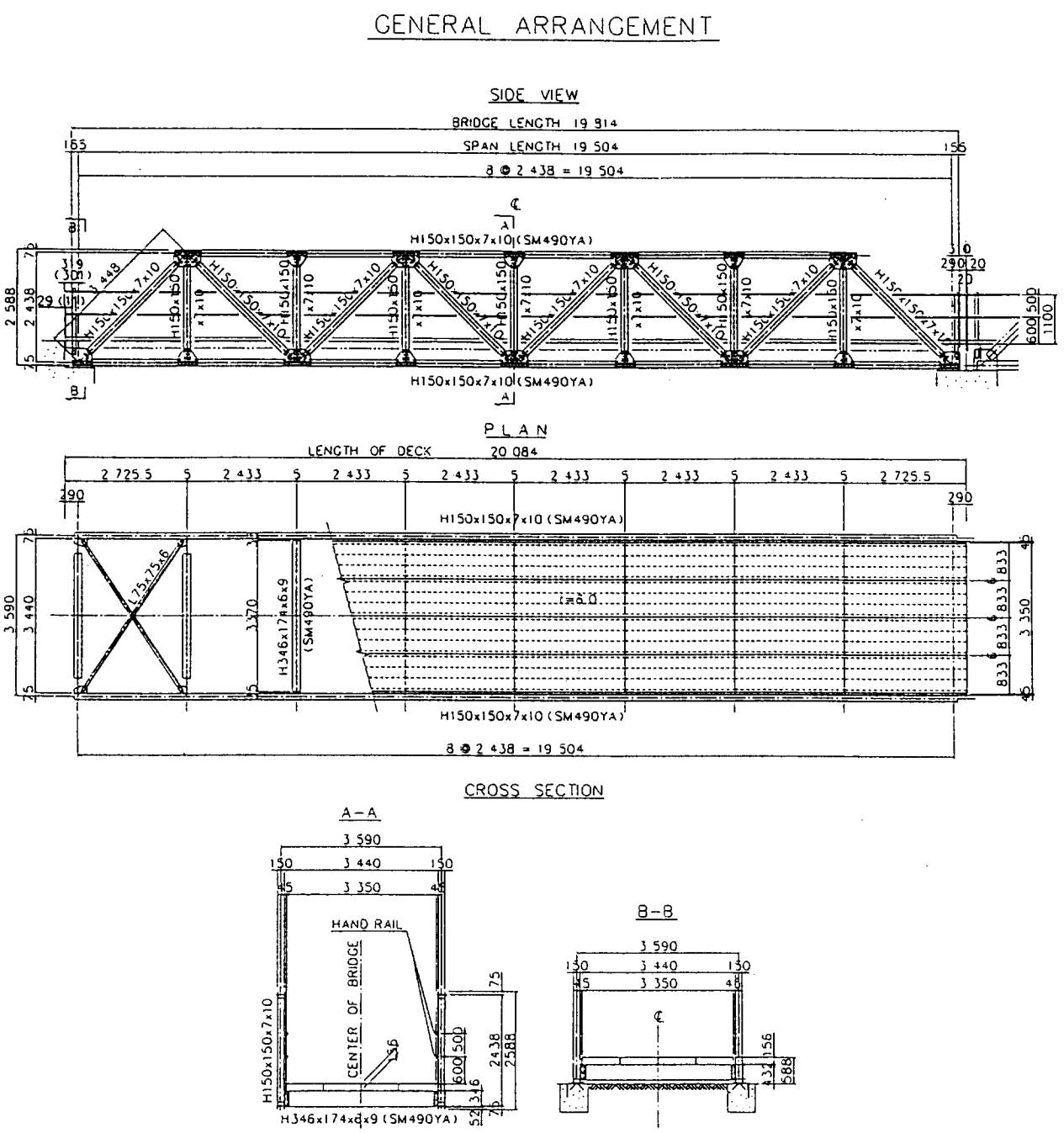


FIGURE 2.3.2-4 (3) STRUCTURAL DRAWINGS FOR SUPERSTRUCTURE (1-LANE, 3.35m WIDTH, 20m SPAN)

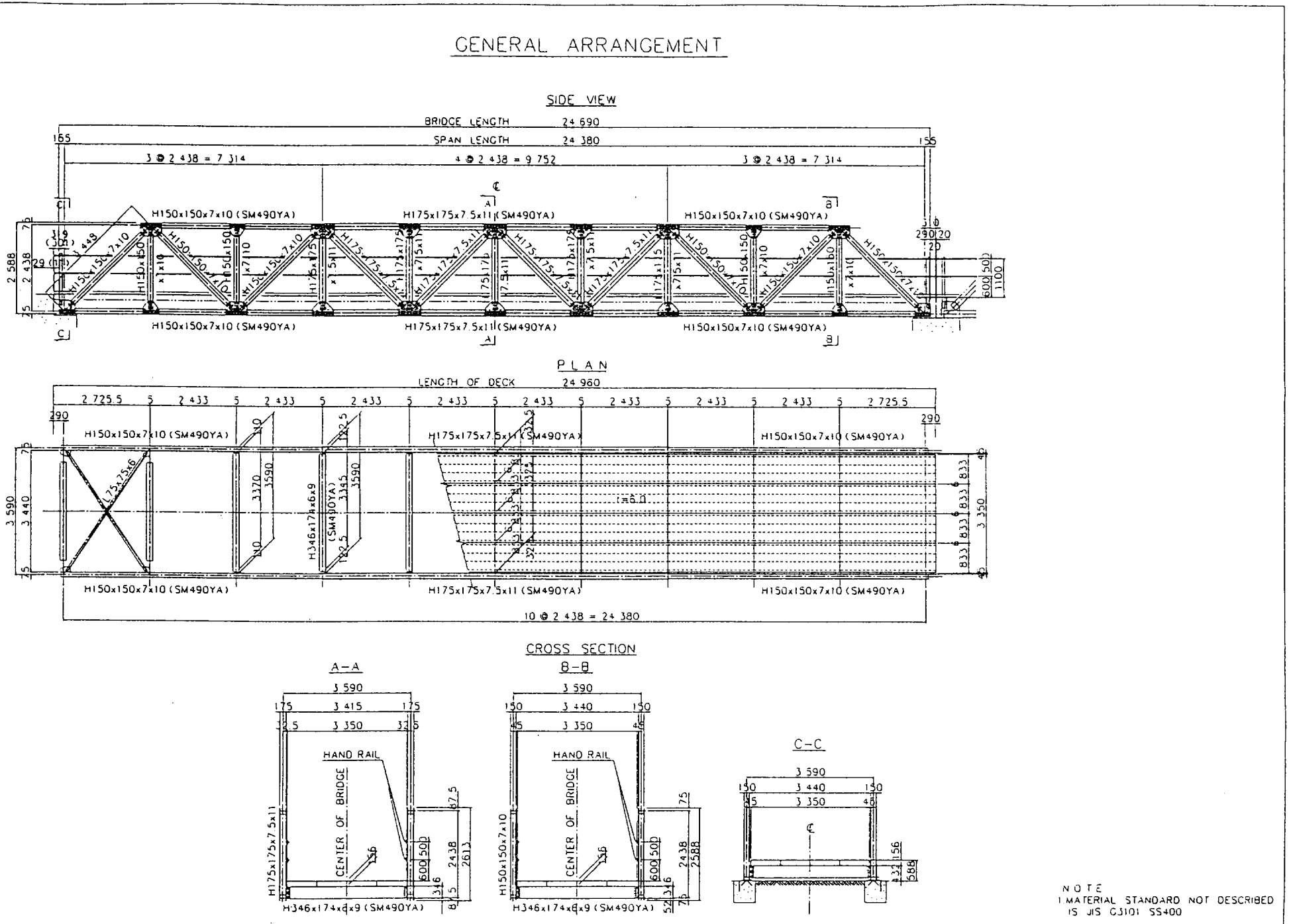


FIGURE 2.3.2-4 (4) STRUCTURAL DRAWINGS FOR SUPERSTRUCTURE (1-LANE, 3.35m WIDTH, 25m SPAN)

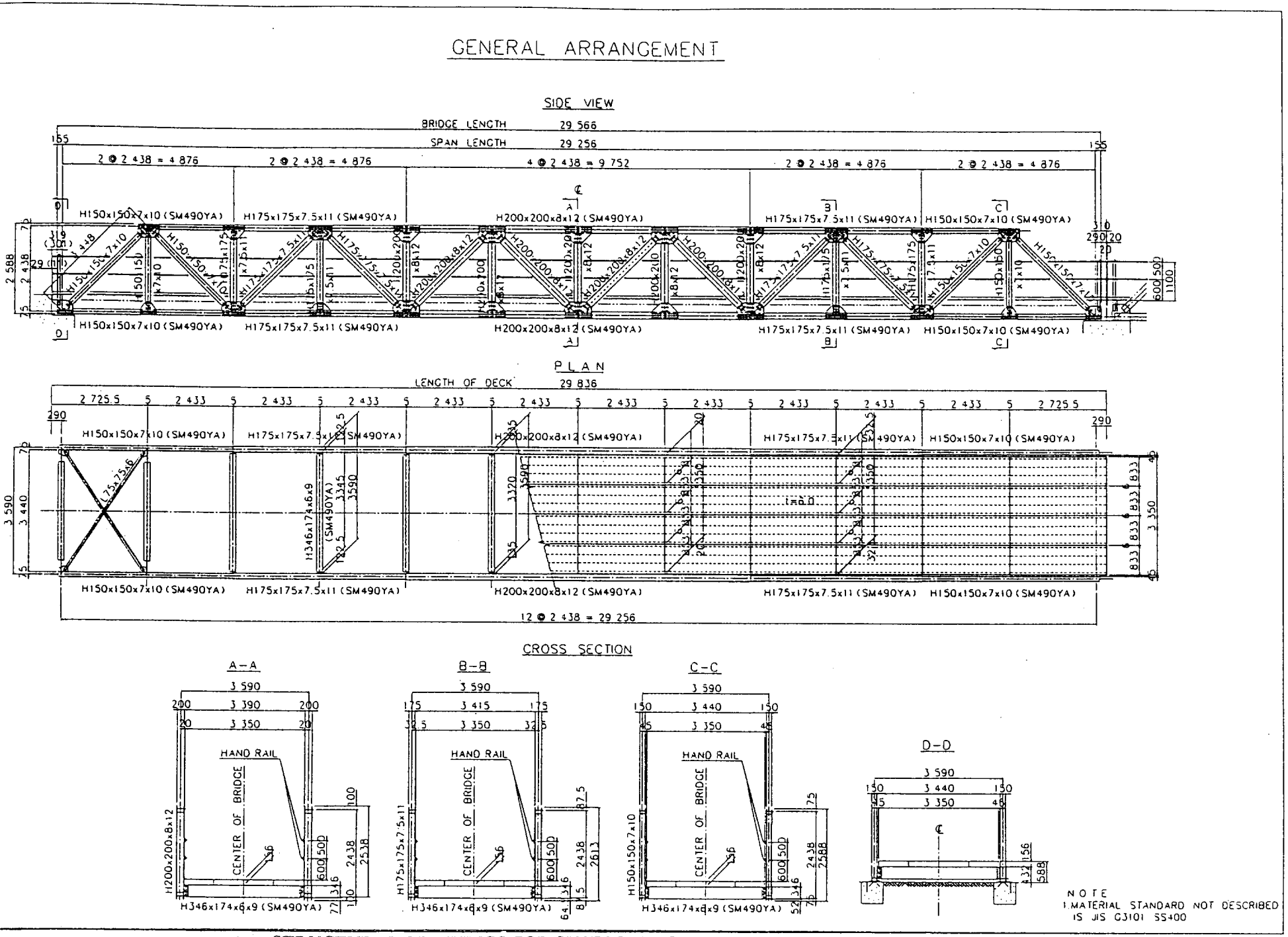


FIGURE 2.3.2-4 (5) STRUCTURAL DRAWINGS FOR SUPERSTRUCTURE (1-LANE, 3.35m WIDTH, 30m SPAN)

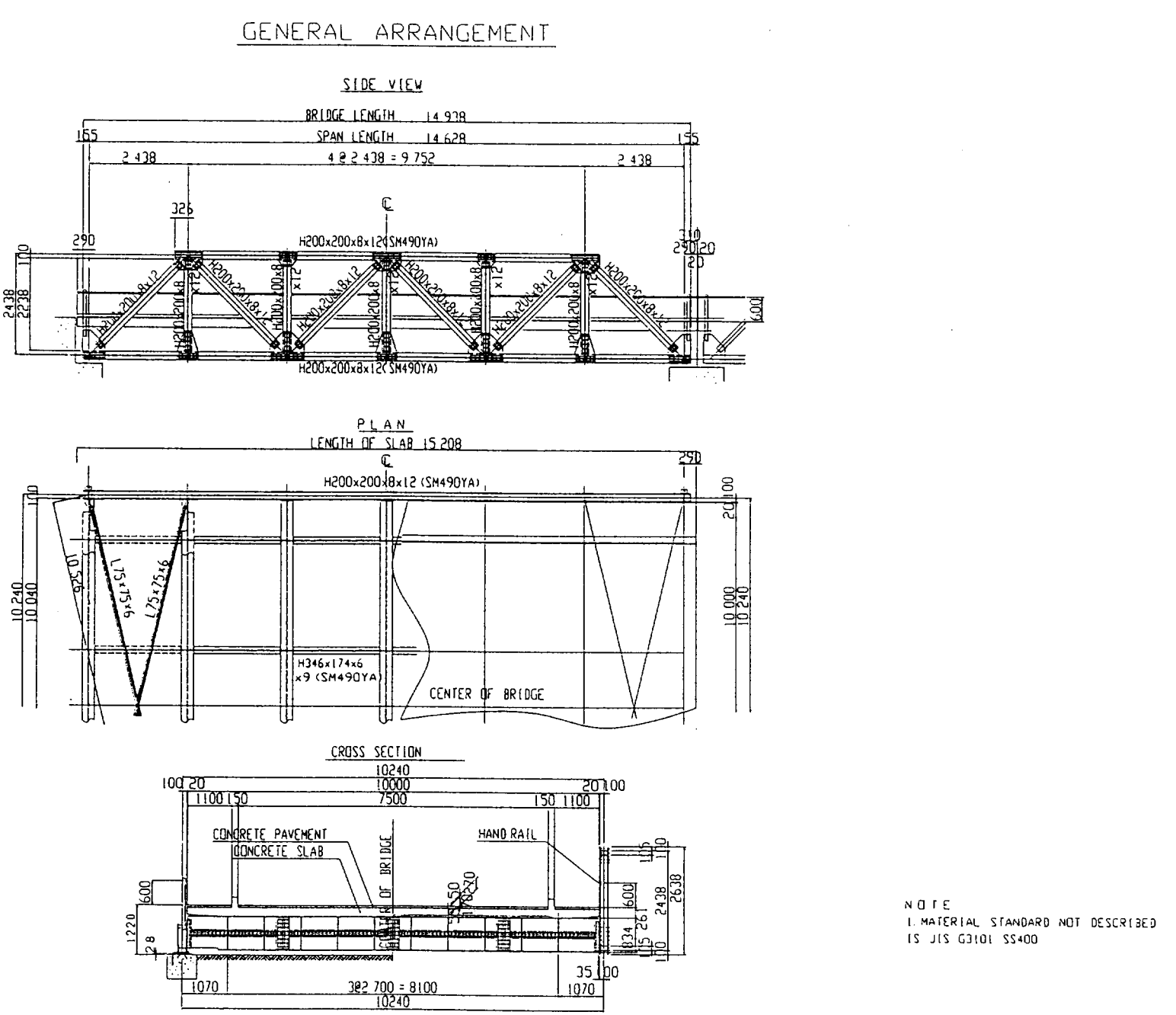
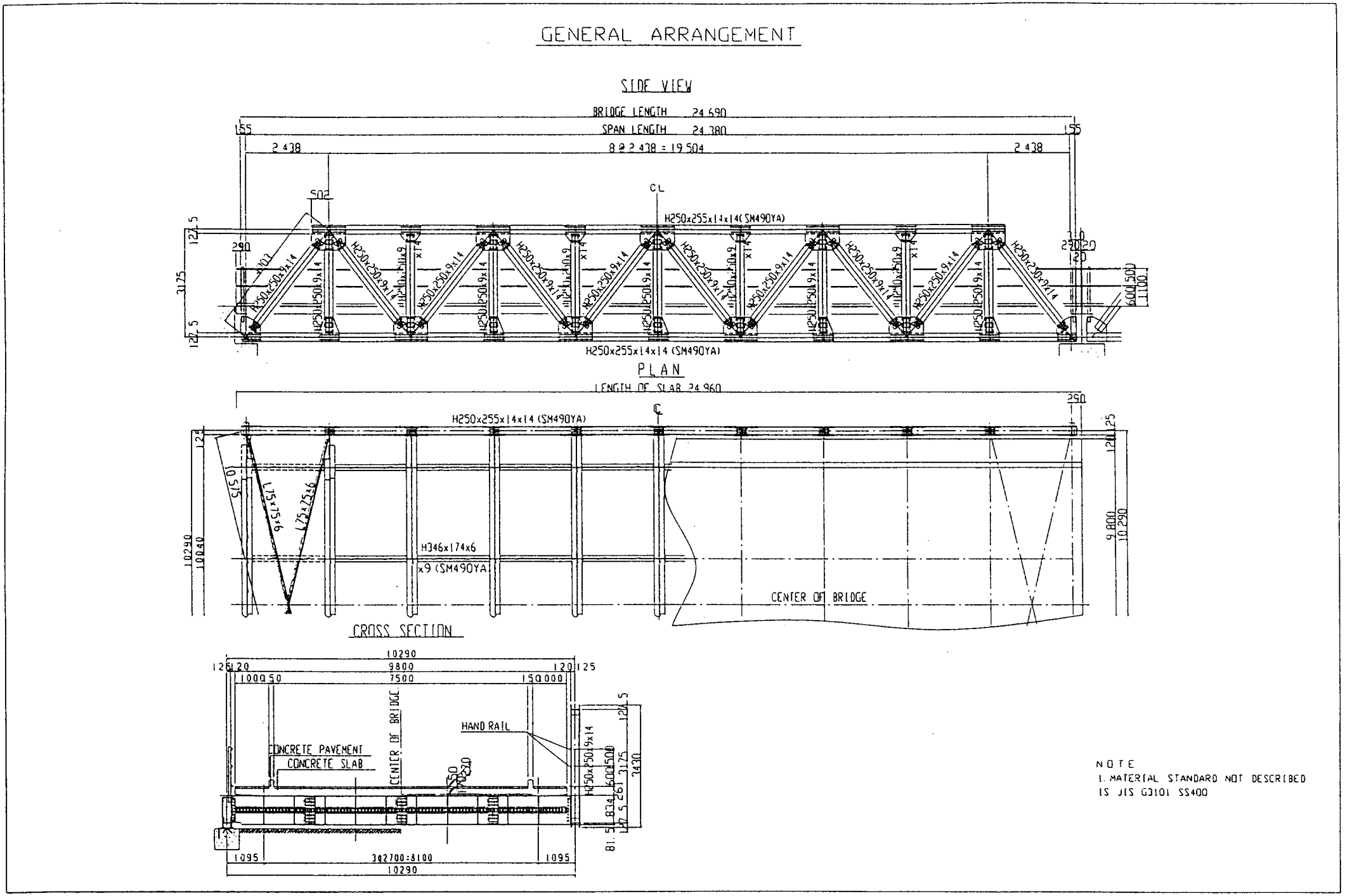


FIGURE 2.3.2-4 (6) STRUCTURAL DRAWINGS FOR SUPERSTRUCTURE (2-LANE, 10m WIDTH, 15m SPAN)



NOTE
1. MATERIAL STANDARD NOT DESCRIBED IS JIS G3101 SS400

FIGURE 2.3.2-4 (7) STRUCTURAL DRAWINGS FOR SUPERSTRUCTURE (2-LANE, 10m WIDTH, 25m SPAN)

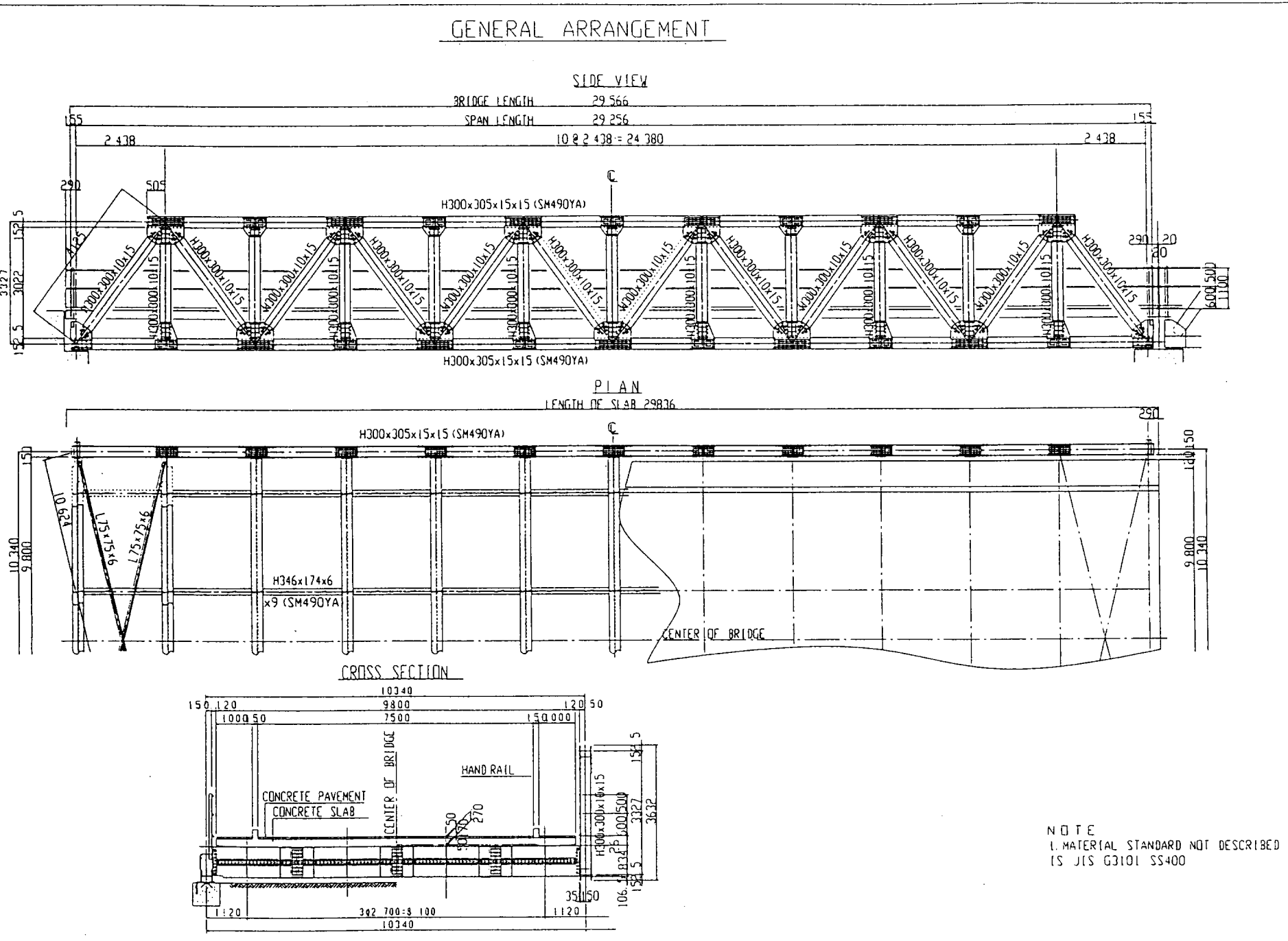


FIGURE 2.3.2-4 (8) STRUCTURAL DRAWINGS FOR SUPERSTRUCTURE (2-LANE, 10m WIDTH, 30m SPAN)

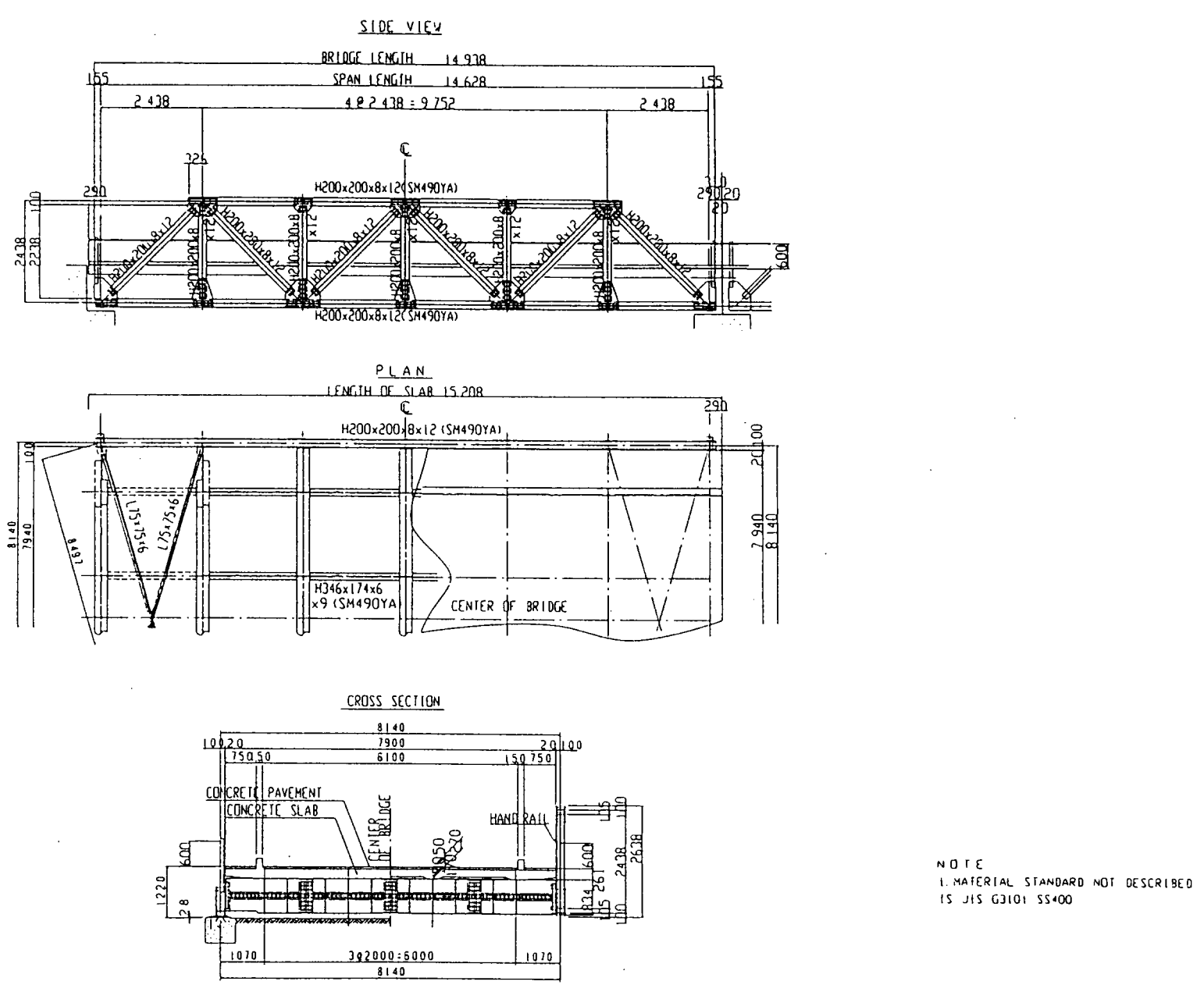


FIGURE 2.3.2-4 (9) STRUCTURAL DRAWINGS FOR SUPERSTRUCTURE (2-LANE, 7.6m WIDTH, 15m SPAN)

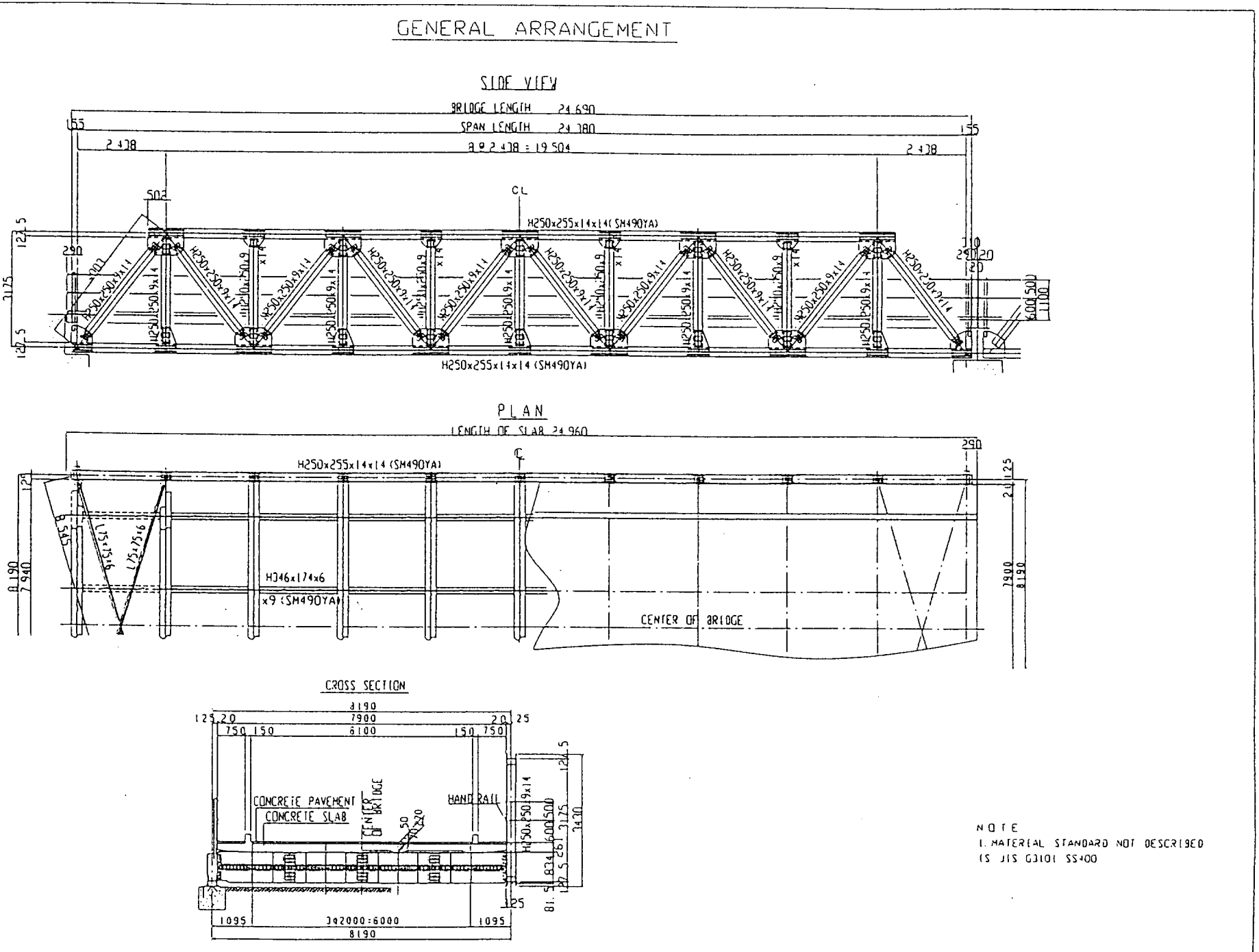


FIGURE 2.3.2-4 (10) STRUCTURAL DRAWINGS FOR SUPERSTRUCTURE (2-LANE, 7.6m WIDTH, 25m SPAN)

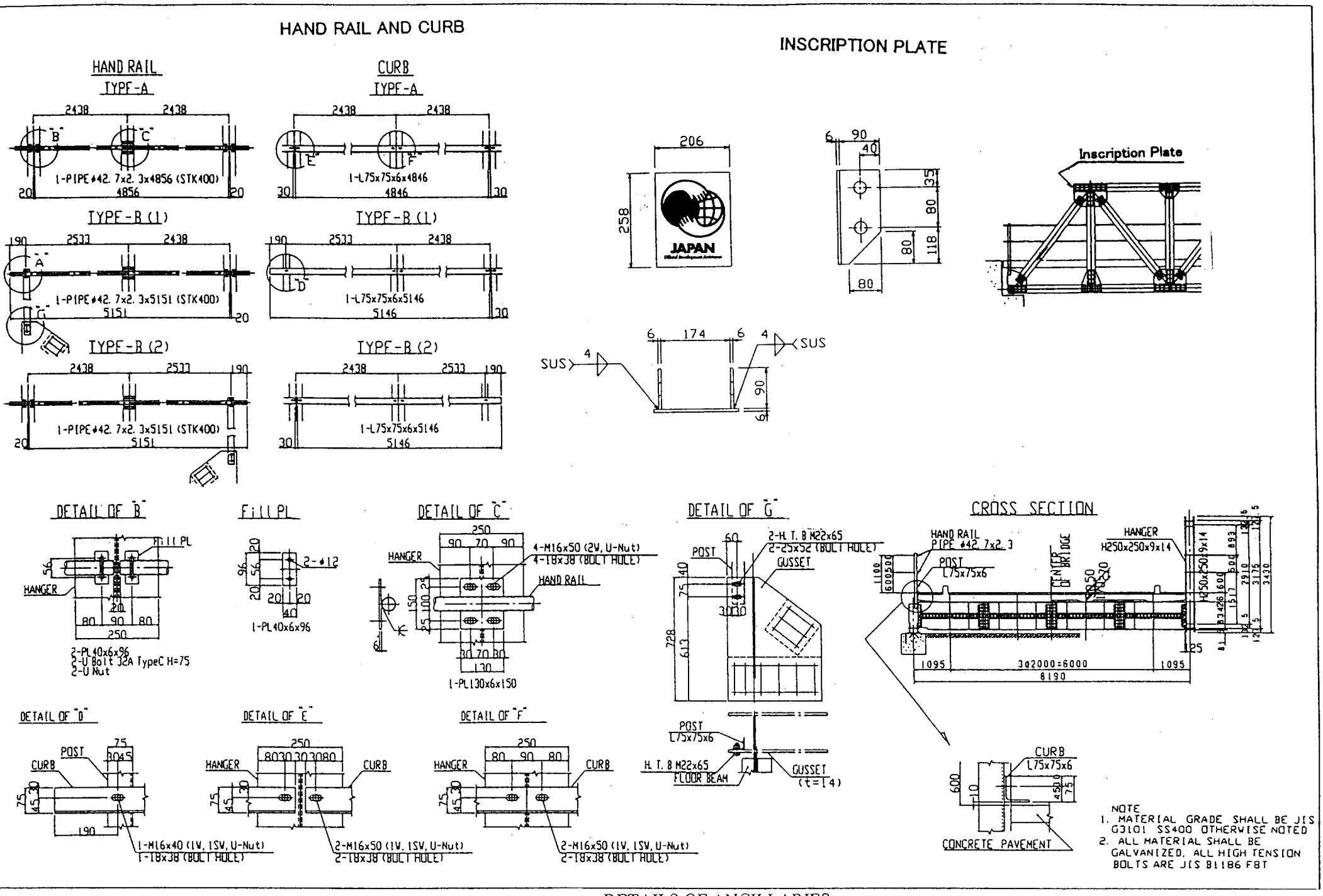


FIGURE 2.3.2-5 DETAILS OF ANCILLARIES

TABLE 2.3.2-5 RESULTS OF DESIGN ANALYSIS (1/2)

Bridge for One Lane (Span Length 20m)

Members		Upper Cord	Lower Cord	Diagonal	Vertical
Section		H-150x150x7x10	H-150x150x7x10	H-150x150x7x10	H-150x150x7x10
Material		SM490YA	SM490YA	SS400	SS400
Character of Members	Radius of Gyration of Area	3.77	3.77	3.77	3.77
	Area (cm^2)	39.65	39.65	39.65	39.65
Normal Force (t)		40.7	40.7	15.7	10.6
Stress	Actual Stress (kg/cm^2)	1,026	1,356	397	267
	Allowable Stress (kg/cm^2)	1,270	1,980	858	1,320

Bridge for One Lane (Span Length 25m)

Members		Upper Cord	Lower Cord	Diagonal	Vertical
Section		H-175x175x7.5x11	H-175x175x7.5x11	H-150x150x7x10	H-150x150x7x10
Material		SM490YA	SS400	SS400	SS400
Character of Members	Radius of Gyration of Area	4.37	4.37	3.77	3.77
	Area (cm^2)	51.42	51.42	39.65	39.65
Normal Force (t)		55.66	55.66	17.2	10.7
Stress	Actual Stress (kg/cm^2)	1,082	1,082	435	270
	Allowable Stress (kg/cm^2)	1,320	1,320	858	1,320

Bridge for One Lane (Span Length 30m)

Members		Upper Cord	Lower Cord	Diagonal	Vertical
Section		H-200x200x8x12	H-200x200x8x12	H-150x150x7x10	H-150x150x7x10
Material		SM490YA	SM490YA	SS400	SS400
Character of Members	Radius of Gyration of Area	5.02	5.02	3.77	3.77
	Area (cm^2)	63.53	63.53	39.65	39.65
Normal Force (t)		72.4	72.4	18.2	10.7
Stress	Actual Stress (kg/cm^2)	1,140	1,509	460	270
	Allowable Stress (kg/cm^2)	1,462	1,980	858	1,320

TABLE 2.3.2-5 RESULTS OF DESIGN ANALYSIS (2/2)

Bridge for Two Lanes (Span Length 15m)

Members		Upper Cord	Lower Cord	Diagonal	Vertical
Section		H-200x200x8x12	H-200x200x8x12	H-200x200x8x12	H-200x200x8x12
Material		SM490YA	SM490YA	SS400	SS400
Character of Members	Radius of Gyration of Area	5.02	5.02	5.02	5.02
	Area (cm^2)	63.53	63.53	63.53	63.53
Normal Force (t)		91.8	91.8	32.6	19.1
Stress	Actual Stress (kg/cm^2)	1,445	1,917	513	301
	Allowable Stress (kg/cm^2)	1,462	1,980	977	1,320

Bridge for Two Lanes (Span Length 25m)

Members		Upper Cord	Lower Cord	Diagonal	Vertical
Section		H-250x255x14x14	H-250x255x14x14	H-250x255x9x14	H-250x255x9x14
Material		SM490YA	SM50YA	SS400	SS400
Character of Members	Radius of Gyration of Area	6.09	6.09	6.32	6.32
	Area (cm^2)	104.7	104.7	91.34	91.34
Normal Force (t)		159.2	159.2	51.1	18.7
Stress	Actual Stress (kg/cm^2)	1,520	1,520	559	205
	Allowable Stress (kg/cm^2)	1,539	1,980	1,001	1,320

Bridge for Two Lanes (Span Length 30m)

Members		Upper Cord	Lower Cord	Diagonal	Vertical
Section		H-300x305x15x15	H-300x305x15x15	H-300x305x10x15	H-300x305x10x15
Material		SM490YA	SM490YA	SS400	SS400
Character of Members	Radius of Gyration of Area	7.26	7.26	7.55	7.55
	Area (cm^2)	133.4	133.4	118.4	118.4
Normal Force (t)		209.2	209.2	60.7	19.0
Stress	Actual Stress (kg/cm^2)	1,568	1,568	513	184
	Allowable Stress (kg/cm^2)	1,588	1,980	1,034	1,320

2.3.2.3 Design of Substructure, Revetment and Approach Road

1) Substructure

Foundation piles were designed based on the geotechnical investigation undertaken for 28 bridges with a total number of borings of 40. For the bridges where no investigation was undertaken, soil conditions were estimated from the data in the vicinity (see Figure 2.3.2-6). The detailed geotechnical investigation should be done in the stage of detailed design.

Standard drawings of abutment and pier are shown in Figure 2.3.2-7 and 2.3.2-8 respectively.

2) Revetment and Approach Road

Standard drawings of revetment and approach road are shown in Figure 2.3.2-9 and 2.3.2-10 respectively.

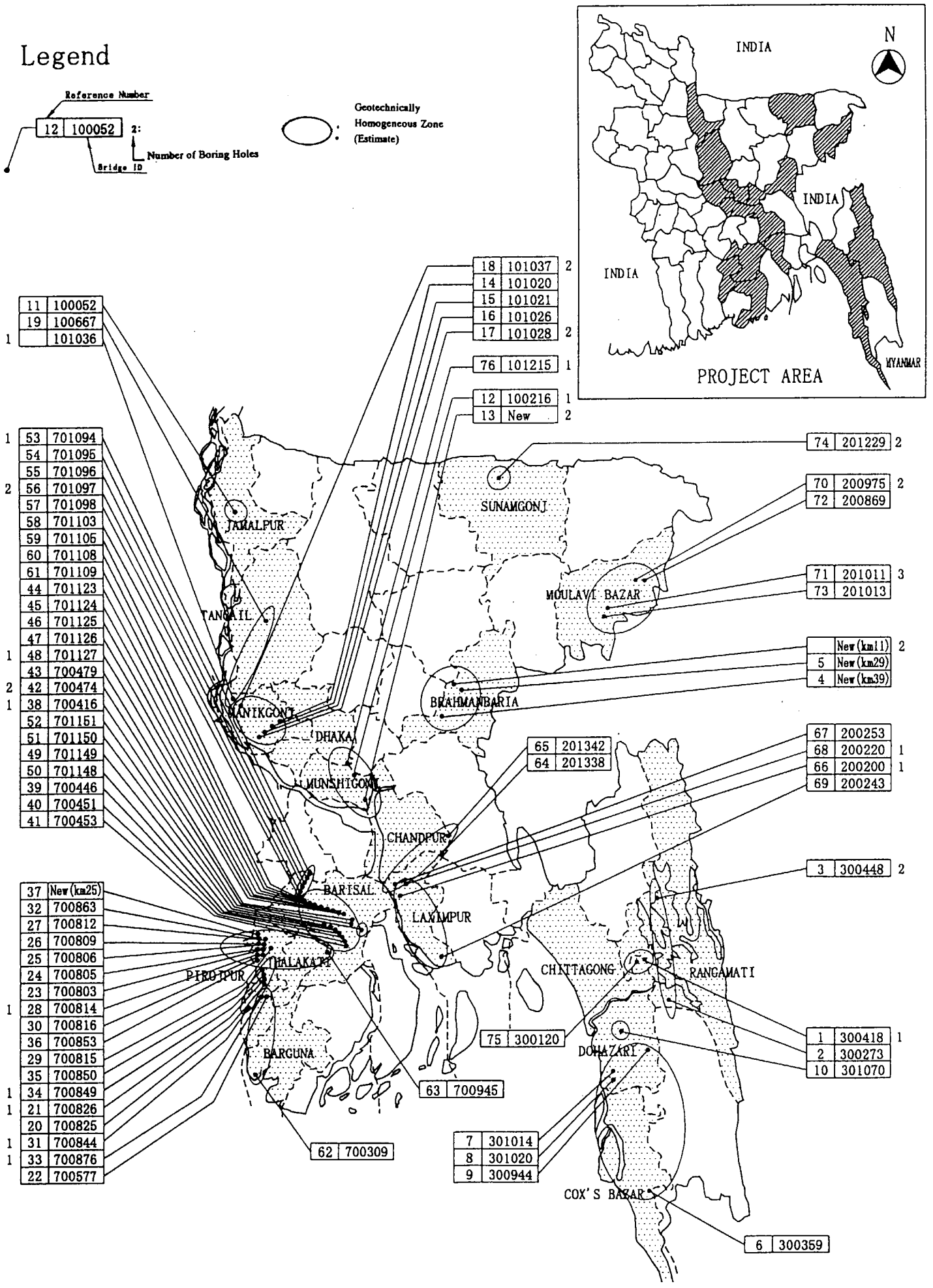


FIGURE 2.3.2-6 LOCATION OF GEOTECHNICAL INVESTIGATION AND ITS APPLICATION TO OTHER BRIDGES

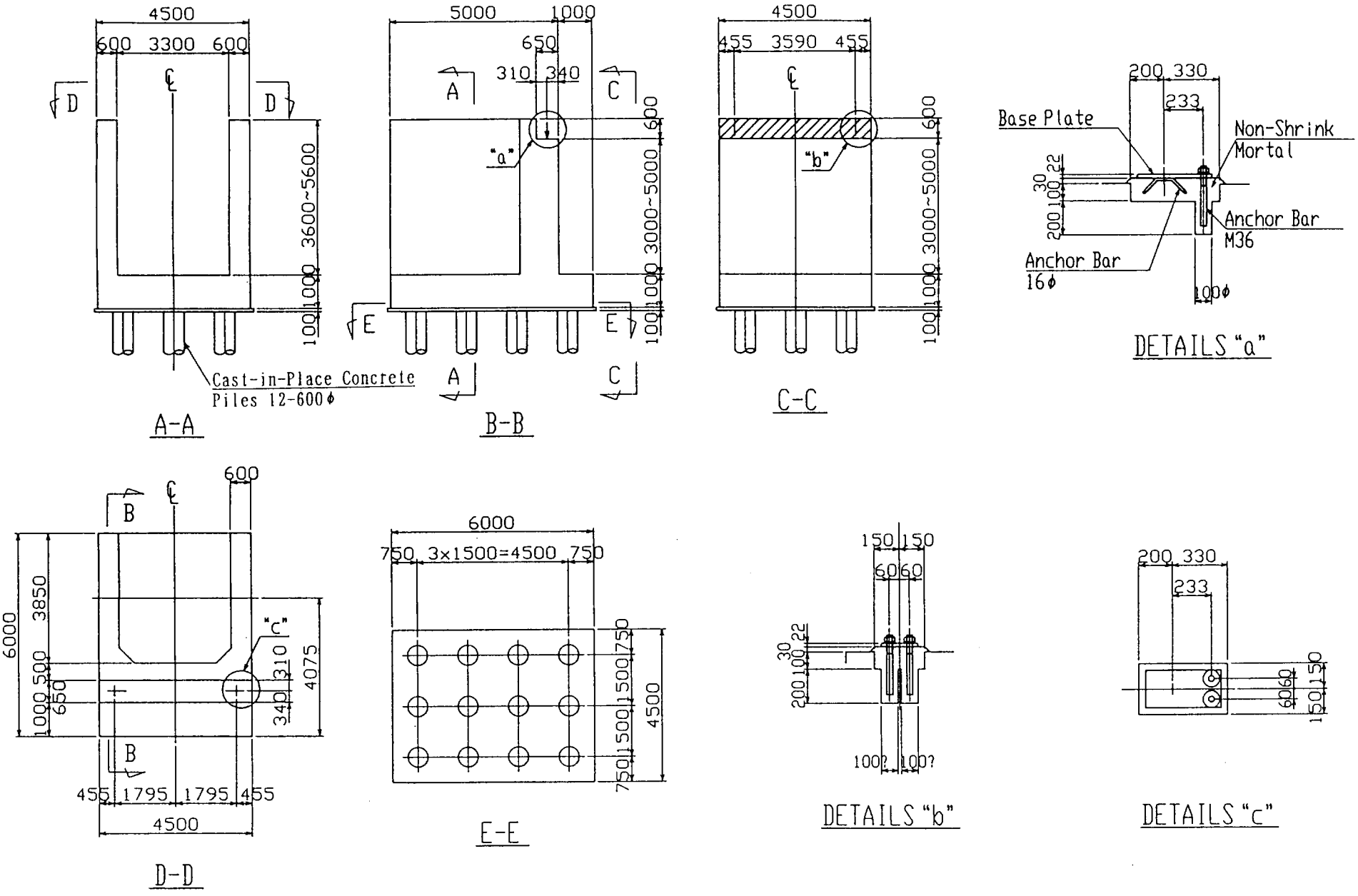


FIGURE 2.3.2-7 STANDARD TYPE OF ABUTMENT

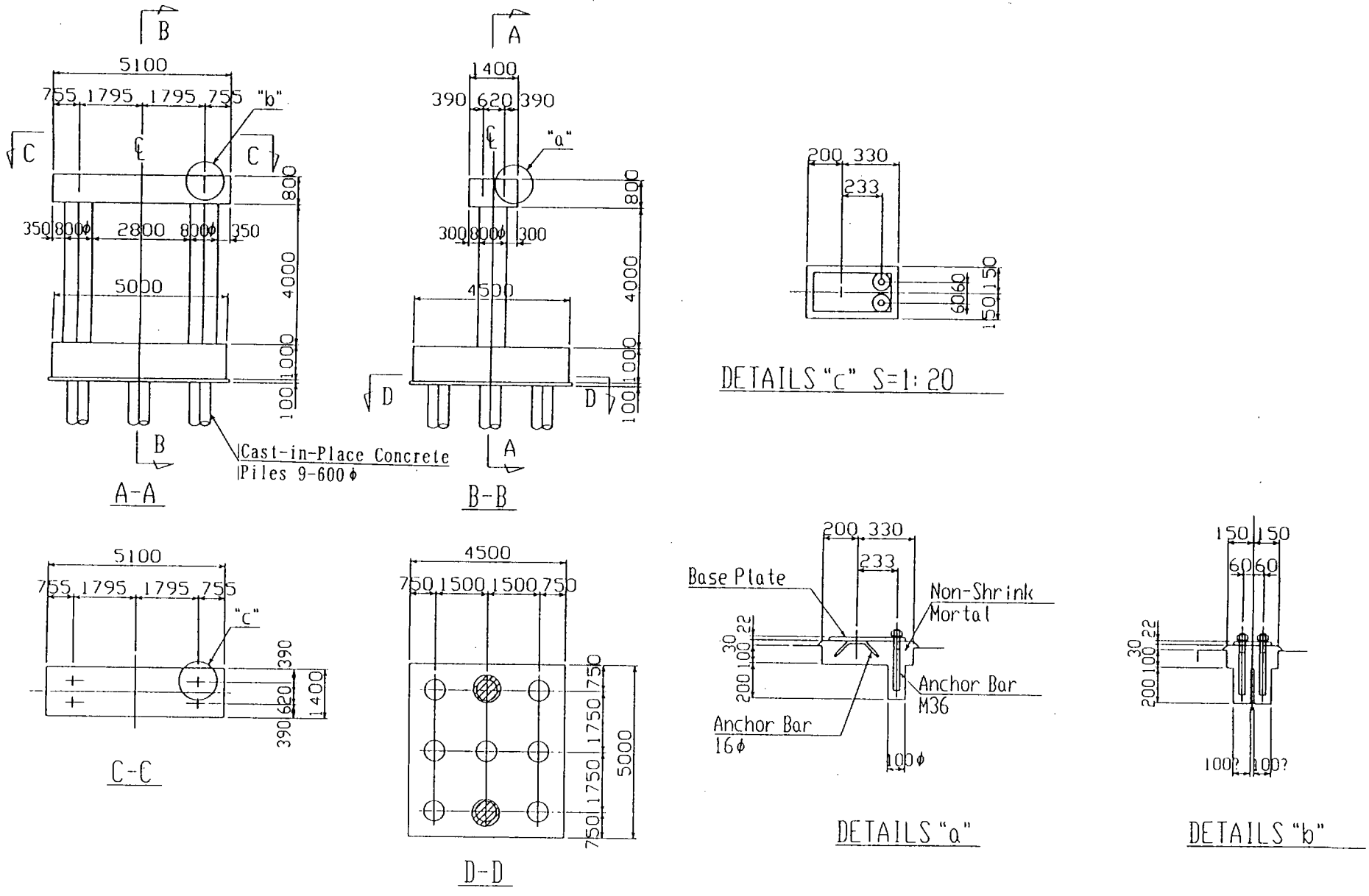


FIGURE 2.3.2-8 STANDARD TYPE OF PIER

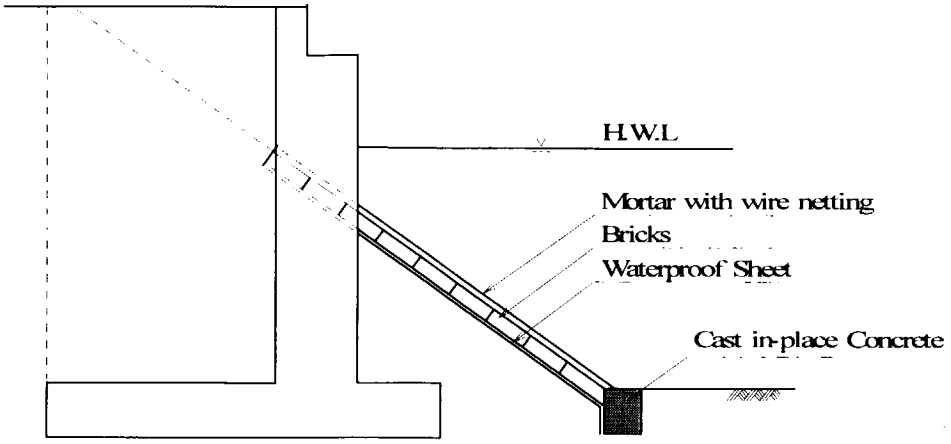


FIGURE 2.3.2-9 STANDARD TYPE OF REVETMENT

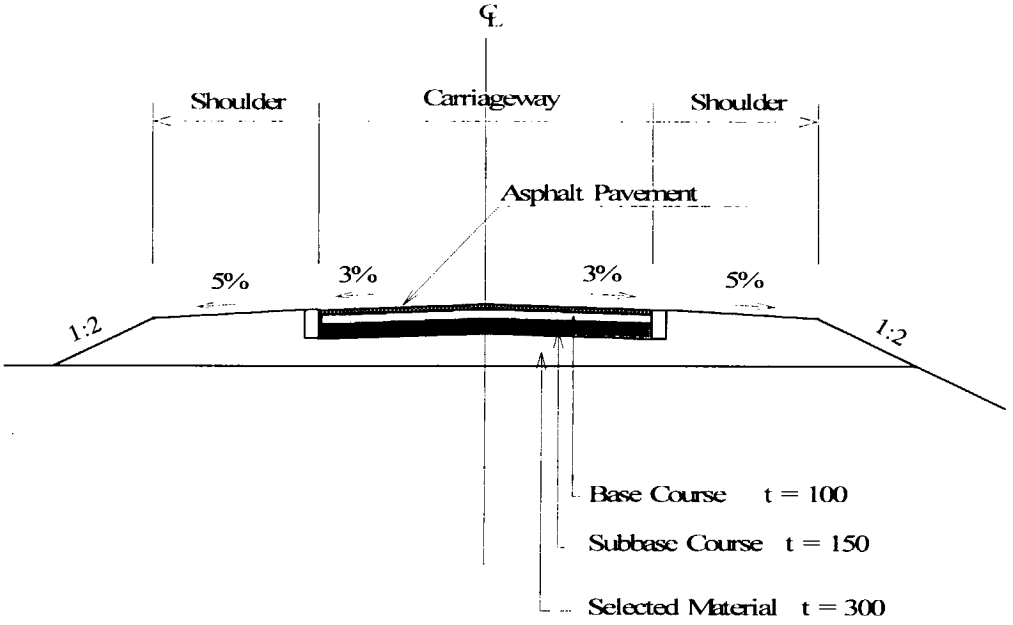


FIGURE 2.3.2-10 TYPICAL CROSS SECTION OF APPROACH ROAD

2.3.2.4 Construction Quantities

The construction quantities of the 76 project bridges are summarized in Table 2.3.2-6. The quantities of steel materials for superstructure are shown in Table 2.3.2-7.

TABLE 2.3.2-6 CONSTRUCTION QUANTITIES

Item			Unit	Phase-1	Phase-2	Total
Number of bridges			Bridge	47	29	76
Superstructure	Truss, 1-lane, 10m span		span	1	1	2
	Truss, 1-lane, 15m span		span	16	4	20
	Truss, 1-lane, 20m span		span	9	19	28
	Truss, 1-lane, 25m span		span	10	11	21
	Truss, 1-lane, 30m span		span	8	6	14
	Truss, 2-lane, 15m span		span	4	-	4
	Truss, 2-lane, 25m span		span	3	-	3
	Truss, 2-lane, 30m span		span	1	-	1
	Steel deck		m^2	3,091.1	3,036.2	6,127.3
	RC deck		m^2	1,323.9	-	1,323.9
Substructure	Abutment	H = 4.5m or lower	each	17	10	27
		H = 4.6m~6.0m	each	53	37	90
		H = 6.0m or higher	each	24	11	35
		Total	each	94	58	152
	Pier	H = 5.0m~7.5m	each	4	10	14
		H = 7.6m~9.5m	each	1	2	3
		H = 9.6m or higher	each	-	-	-
		Total	each	5	12	17
	Foundation Pile ϕ600		each	1,287	804	2,091
			m	18,070	14,001	32,071
Revetment			place	84	48	132
			m^2	12,960	8,935	21,895
Approach Road			m	1,880	1,160	3,040

TABLE 2.3.2-7 QUANTITIES OF STEEL MATERIALS FOR SUPERSTRUCTURE

Materials			Weight (kg)		
Shape	Material Standard	Dimension (mm)	Phase-1	Phase-2	Total
Plate	SS400	6	1,118	920	2,038
		8	376	82	458
		12	2,580	2,250	4,830
	SM400A	6	8,240	8,060	16,300
		8	2,096	1,640	3,736
		9	1,310	0	1,310
		12	1,172	738	1,910
		14	228	0	228
		15	98	0	98
		22	3,458	2,542	6,000
	SM490YA	8	24,413	0	24,413
		9	46,217	0	46,217
		10	28,518	29,376	57,894
		11	14,764	13,238	28,002
		12	27,269	10,266	37,535
		13	1,266	0	1,266
		14	24,829	0	24,829
		15	6,024	0	6,024
	SM490YB	14	784	0	784
		17	53,592	0	53,592
	Sub Total		248,352	69,112	317,464
H Shape	SS400	150 x 150 x 7 x 10	78,526	81,104	161,342
		175 x 175 x 7.5 x 11	32,188	30,714	62,902
		200 x 200 x 8x 12	29,384	13,572	42,956
		250 x 250 x 9 x 14	25,182	0	25,182
		300 x 300 x 10 x 15	13,716	0	13,716
	SM490YA	150 x 75 x 5 x 7	205,824	202,176	408,000
		150 x 150 x 7 x 10	68,728	71,314	140,042
		175 x 175 x 7.5 x 11	28,296	26,724	55,020
		200 x 200 x 8 x 12	25,568	11,616	37,184
		250 x 255 x 9 x 14	22,128	0	22,128
		346 x 174 x 6 x 9	83,062	55,878	138,940
		300 x 305 x 10 x 15	11,504	0	11,504
	Sub Total		624,106	493,098	1,117,204
L Shape	SS400	75 x 75 x 6	23,698	18,458	42,156
Pipe	STK400	42.7 x 2.3	9,904	8,244	18,148
Flat Bar	SS400	100x6	22,080	21,720	43,800
Round Bar	SS400	16ϕ	989	246	1,235
Anchor Bolt	SS400	25ϕ	608	492	1,100
Checker Plate	SS400	t = 6	149,952	147,288	297,240
Bolt & Nut	SS400	M16	3,798	3,612	7,410
		M24	224	164	388
H.T. Bolt	F8T	M22	74,053	39,552	113,605
U-Bolt	SS400	M32	268	208	476
Total			1,158,032	802,194	1,960,226

CHAPTER 3 IMPLEMENTATION PLAN

3.1 Implementation Plan

3.1.1 Implementation Concept

The following are the basic conditions for implementing this project:

- The project, if approved, will be implemented in accordance with the provisions of Japan's Grant Aid Program after the signing of the Exchange of Notes between the Governments of Japan and the People's Republic of Bangladesh.
- The Roads and Highways Department (RHD), Ministry of Communication is the responsible agency for implementing the project.
- The detailed design, tender and construction supervision of the project will be undertaken by a Japanese consulting firm in accordance with a contract between the RHD and the consultant.
- The procurement of steel materials for superstructure and erection tools will be undertaken by the successful Japanese tenderer in awarding the contract with the RHD.
- The Government of Bangladesh shall construct the designated project bridges with the materials and tools within two years from the date of handing-over thereof.
- The bridge construction will be promoted by a technical assistance provided by the Government of Japan as a soft component of the project.

3.1.2 Considerations on Implementation

1) Transportation and Storage of Materials

The materials will be transported to Chittagong International Port. After unloading and customs clearance, the materials will be handed over to the Government of Bangladesh. The materials will be transported to the RHD Central Stockyard in Chittagong and temporarily stored therein until they are delivered to individual construction sites according to the construction schedule.

Cares to be given in storage of the materials are as follows:

- Tools for girder erection and bolts for girder connection should be stored in the warehouse.
- Members of girder should be placed, keeping packed, on the concrete supports at least 15cm above the ground. Members should not be piled exceeding 2.5 meter in height from the ground.

2) Securing of Traffic during Construction

Temporary detours are needed to secure the traffic during construction as shown in Table 3.1.2-1.

TABLE 3.1.2-1 TEMPORARY DETOURS DURING CONSTRUCTION

Situation		Number of Corresponding Bridges	Detour
No existing bridge		5	Not needed.
Bridge location different from the existing bridge		11	Not needed since the existing bridge can be used.
Bridge location same as the existing bridge	Embankment possible because of low water depth in dry season	25	Construction of detour with embankment
	Embankment impossible, presently only pedestrians passing	17	Construction of simple pedestrian bridge for detour
	Embankment impossible, presently vehicles passing	18	Construction of bailey bridge for detour

3) Girder Erection

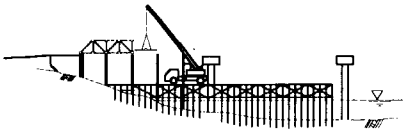
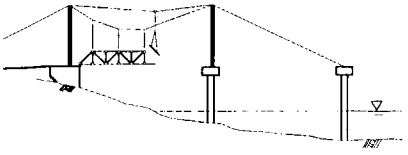
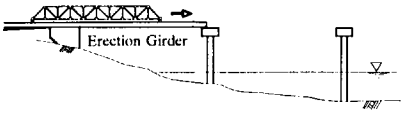
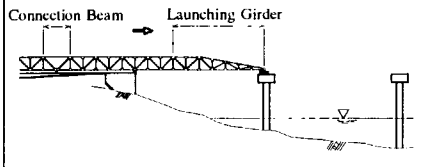
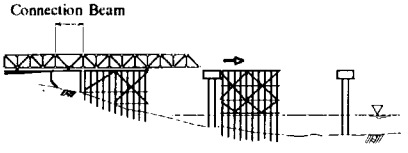
There are various erection methods. Table 3.1.2-2 shows their comparison. Staging method and draw erection method with semi-staging are applied taking their advantage that the erection can be done mainly by man power without special equipment nor highly skilled technique. Application of both methods are as follows:

Staging method: Where approach road is curved and/or insufficient space for assembly is secured. (35 bridges)

Draw erection method with semi-staging:
Where water is deep or in case of multi-span bridge.
(41 bridges)

The applied method for each bridge is shown in Table 2.3.2-4.

TABLE 3.1.2-2 COMPARISON OF ERECTION METHODS

Erection Method		Remarks	Evaluation			
			Construc-tability	Economic Factor	Period Required	Overall Evaluation
Staging Method		・Impossible during rainy season. ・Difficult where water is deep even in dry season. ・Needs no special equipment. ・Needs no high skill.	△	○	△	Applicable
Truck Crane Method with Bent		・Impossible during rainy season. ・Needs truck crane. ・Needs access way and working stage for truck crane. ・Needs no high skill.	X	△	○	Not Applicable
Cable Erection Method		・Needs materials such as tower, cable, carrier, etc. ・Needs high skill.	X	○	△	Not Applicable
Draw Erection Method with Erection Girder		・Needs erection girder. ・Needs no high skill.	○	X	○	Not Applicable
Draw Erection Method with Launching Girder		・Needs launching girder. ・Needs no high skill.	○	X	○	Not Applicable
Draw Erection Method with Semi-Staging		・Impossible during rainy season. ・Needs no special equipment. ・Needs no high skill.	△	○	○	Applicable

4) Erection Tools

In consideration of number of bridges and construction period, necessary sets of tools for assembly and draw erection for each phase are estimated as shown in Table 3.1.2-3.

TABLE 3.1.2-3 NECESSARY SETS OF ERECTION TOOLS

Unit : set

Works		Phase-1	Phase-2	Supply
Assembly	for 1-span	4	3	3
	for multi-span	1	2	2*
Draw Erection	for 1-span	2	1	1
	for multi-span	1	2	2*

* One set will be used for 1-span bridge in Phase-1.

All tools are planned to be procured under the Phase-1.

Quantities of the tools are shown in Table 3.1.2-4.

TABLE 3.1.2-4 LIST OF ERECTION TOOLS (1/2)

1. Tools for Assembly

Tools		Specification	Unit	Quantity		
				For 1-Span	For Multi-span	Supply*
1) Survey Tools						
(1)	Level Gauge	Steel, 90cm	Pcs.	1	1	5
(2)	Plumb	Plumb-bob 800g	"	4	8	28
(3)	Measuring Tape	Steel, 50m	"	1	1	5
2) Assemble Tools						
(1)	Torque Wrench	7,500 QLE	Pcs.	4	4	20
(2)	Socket for Torque Wrench	60° x 36mm	"	4	4	20
(3)	Socket Wrench	60° x 36mm	"	8	8	40
(4)	Sledge Hammer	#8 (3.5kg)	"	2	4	14
(5)	Hand Hammer	#3 (1.3kg)	"	4	4	20
(6)	Wrench	L = 300mm	"	2	2	10
(7)	Lever Block	1.5 Ton	"	4	4	20
(8)	Wire Rope Cutter	for 20 ϕ wire	"	1	1	5
(9)	Wire Rope Clip	ϕ 12	"	20	40	140
(10)	Craw Bar	L = 1.0m	"	1	1	5
(11)		L = 1.5m	"	1	1	5
(12)	Erection Bolt	M22 x 50	"	400	1,000	3,200
(13)	Drift Pin	ϕ 24.5	"	200	500	1,600
(14)	Taper Pin	ϕ 24.5 - ϕ 22.0	"	20	20	100
3) Lifting Equipment						
(1)	Connection for Tripod	2 Ton	Pcs.	2	2	10
(2)	Pulley Block	Hook Type	"	4	4	20
(3)	Shackle	5/8"	"	4	10	32
(4)	Turnbuckle		"	4	4	20
(5)	Pipe for Tripod	ϕ 60.5 x 7m	"	6	6	30
(6)	Nylon Sling	1.5 Ton x 5m	"	6	6	30
(7)	Hand Winch	3 Ton	"	2	2	10
(8)	Wire Rope	ϕ 12 x 45m	"	2	2	10
(9)	Wire Rope	ϕ 12 x 3m	"	2	2	10
(10)	Base Beam	H150 x 1.5m	"	4	4	20
4) Scaffolding						
(1)	Scaffolding Frame	KA3055A	Set	4	4	20
(2)	Scaffolding Plank	KPS5183	Pcs.	4	4	20
(3)	Jack Base	KA752	"	8	8	40
(4)	Ladder	KA3055S	"	2	2	10
(5)	Bracing	KA14	"	4	4	20
5) Jacks						
(1)	Mechanical Jack	25t Slide Type	Pcs.	4	4	20
(2)		30t Slide Type	"	0	4	8

* Supply Quantity = (Quantity for 1-Span) x 3 + (Quantity for Multi-Span) x 2

TABLE 3.1.2-4 LIST OF ERECTION TOOLS (2/2)

2. Tools for Draw Erection

Tools			Specification	Unit	Quantity		
					For 1 Span	For Multi-span	Supply*
1)	Launching Rail						
	(1)	Launching Rail	73.8 kg/m	Ton	6.642	10.332	27.306
	(2)	Base Plate	T = 25mm	"	0.4	0.8	2
2)	Launching Equipment						
	(1)	Til-Tank	25 Ton	Pcs.	4	8	20
	(2)	Screw Clamp	100mm	"	16	32	80
	(3)	Clamp	100mm	"	16	32	80
	(4)	Winch	3 Ton	"	2	2	6
	(5)	Chain Block	1.5 Ton	"	2	6	14
	(6)	Pulley Block	Double Wheels	"	2	2	6
	(7)		Single Wheel	"	2	4	10
	(8)	Wire Rope	ϕ 12 x 2m	"	6	6	18
	(9)	Wire Rope	ϕ 12 x 200m	"	2	2	6
	(10)	SC Shackle	5/8"	"	4	8	20
	(11)	Shackle	RS5	"	4	4	12
	(12)	Turnbuckle		"	4	8	20
	(13)	Beam for Til-Tank	H150 x 4m	"	4	8	20
	(14)	Liner Plate	6 x 200 x 200	"	16	32	80
	(15)		25 x 200 x 200	"	8	24	56
	(16)		10 x 200 x 200	"	8	24	56
	(17)	Beam for Winch	H150 x 1.5m	"	6	6	18
3)	Connection Member						
	(1)	Connection Members	0.386 Ton/Set	Set	-	4	8

* Supply Quantity = (Quantity for 1-Span) + (Quantity for Multi-Span) x 2

3.1.3 Soft Component Plan

The Government of Bangladesh is responsible for construction of the bridges with the materials and tools to be supplied by the Japanese Government. For early realization of the effect of the project, construction of the bridges shall be completed within two years from the date of handing-over the materials under the physical condition that the construction works are limited only during dry season, and thus the prompt execution is required. For the project to be smoothly implemented, the following points should be regarded:

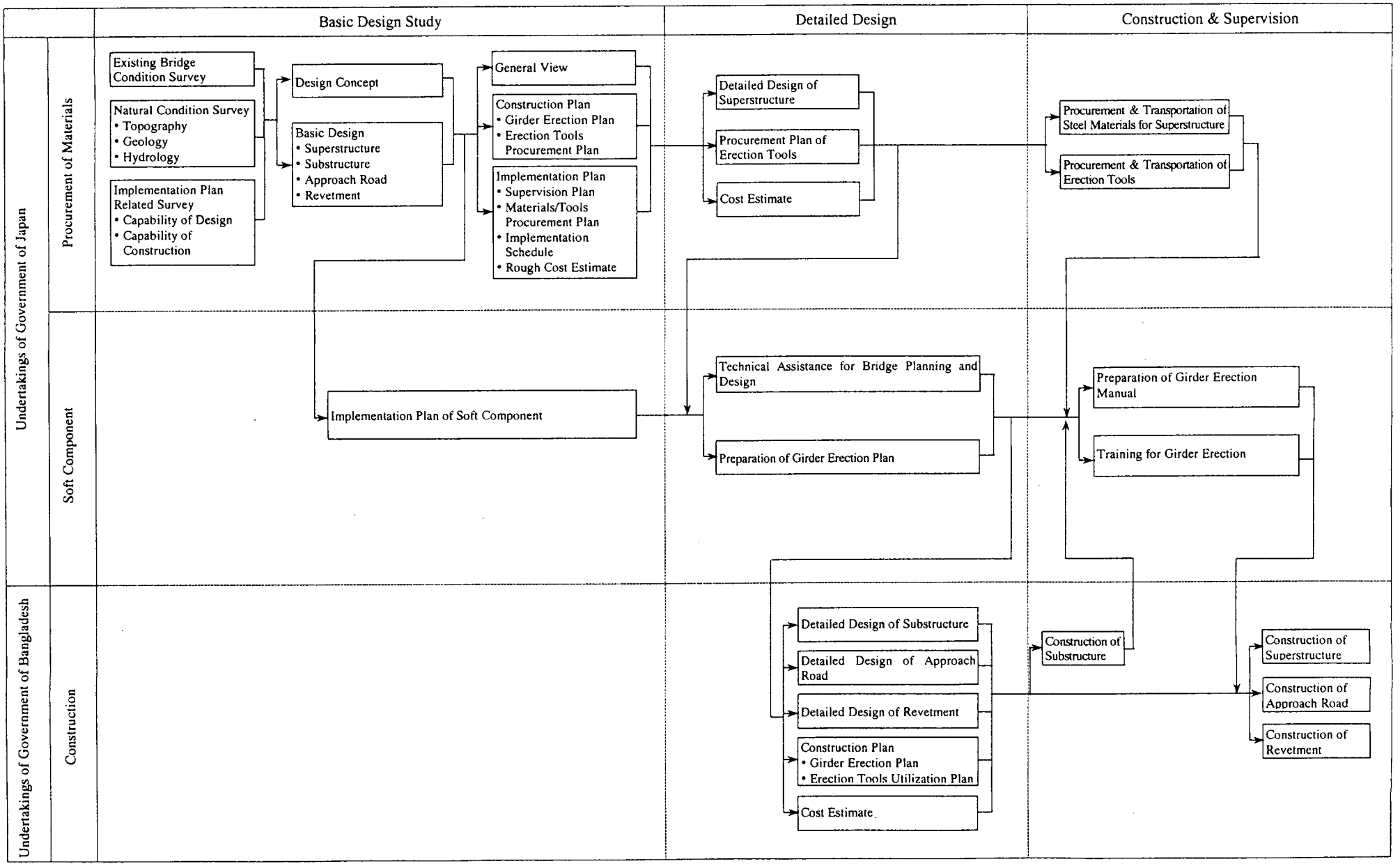
- The result of the hydrological analysis is one of the important elements in the design of the bridge and its related works including revetment and approach road. The design of the substructure and the related works to be carried out by Bangladesh side should reflect the conditions in the superstructure design to be done by Japanese side including the hydrological conditions and thus the consistency should be secured between superstructure and substructure designs.
- The girder erection plan should be carefully prepared to be economical and constructable, securing the consistency with girder structure. Due consideration should be given to characteristics of girders, availability of assembly yard, topographical conditions in the vicinity, assembly/erection tools, methods of storage and transportation of girders, etc.
- The technology for girder erection should be well mastered to ensure the accuracy, quality and safety in construction as well as to complete the project within the specified period of time.

In view of the above, the following technical assistance will be provided by the government of Japan as a soft component of the project.

- Technical Assistance for Bridge Planning and Design
  Give the technical assistance for bridge planning including location, bridge length, bridge elevation, types of abutment, pier, foundation and revetment, etc. and detailed design of substructure and related works, for selected typical bridges to keep the consistency between superstructure and substructure designs.
- Preparation of Girder Erection Plan
  Prepare a girder erection plan to keep the consistency between the structure of guider and its erection method.
- Training for Girder Erection at Construction Site
  Prepare a girder erection manual and conduct the training for girder erection at the construction site to ensure the accuracy of construction and transfer the technology for schedule control and safety control.

The undertakings of both governments and the relation of the soft component thereto in each stage of the project are shown in Table 3.1.3-1.

TABLE 3.1.3-1 RELATION BETWEEN UNDERTAKINGS OF BOTH GOVERNMENTS AND SOFT COMPONENT



3.1.4 Scope of Works

The undertakings of both governments, Japan and Bangladesh are as shown in Table 3.1.4-1.

TABLE 3.1.4-1 UNDERTAKINGS OF BOTH GOVERNMENTS

Item		Undertaken by		Remarks
		Japan	Bangladesh	
Detailed Design	Superstructure Design	○		
	Substructure Design	☆	○	
	Related Works Design	☆	○	Approach road, revetment, etc.
	Girder Erection Plan	☆	○	
Procurement and Transportation of Materials and Tools	Fabrication of Steel Materials for Superstructure	○		
	Procurement of Erection Tools	○		
	Marine Transportation	○		
	Tax Exemption and Customs Clearance		○	
	Internal Transportation		○	
Preparatory Works	Securing of Lands for Construction		○	Right-of-way, stockyard, assembly yard, etc.
	Demolition of Existing Bridges		○	
Construction	Construction of Substructure		○	
	Erection of Girder	☆	○	
	Construction of Reinforced Concrete Deck Slab		○	2-lane bridges
	Construction of Related Works		○	Approach road, revetment, etc.

☆ Technical assistance by the Government of Japan (soft component)

3.1.5 Consultant Services Plan

A Japanese consulting form will enter into a contract with the RHD and based thereon, provide the following services:

1) Detailed Design
   - Detailed design of superstructure and erection tools
   - Preparation of drawings and specifications

- Preparation of procurement plan of steel materials for superstructure and erection tools
- Preparation of tender documents

2) Soft Component Works (Detailed Design Stage)
   - Technical assistance for bridge planning and design
   - Preparation of girder erection plan

3) Assistance in Tendering
   - Tender publication
   - Pre-qualification of interested tenderers
   - Tendering
   - Tender evaluation
   - Contract facilitation

4) Construction Supervision
   - Quality control
   - Inspection of shop assembly of the steel bridges
   - Handover of the materials and tools

5) Soft Component Works (Construction Stage)
   - Training for girder erection at construction site

3.1.6 Procurement Plan

The steel materials for superstructure and erection tools will be procured in Japan.

3.1.7 Implementation Schedule

The project is planned to be implemented in two phases as stated in 2.3.1.1 8). The bridges under each phase are as follows (Table 2.2.1-2):

Phase-1 : 47 bridges with a total length of 1,085m
Phase-2 : 29 bridges with a total length of 905m

The implementation schedule for undertakings of Japanese Government is shown in Table 3.1.7-1.

TABLE 3.1.7-1 IMPLEMENTATION SCHEDULE

	Work Item \ Month	1	2	3	4	5	6	7	8
Phase-1	Detailed Design	(Work in Bangladesh)							
			(Work in Japan)						
				(Work in Bangladesh)					(Total 3.0 months)
	Procurement		(Fabrication, Procurement)						
							(Marine Transportation)		
								(Handover)	
				(Total 7.5 months)					
	Soft Component (Detailed Design Stage)		(Work in Bangladesh)						
									(Total 1.5 months)
	Soft Component (Construction Stage)				(Work in Bangladesh)				
									(Total 3.5 months)
Phase-2	Detailed Design	(Work in Bangladesh)							
			(Work in Japan)						
				(Work in Bangladesh)					(Total 3.0 months)
	Procurement		(Fabrication, Procurement)						
							(Marine Transportation)		
								(Handover)	
				(Total 7.5 months)					
	Soft Component (Detailed Design Stage)			(Work in Bangladesh)					
									(Total 1.5 months)

3.1.8 Obligations of the Government of Bangladesh

The following necessary measures should be taken by the Government of the People's Republic of Bangladesh on condition that the grant aid by the Government of Japan is extended to the project:

- Detailed design of substructures and related works (revetments, approach roads, etc.)
- Tax exemption and customs clearance of steel materials for superstructure and erection tools at the port of disembarkation
- Securing of the lands necessary for bridge construction
- Demolition of existing bridges
- Construction of substructures
- Erection of girders
- Construction of reinforced concrete deck slab of 2-lane bridges
- Construction of related works

The Government of Bangladesh shall complete the bridge construction within two years from the date of handing-over the materials. The construction quantities are shown in Table 2.3.2-7.

3.2 Project Cost Estimation

Project cost born by the Government of Bangladesh is estimated at 652 million Taka (refer to Appendix 5).

3.3 Operation and Maintenance Costs

Maintenance of the bridges to be constructed under this project will be carried out by the RHD.

Since the main structures of the bridges are structurally durable and galvanized for long-term protection from rust, little maintenance/repair work is required except for partial repair of damaged deck slab.

Maintenance activities will include routine inspection, cleaning, repair works of deck slab, pavement and embankment slope of approach road, revetment, etc. Maintenance activities and costs are estimated as shown in Table 3.3-1. The annual cost is estimated at 2.4 million Taka.

TABLE 3.3-1 MAINTENANCE ACTIVITIES AND COST ESTIMATE

Works	Cost for One Time (Taka)	Times Per Year	Number of Bridges	Annual Cost (Taka)
Inspection	500	3	76	114,000
Cleaning	1,500	3	76	342,000
Repair	25,000	1	76	1,900,000
			Total	2,356,000

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

4.1 Project Effect

This project aims to provide adequate transport means for passage of people and transportation of local products and subsistence goods by constructing the selected 76 bridges on national highways, regional highways and feeder roads-A in 18 divisions within four zones of Dhaka, Comilla, Chittagong and Barisal using the steel materials to be procured under this project.

Direct beneficiaries of the project are the population residing in the 18 divisions, amounting to about 3.7 million in 1991.

The major direct effects of the project are as follows:

Provision of Safe and Stable Transport Means

The problems of the existing bridges such as absence of bridge, impassability for vehicles serving only for pedestrians, insufficient capacity for vehicles, traffic congestion causing a bottleneck, etc. will be solved and safe and stable transport means will be secured.

Increase of Transport Capacity

Transport capacity will be remarkably increased since large vehicles can pass.

Savings in Transport Cost

Transport cost will be reduced resulting from improvement of transport efficiency since large vehicles can pass.

Savings in Maintenance Cost

Maintenance cost will be reduced because little cost is needed for repair of the bridges.

Improvement of Inhabitants' Convenience

Daily life of inhabitants in attending school, commuting, shopping, visiting mosque, etc. will be improved by providing safe and stable means for passage.

Improvement of Emergent Medical Treatment

Emergent medical treatment will be possible due to improvement of accessibility to the hospital.

Furthermore, the following indirect effects are expected from the project:

Acceleration of Agricultural Production

Farmer's will to produce marketable products will be raised by the rise of the farmgate prices resulting from provision of stable means of transportation of the products to the market, and consequently agricultural production will be accelerated.

Promotion of Industries and Generation/Expansion of Employment Opportunities

Agro-industry like food processing and transport industry will be promoted by the increase of agricultural production and provision of stable means of transport respectively, and consequently employment opportunities will be generated.

Stabilization of Prices

Prices will be stabilized due to stable supply of subsistence goods.

Alleviation of Poverty

The project will contribute to the alleviation of poverty especially of the rural population through the acceleration of agricultural production, expansion of employment opportunities, stabilization of prices, etc.

4.2 Recommendation

The project will greatly contribute to the improvement of the basic human needs of the inhabitants as well as it will have many effects as mentioned above. It is therefore concluded that it is appropriate to implement the project under the Japan's Grant Aid.

The system, personnel and budget of the Government of Bangladesh for implementation of the project and its maintenance after completion are considered to be well arranged and no problem is expected.

To realize and sustain the effects of the project at a maximum, the matters to be undertaken by the Government of Bangladesh are as follows:

- To improve the connection roads and other bridges on the same routes.
- To carry out the maintenance and repair works as necessary to keep the roads and bridges in good condition and prolong their serviceable lives.
- To secure the budget for the above.