Geology

The three large rivers of the Ganges, Brahmapura and Meguna developed an extreme sediment accumulation which is called the Great Bengal Delta. The alluvial stratum consists of loose to medium silt and clay deposits ranging around 50 m deep.

Earthquake

Bangladesh is not an earthquake prone area. No disastrous earthquakes have been recorded except for very local earthquakes in 1885, 1897 and 1918.

(2) Socio-economic Conditions

Population

The land area, population and population density of the 15 districts covered by the project are presented in Table 3-3. The major indicators of socio-economic conditions (as of 1988) are as follows:

- Population growth rate: 2.03%
- Literacy rate : 24.8%
- Urban population rate : 10.7%
- Life expectancy : 56.1 years
- School attendance rate
    - Primary school : 94.6%
    - Middle school : 27.6%
    - High school : 4.2%
- Population below poverty line
    - Urban : 10.5 mil. (44%)
    - Rural : 40.5 mil. (48%) .

Table 3-3 LAND AREA, POPULATION AND POPULATION DENSITY IN THE PROJECT AREA

(As of 1991)

District	Area (sq.km)	Population (thousand)	Population Density (persons/sq.km)
Cox's Bazar	2,242	1,465	653
Feni	984	1,156	1,175
Chittagong	5,213	5,730	1,099
Habigonj	2,514	1,566	623
Moulvibazar	3,164	1,446	457
Chandpur	1,655	2,140	1,293
B. Baria	1,875	2,140	1,205
Comilla	3,069	4,254	1,386
Noakhali	3,053	2,346	768
Laxmipur	1,421	1,383	973
Narsingdi	1,116	1,708	1,530
Faridpur	2,082	1,552	745
Dhaka	1,468	6,146	4,187
Munshigonj	986	1,222	1,239
Gazipiur	1,820	1,703	935
Whole country (64 dist.)	148,393	109,877	740

Source : Statistic Pocket Book of Bangladesh 92

Industry

The project area's economy is largely dominated by agriculture. Major agricultural products are rice, jute, wheat and sugar cane. Jute is widely cultivated as the second crop of rice field. The jute industry earns 60 % of the total exports of the country. Cereal production has been increasing steadily but is still short of domestic consumption.

Heavy, medium and light industry are located around Chittagong which is the second largest city and the international sea port. Printing, paper mill, fertilizer, cement, steel and other production factories are located there.

(3) Roads conditions

Regarding Type-B feeder roads and rural roads, road length by surface condition and by district is presented in Table 3-4. The length of structures by condition is also presented in the table.

Only a few sections of Type-B feeder roads and rural roads have been paved as mentioned in the table. Unpaved roads in the project area become muddy in the rainy season since the earth here is clayey. It is hard to drive over rough and narrow road in more than half of the rural roads even in the dry season. Where numerous gaps cut the roads, travelers cross rivers by boat or other means which are inconvenient and unsafe.

Table 3-4 TYPE-B FEEDER ROAD AND RURAL ROADS LENGTH BY SURFACE CONDITION IN THE PROJECT AREA

Feeder Road Type-B

District	Total Length (km)	Surface Type				Surface Condition				Existing Structure Condition					
		Paved Road (km)	(%)	Earthen Road (km)	(%)	Good (km)	(%)	Poor (km)	(%)	Good (km)	(%)	Poor (km)	(%)	No. of Gap	Total Length of Gap (m)
1. Cox's Bazar	29.7	5.0	17	24.7	83	0.0	0	29.7	100	34.9	41	49.4	59	14	108.3
2. Feni	16.8	0.0	0	16.8	100	0.0	0	16.8	100	44.9	55	36.9	45	3	27.9
3. Chittagong	95.0	37.9	40	57.1	60	10.5	11	84.5	89	283.6	71	117.8	29	25	204.2
4. Habigonj	258.1	29.2	11	228.9	89	20.3	8	237.8	92	980.0	68	451.2	32	112	1,390.2
5. Moulvibazar	125.3	30.5	24	94.8	76	3.5	3	121.8	97	880.5	66	460.4	34	62	655.7
6. Chandpur	154.4	8.7	6	145.7	94	21.9	14	132.5	86	683.4	64	388.8	36	58	349.6
7. B. Baria	124.6	0.0	0	124.6	100	11.3	9	113.3	91	596.7	88	81.8	12	22	164.2
8. Comilla	274.9	64.3	23	210.6	77	3.9	1	271.0	99	1,060.4	69	480.0	31	120	684.4
9. Noakhali	97.5	8.1	8	89.4	92	25.1	26	72.4	74	198.4	53	174.5	47	17	42.8
10. Laxmipur	44.2	18.3	41	25.9	59	10.3	23	33.9	77	66.8	32	142.2	68	4	18.4
11. Narsingdi	96.1	31.6	33	64.5	67	26.5	28	69.6	72	167.8	67	83.8	33	20	182.9
12. Faridpur	259.3	84.5	33	174.8	67	84.5	33	174.8	67	1,858.4	82	414.3	18	33	462.0
13. Dhaka	82.6	24.9	30	57.7	70	12.6	15	70.0	85	107.1	63	62.1	37	3	361.4
14. Munshigonj	85.6	11.4	13	74.2	87	0.0	0	85.6	100	312.7	48	335.5	52	27	505.4
15. Gazipur	167.3	56.4	34	110.9	66	53.1	32	114.2	68	507.7	51	496.3	49	23	184.6
Total	1,911.3	410.7	21	1,500.6	79	283.5	15	1,627.8	85	7,783.3	67	3,775.0	33	543	5,342.0

Rural Road (R1, R2, R3)

District	Total Length (km)	Surface Type				Surface Condition				Existing Structure Condition					
		Paved Road (km)	(%)	Earthen Road (km)	(%)	Good (km)	(%)	Poor (km)	(%)	Good (km)	(%)	Poor (km)	(%)	No. of Gap	Total Length of Gap (m)
1. Cox's Bazar	1,142.9	46.3	4	1,096.6	96	215.2	19	927.7	81	1,332.0	50	1,341.3	50	595	3,102.5
2. Feni	1,271.2	21.0	2	1,250.2	98	23.2	2	1,248.0	98	1,358.5	34	2,650.9	66	455	1,444.8
3. Chittagong	4,427.1	232.3	5	4,194.8	95	94.2	2	4,332.9	98	4,989.6	42	7,011.6	58	1,384	4,662.3
4. Habigonj	1,215.7	19.0	2	1,196.7	98	37.0	3	1,178.7	97	1,191.4	54	999.6	46	717	5,074.9
5. Moulvibazar	851.0	0.0	0	851.0	100	20.4	2	830.6	98	1,317.4	50	1,319.8	50	552	2,182.4
6. Chandpur	1,084.7	5.5	1	1,079.2	99	78.1	7	1,006.6	93	1,575.1	47	1,762.3	53	319	2,496.1
7. B. Baria	940.6	13.5	1	927.1	99	26.7	3	913.9	97	1,527.9	59	1,083.4	41	301	2,510.9
8. Comilla	4,536.3	58.1	1	4,478.2	99	8.4	0	4,527.9	100	6,373.9	55	5,210.8	45	2,884	12,279.3
9. Noakhali	3,282.6	39.3	1	3,243.3	99	67.7	2	3,214.9	98	2,442.4	43	3,194.2	57	967	3,673.7
10. Laxmipur	1,471.0	26.2	2	1,444.8	98	73.1	5	1,397.9	95	1,727.1	46	2,005.5	54	271	1,691.6
11. Narsingdi	1,085.9	20.4	2	1,065.5	98	100.3	9	985.6	91	1,233.7	42	1,692.4	58	194	1,142.6
12. Faridpur	1,814.9	26.9	1	1,788.0	99	20.2	1	1,794.7	99	1,723.0	56	1,357.4	44	471	4,584.7
13. Dhaka	1,502.6	52.7	4	1,449.9	96	80.8	5	1,421.8	95	1,526.5	49	1,581.8	51	491	4,770.2
14. Munshigonj	745.4	3.9	1	741.5	99	11.5	2	733.9	98	1,133.3	23	3,689.7	77	169	3,135.6
15. Gazipur	681.6	41.9	6	639.7	94	41.5	6	640.1	94	815.6	64	451.4	36	193	1,212.7
Total	26,053.5	607.0	2	25,446.5	98	898.3	3	25,155.2	97	30,267.4	46	35,352.1	54	9,891	53,964.3

Source : Inventory of Road & Road Structure of FRB & Rural Roads, 1993, LGED

3.3 STUDY AND EXAMINATION OF THE REQUEST

3.3.1 Appropriateness and Necessity of the Project

(1) Investigation of request bridge sites

To examine the appropriateness and necessity of the project under Japan's Grant Aid, the Study Team investigated the 83 requested bridge sites to collect the necessary data.

Summary of site data of requested bridges are presented in Table 3-5.

The survey items of the investigation were as follows:

- Present condition of bridges (bridge type, length, condition)
- Socio-economic conditions in affected areas (population, landuse, industry)
- Approach road conditions (road class, width, surface type, surface condition)
- Traffic volume (ADT) by type
- Engineering data (topography, geology, river condition, construction condition)
- Recommendations for bridge planning (bridge length, height)

(2) Selection of high priority bridges

Based on the results of site investigation, the socio-economic effects, appropriateness and necessity of construction of each request bridge were evaluated, and high priority bridges were selected. The evaluation criteria are as follows:

<u>Socio-economic effects</u>

Evaluation items are:

- Transportation conditions to be improved
- Traffic volume
- Population and area to have benefit
- Contribution to socio-economic activities

Engineering necessity

Evaluation items are:
- Deterioration of bridge
- Inconvenience and obstacle for transportation
- Hazardousness for passengers
- Existence of detour

Appropriateness of project

Evaluation items are:
- Urgency and necessity of implementation
- Population and area to have benefit
- Improvement of transportation and living standard
- Availability of maintenance

The evaluation of each bridge project is as shown in Table 3-5. As a result, 79 bridges were evaluated as having high priority. The other 4 bridges were evaluated as having low priority and excluded from the project. The low priority bridges have less necessity of implementation since their present condition is reparable damage only.

Socio-economic effects, engineering necessity and appropriateness of the project as a whole are summarized as follows:

Socio-economic effects

Since the roads on which project bridges are located connect villages, farms and markets in agricultural areas, construction of bridges contributes to activate farming and production of marketable products. A population of 36,076,000 in 32,662 sq.km is expected to have direct and indirect benefits by construction of the bridges.

Engineering necessity

The bridges for the project have an urgent necessity to be constructed to provide safe and reliable traffic facilities across rivers. The present conditions of the bridges are:

- Washed out or collapsed by flood, which cut roads.
- Dilapidated or seriously deteriorated, which are too weak to use.
- Not yet constructed, where travelers cross by boat.

Appropriateness

- Urgency and necessity of the project is very high.
- Implementation of the project benefits a great number of ordinary citizens.
- Providing safe and reliable transportation means promotes more employment opportunities and higher income for people in the project area.
- No difficulty in implementation of the project is foreseen.

Table 3-5 SITE DATA OF REQUESTED BRIDGES AND EVALUATION OF PRIORITY OF BRIDGES (1/4)

No.	Bridge No. /Location	Present Condition of Bridge: Exist / None	Bridge Type	Bridge Length (m)	Present Condition	Socio Economic and Approach Road Information: No. of Affected Population (Thou.)	Land Use	Main Products	Road Class	Road Width	Road Surface Type	Road Present Condition	Traffic Volume (ADT) (Rainy Season): Vehicle	Rickshaw	Walking	Boat	Engineering Information: Geo. Condition	Topo. Condition	River Hydrogical Condition: Depth (m) LWL	Depth (m) HWL	Width (m) LWL	Width (m) HWL	Current Velocity (M/S)	River Dike Existence	Alignment	Present Condition of Access Road	Recommendation: Bridge Length (m)	Bridge Height (m)	Selection of High Priority Bridges: Socio Economic Effect	Urgency	Appropriateness	Judgment	Remarks
1	01-01-01 COX'S BAZAR	Yes	Timber	52.0	Bad	30	Farm	Salt Shrimp	R1	3.0	Earthen	Bad	0	0	2,000	0	Flat	Clay	0.8	4.7	36.0	70.0		None	Fixed	Pass-able	70.0	7.0	Yes	Yes	Yes	Yes	• Fairway for small boats
2	01-02-01 COX'S BAZAR	None	-	-	-	30	Farm	Rice Veg.	FRB	7.0	Earthen	Fair	0	0	0	300	Flat	Sand	0.9	4.3	60.0	160.0		None	Fixed	Pass-able	120.0	5.0	Yes	Yes	Yes	Yes	
3	02-01-01 FENI	Yes	-	70.0	Col-lapsed	55	Farm	Rice	R1	2.5	Earthen	Fair	0	0	0	1,000	Flat	Clay	2.0	7.0	30.0	80.0	0.3	None	Fixed	Pass-able	70.0	8.0	Yes	Yes	Yes	Yes	• Irrigation canal
4	02-02-01 FENI	Yes	RC	26.7	Bad	45	Farm	Rice	R2	3.0	Earthen	Fair	0	100	2,000	0	Flat	Clay	1.0	5.4	9.0	31.0	0.3	Yes	Fixed	Pass-able	40.0	5.5	Yes	Yes	Yes	Yes	• Irrigation canal
5	02-02-02 FENI	Yes	RC	27.5	Bad	60	Farm	Rice	R2	2.5	Earthen	Fair	0	200	2,500	0	Flat	Silt	1.0	5.6	8.0	35.0	0.4	Yes	Fixed	Pass-able	40.0	6.0	Yes	Yes	Yes	Yes	
6	03-01-01 CHITTAGONG	Yes	Balley	27.5	Fair	50	Farm	Rice Veg.	FRB	6.8	Earthen	Fair	50	290	3,000	0	Flat	Silt	0.8	4.8	14.0	28.0	0.6	None	Fixed	Pass-able	28.0	5.4	Yes	No	Yes	No	• No need reconstruction
7	03-01-02 CHITTAGONG	Yes	Balley	27.5	Damaged	35	Farm	Rice Veg.	FRB	6.8	Earthen	Fair	50	250	3,000	0	Flat	Silt	0.9	6.5	20.0	36.0		None	Fixed	Pass-able	36.0	7.5	Yes	No	Yes	No	• Damage is reparable • No need reconstruction
8	03-02-01 CHITTAGONG	None	-	-	-	50	Farm	Rice Veg.	FRB	2.5	Earthen	Fair	0	0	0	600	Flat	Sand	2.0	7.5	50.0	70.0		None	Fixed	Pass-able	80.0	7.5	Yes	Yes	Yes	Yes	
9	03-03-01 CHITTAGONG	None	-	-	-	30	Farm	Rice Veg.	R1	3.0	HBB	Good	0	60	0	300	Moun-tains	Clay	0.5	5.8	8.0	62.0	1.0	None	Fixed	Pass-able	70.0	6.3	Yes	Yes	Yes	Yes	
10	03-04-01 CHITTAGONG	None	-	-	-	60	Farm	Rice Veg.	FRB	5.0	Earthen	Fair	0	0	0	500	Flat	Clay	1.9	5.7	25.0	35.0	1.0	None	Fixed	Pass-able	35.0	6.8	Yes	Yes	Yes	Yes	
11	03-05-01 CHITTAGONG	Yes	RCDG	21.9	Settle-ment	50	Farm	Rice	FRB	5.4	Earthen	Poor	35	125	2,000	0	Flat	Sand	2.0	4.0	16.0	22.0		None	Fixed	Pass-able	22.0	5.0	Yes	Yes	Yes	Yes	
12	03-06-01 CHITTAGONG	Yes	Steel	85.0	Col-lapsed	25	Farm	Salt Rice	FRB	6.8	Earthen	Poor	0	0	0	1,000	Flat	Clay	4.5	13.1	37.0	87.0		None	Fixed	Pass-able	95.0	14.0	Yes	Yes	Yes	Yes	
13	04-01-01 HABIGONJ	None	-	-	-	15	Farm	Rice	FRB	3.0	Earthen	Bad	0	0	0	200	Flat	Clay	3.0	10.5	25.0	Flood	0.9	None	Fixed	Pass-able	60.0	12.0	Yes	Yes	Yes	Yes	
14	04-02-01 HABIGONJ	None	-	-	-	2	Farm	Rice	FRB	4.0	Earthen	Fair	0	0	0	200	Flat	Clay	1.0	6.5	10.0	84.0	1.5	None	Fixed	Pass-able	80.0	8.0	Yes	Yes	Yes	Yes	
15	04-03-01 HABIGONJ	None	-	-	-	20	Farm	Rice	FRB	3.5	Earthen	Bad	0	0	0	200	Flat	Clay	0.8	5.5	20.0	Flood	1.0	None	Fixed	Pass-able	30.0	8.5	Yes	Yes	Yes	Yes	
16	04-04-01 HABIGONJ	None	-	-	-	10	Farm	Rice	FRB	2.0	Earthen	Bad	0	0	0	200	Flat	Clay	4.0	8.5	30.0	48.0	1.0	None	Fixed	Pass-able	48.0	10.5	Yes	Yes	Yes	Yes	
17	04-04-02 HABIGONJ	None	-	-	-	10	Farm	Rice	FRB	2.0	Earthen	Bad	0	0	0	200	Flat	Clay	2.5	7.7	35.0	Flood	1.0	None	Fixed	Pass-able	50.0	9.0	Yes	Yes	Yes	Yes	
18	05-01-01 MOULVIBAZAR	Yes	RCBX	16.7	Settle-ment	15	Farm	Rice Veg.	FRB	3.7	Earthen	Fair	0	250	1,000	0	Flat	Clay	1.0	2.5	7.3	17.0		None	Fixed	Pass-able	20.0	4.0	Yes	Yes	Yes	Yes	
19	05-01-02 MOULVIBAZAR	Yes	RCDG	29.5	Settle-ment	10	Farm	Rice Veg.	FRB	6.0	Earthen	Fair	0	350	1,000	0	Roll-ing	Clay	0.5	3.3	23.0	30.0		None	Fixed	Pass-able	35.0	5.5	Yes	Yes	Yes	Yes	
20	05-02-01 MOULVIBAZAR	Yes	Steel	21.0	Bad	40	Farm	Rice Veg.	FRB	6.0	Earthen	Fair	0	350	1,000	0	Roll-ing	Clay	1.0	5.2	15.0	21.0		Yes	Fixed	Pass-able	25.0	6.5	Yes	Yes	Yes	Yes	
21	05-02-02 MOULVIBAZAR	Yes	Steel	32.0	Col-lapsed	40	Farm	Rice Veg.	FRB	6.0	Earthen	Fair	0	0	1,000	0	Roll-ing	Silt	1.0	4.3	20.0	32.0		Yes	Fixed	Pass-able	35.0	6.5	Yes	Yes	Yes	Yes	

Table 3-5 SITE DATA OF REQUESTED BRIDGES AND EVALUATION OF PRIORITY OF BRIDGES (2/4)

No.	Bridge No. /Location	Present Condition of Bridge				Socio Economic and Approach Road Information											Engineering Information										Recommen- dation		Selection of High Priority Bridges				Remarks
													Traffic Volume (ADT) (Rainy Season)						River Hydrogical Condition														
																			Depth (m)		Width (m)												
		Exist / None	Bridge Type	Bridge Length (m)	Present Condi- tion	No. of Affect- ed Popula- tion (Thou.)	Land Use	Main Prod- ucts	Road Class	Road Width	Road Surface Type	Road Pre- sent Condi- tion	Vehicle	Rick- shaw	Walking	Boat	Geo. Condi- tion	Topo.- Condi- tion	LWL	HWL	LWL	HWL	Current Velocity (M/S)	River Dike Exis- tence	Align- ment	Present Condi- tion of Access Road	Bridge Length (m)	Bridge Height (m)	Socio Economic Effect	Urgency	Appropriateness	Judgment	
22	05-03-01 MOULVIBAZAR	None	-	-	-	10	Farm	Rice Veg.	FRB	6.0	Earthen	Fair	0	0	0	500	Roll- ing	Clay	1.3	11.0	13.0	55.0	1.0	Yes	Fixed	Pass- able	55.0	12.5	Yes	Yes	Yes	Yes	
23	05-04-01 MOULVIBAZAR	Yes	RCDG	10.3	Poor	15	Farm	Rice	FRB	4.5	Bit Seal	Fair	0	120	1,000	0	Flat	Clay	1.0	5.3	8.0	13.0		Yes	Fixed	Pass- able	20.0	7.0	Yes	Yes	Yes	Yes	
24	06-01-01 CHANDOPUR	Yes	Bamboo	25.0	-	20	Farm	Rice	FRB	5.6	Earthen	Fair	0	0	1,000	0	Flat	Clay	1.0	5.8	12.0	25.0	0.8	None	Fixed	Pass- able	25.0	7.0	Yes	Yes	Yes	Yes	
25	06-02-01 CHANDOPUR	Yes	Bamboo	17.0	-	7	Farm	Rice	R2	3.0	Earthen	Fair	0	0	1,000	0	Flat	Clay	0.0	4.5	0.0	15.0	0.1	None	Fixed	Pass- able	15.0	5.0	Yes	Yes	Yes	Yes	
26	06-03-01 CHANDOPUR	Yes	Bamboo	40.0	-	10	Farm	Rice	R1	2.4	Earthen	Fair	0	0	1,000	0	Flat	Clay	2.0	6.0	20.0	40.0	0.5	None	Fixed	Pass- able	40.0	8.0	Yes	Yes	Yes	Yes	
27	06-03-02 CHANDOPUR	Yes	Bamboo	25.0	Poor	5	Farm	Rice	R1	2.0	Earthen	Fair	0	225	1,000	0	Flat	Clay	1.9	2.5	18.0	25.0	0.1	None	Fixed	Pass- able	25.0	3.0	Yes	Yes	Yes	Yes	
28	06-04-01 CHANDOPUR	Yes	Bamboo	28.0	-	4	Farm	Rice	FRB	2.4	Earthen	Fair	0	0	500	0	Flat	Clay	3.0	5.0	28.0	30.0	0.1	None	Fixed	Pass- able	30.0	7.0	Yes	Yes	Yes	Yes	
29	06-04-02 CHANDOPUR	Yes	Bamboo	27.0	-	5	Farm	Rice	FRB	2.3	Earthen	Fair	0	0	500	0	Flat	Clay	3.0	4.5	24.0	27.0	0.0	None	Fixed	Pass- able	25.0	6.0	Yes	Yes	Yes	Yes	
30	07-01-01 B. BARIA	None	-	-	-	25	Farm	Rice Jute	FRB	6.0	Earthen	Fair	0	0	0	200	Flat	Clay	1.0	4.5	10.0	22.0	0.5	None	Fixed	Pass- able	20.0	5.5	Yes	Yes	Yes	Yes	
31	07-01-02 B. BARIA	None	-	-	-	30	Farm	Rice Jute	FRB	6.0	Earthen	Fair	0	0	0	200	Flat	Clay	1.5	6.5	10.0	90.0	0.5	None	Fixed	Pass- able	85.0	7.5	Yes	Yes	Yes	Yes	
32	07-02-01 B. BARIA	None	-	-	-	20	Farm	Rice Jute	FRB	6.0	Earthen	Fair	0	0	0	200	Flat	Clay	0.5	3.5	5.0	30.0	0.5	None	Fixed	Pass- able	30.0	4.5	Yes	Yes	Yes	Yes	
33	07-02-02 B. BARIA	Yes	Bamboo		Bad	20	Farm	Rice Jute	FRB	6.0	Earthen	Fair	0	0	500	0	Flat	Clay	0.3	2.2	4.0	13.0	0.5	None	Fixed	Pass- able	15.0	3.8	Yes	Yes	Yes	Yes	
34	07-03-01 B. BARIA	None	-	-	-	30	Farm	Rice Jute	R2	4.0	Earthen	Fair	0	0	0	200	Flat	Clay	1.5	6.5	25.0	60.0	2.0	None	Fixed	Pass- able	60.0	7.5	Yes	Yes	Yes	Yes	
35	07-03-02 B. BARIA	Yes	RCDG	29.1	Settle- ment	25	Farm	Rice	R1	3.5	Earthen	Bad	0	10	800	0	Flat	Silt	3.0	6.5	18.0	30.0	1.8	None	Fixed	Pass- able	30.0	10.0	Yes	Yes	Yes	Yes	
36	07-04-01 B. BARIA	Yes	Bamboo	28.5	-	20	Farm	Rice	R2	2.5	Earthen	Fair	0	0	200	0	Flat	Clay	0.5	4.5	8.0	27.0	0.8	None	Fixed	Pass- able	25.0	5.5	Yes	Yes	Yes	Yes	
37	08-01-01 COMILLA	Yes	Balley	27.5	Col- lapsed	25	Farm	Rice Veg.	FRB	3.5	Earthen	Bad	0	500	2,000	0	Roll- ing	Clay	1.0	3.5	10.0	24.0	0.5	Yes	Fixed	Pass- able	25.0	5.0	Yes	Yes	Yes	Yes	
38	08-01-02 COMILLA	Yes	RC Arch	22.0	Bad	8	Farm	Rice	R2	3.5	Earthen	Fair	50	250	2,500	0	Roll- ing	Clay	0.5	2.5	3.0	18.0	0.2	Yes	Fixed	Pass- able	25.0	5.0	Yes	Yes	Yes	Yes	
39	08-01-03 COMILLA	Yes	RCDG	43.3	Poor	20	Farm	Rice	R2	3.3	Earthen	Fair	25	425	2,000	0	Flat	Clay	1.0	3.7	28.0	43.0	0.3	Yes	Fixed	Pass- able	37.0	5.0	Yes	Yes	Yes	Yes	
40	08-02-01 COMILLA	Yes	Timber	28.0	Bad	20	Farm	Rice	R2	2.0	Earthen	Fair	0	40	2,000	0	Flat	Clay	1.5	5.0	15.0	28.0	0.0	None	Fixed	Pass- able	30.0	6.5	Yes	Yes	Yes	Yes	
41	08-02-02 COMILLA	Yes	RCDG	17.0	Poor	15	Farm	Rice	R2	3.0	Earthen	Fair	0	250	500	0	Flat	Clay	0.5	1.7	8.0	17.0	0.1	None	Fixed	Pass- able	25.0	4.0	Yes	Yes	Yes	Yes	
42	08-03-01 COMILLA	Yes	Bamboo	26.0	-	6	Farm	Rice	R1	2.4	Earthen	Fair	0	0	200	0	Flat	Clay	0.0	3.7	0.0	28.0	0.2	None	Fixed	Pass- able	30.0	5.0	Yes	Yes	Yes	Yes	

Table 3-5 SITE DATA OF REQUESTED BRIDGES AND EVALUATION OF PRIORITY OF BRIDGES (3/4)

No.	Bridge No. /Location	Present Condition of Bridge: Exist / None	Bridge Type	Bridge Length (m)	Present Condition	Socio Economic and Approach Road Information: No. of Affected Population (Thou.)	Land Use	Main Products	Road Class	Road Width	Road Surface Type	Road Present Condition	Traffic Volume (ADT) (Rainy Season): Vehicle	Rickshaw	Walking	Boat	Engineering Information: Geo. Condition	Topo. Condition	River Hydrogical Condition: Depth (m) LWL	Depth (m) HWL	Width (m) LWL	Width (m) HWL	Current Velocity (M/S)	River Dike Existence	Alignment	Present Condition of Access Road	Recommendation: Bridge Length (m)	Bridge Height (m)	Selection of High Priority Bridges: Socio Economic Effect	Urgency	Appropriateness	Judgment	Remarks
43	08-03-02 COMILLA	None	-	-	-	5	Farm	Rice	R1	2.4	Earthen	Fair	0	0	0	200	Flat	Clay	1.0	4.3	5.0	25.0	0.5	None	Fixed	Passable	25.0	5.0	Yes	Yes	Yes	Yes	
44	08-04-01 COMILLA	None	-	-	-	8	Farm	Rice	FRB	1.5	Earthen	Bad	0	0	0	200	Flat	Clay	0.0	4.5	0.0	25.0	0.5	None	Fixed	Passable	25.0	6.5	Yes	Yes	Yes	Yes	
45	08-04-02 COMILLA	None	-	-	-	7	Farm	Rice	FRB	1.5	Earthen	Bad	0	0	0	200	Flat	Clay	1.0	5.0	4.5	30.0	0.5	None	Fixed	Passable	30.0	6.5	Yes	Yes	Yes	Yes	
46	08-04-03 COMILLA	None	-	-	-	25	Farm	Rice	FRB	6.0	Earthen	Fair	0	0	0	200	Flat	Clay	2.0	6.0	45.0	60.0	0.7	None	Fixed	Passable	65.0	8.0	Yes	Yes	Yes	Yes	
47	09-01-01 NOAKHALI	Yes	RC	45.2	Bad	90	Farm	Rice	R1	3.7	Earthen	Fair	0	200	500	0	Flat	Clay	1.2	4.0	25.0	60.0	0.4	None	Fixed	Passable	50.0	5.3	Yes	Yes	Yes	Yes	
48	09-01-02 NOAKHALI	Yes	Timber	12.5	Bad	70	Farm	Rice	R1	3.7	Earthen	Fair	0	250	500	0	Flat	Clay	2.0	8.0	10.0	14.0	0.3	None	Fixed	Passable	15.0	5.0	Yes	Yes	Yes	Yes	• Irrigation canal
49	09-02-01 NOAKHALI	Yes	RCDG	21.2	Damaged	35	Residence	Rice	R2	3.4	HBB	Fair	25	120	3,000	0	Flat	Clay	1.0	3.8	17.0	21.0	0.3	None	Fixed	Passable	20.0	6.0	Yes	Yes	Yes	Yes	
50	09-02-02 NOAKHALI	Yes	RCDG	13.6	Damaged	40	Farm	Rice	R2	3.9	Earthen	Fair	2	200	1,500	0	Flat	Clay	1.0	4.0	10.0	16.0	0.3	None	Fixed	Passable	15.0	5.7	Yes	Yes	Yes	Yes	
51	09-03-01 NOAKHALI	None	-	-	-	40	Farm	Rice	R2	2.5	Earthen	Fair	0	0	0	200	Flat	Clay	1.5	5.0	15.0	35.0	0.4	None	Fixed	Passable	40.0	6.0	Yes	Yes	Yes	Yes	
52	09-04-01 NOAKHALI	Yes	RCDG	16.4	Fair	35	Farm	Rice	R2	3.5	HBB	Good	15	56	1,600	0	Flat	Clay	2.0	4.4	10.0	16.0	0.3	None	Fixed	Passable	18.0	5.5	Yes	No	Yes	No	• Existing bridge is fair • No need reconstruction
53	09-05-01 NOAKHALI	Yes	RC Arch	15.6	Fair	50	Residence	Rice	R1	3.0	Earthen	Fair	3	70	2,000	0	Flat	Clay	2.0	4.0	10.0	16.0	0.4	None	Fixed	Passable	15.0	4.5	Yes	No	Yes	No	• Existing bridge is fair • No need reconstruction
54	10-01-01 LAXMIPUR	Yes	Bamboo	33.5	-	50	Farm	Rice	R2	3.0	Earthen	Fair	0	0	1,500	0	Flat	Clay	1.8	5.0	20.0	30.0	0.3	None	Fixed	Passable	34.0	6.0	Yes	Yes	Yes	Yes	• Irrigation canal
55	10-02-01 LAXMIPUR	Yes	-	80.0	Collapsed	75	Farm	Rice	R1	5.0	Earthen	Fair	0	0	0	1,000	Flat	Clay	3.0	5.0	75.0	87.0	0.4	None	Fixed	Passable	75.0	7.7	Yes	Yes	Yes	Yes	
56	10-03-01 LAXMIPUR	Yes	-	-	-	45	Farm	Rice	R3	2.5	Earthen	Bad	0	0	5	400	Flat	Clay	0.6	3.0	30.0	65.0	0.3	None	Fixed	Passable	61.0	4.5	Yes	Yes	Yes	Yes	
57	11-01-01 NARSINGDI	Yes	Timber	73.0	Bad	100	Residence	Rice	FRB	2.5	Earthen	Bad	0	100	10,000	0	Flat	Clay	1.0	5.5	73.0	73.0	0.0	None	Fixed	Passable	75.0	8.0	Yes	Yes	Yes	Yes	• Fairway for small boats
58	11-02-01 NARSINGDI	None	-	-	-	5	Farm	Rice	FRB	3.8	Earthen	Fair	0	0	0	500	Flat	Clay	1.0	3.0	18.0	18.0	0.3	None	Fixed	Passable	25.0	5.0	Yes	Yes	Yes	Yes	
59	11-02-02 NARSINGDI	None	-	-	-	5	Farm	Rice	FRB	3.8	Earthen	Fair	0	0	0	600	Flat	Clay	1.0	3.0	16.0	16.0	0.3	None	Fixed	Passable	16.0	5.0	Yes	Yes	Yes	Yes	
60	11-02-03 NARSINGDI	None	-	-	-	6	Farm	Rice	FRB	3.8	Earthen	Fair	0	0	0	600	Flat	Clay	1.0	3.0	15.0	15.0	0.3	None	Fixed	Passable	15.0	5.0	Yes	Yes	Yes	Yes	
61	11-02-04 NARSINGDI	None	-	-	-	15	Farm	Rice	FRB	3.7	Earthen	Fair	0	0	0	1,500	Flat	Clay	1.5	3.5	65.0	65.0	0.3	None	Fixed	Passable	65.0	8.0	Yes	Yes	Yes	Yes	
62	11-03-01 NARSINGDI	None	-	-	-	15	Farm	Rice	R1	2.0	Earthen	Fair	0	15	0	500	Flat	Silt	1.3	10.0	40.0	450.0	0.5	None	Fixed	Passable	400.0	13.0	Yes	Yes	Yes	Yes	• Fairway for small boats
63	11-03-02 NARSINGDI	None	-	-	-	30	Farm	Rice	R1	3.0	Earthen	Bad	0	40	0	700	Flat	Silt	0.3	4.5	85.0	150.0	0.3	None	Fixed	Passable	125.0	8.0	Yes	Yes	Yes	Yes	• Fairway for small boats

Table 3-5 SITE DATA OF REQUESTED BRIDGES AND EVALUATION OF PRIORITY OF BRIDGES (4/4)

No.	Bridge No. /Location	Present Condition of Bridge: Exist / None	Bridge Type	Bridge Length (m)	Present Condition	Socio Economic and Approach Road Information: No. of Affected Population (Thou.)	Land Use	Main Products	Road Class	Road Width	Road Surface Type	Road Present Condition	Traffic Volume (ADT) (Rainy Season): Vehicle	Rickshaw	Walking	Boat	Engineering Information: Geo. Condition	Topo. Condition	River Hydrogical Condition: Depth (m) LWL	Depth (m) HWL	Width (m) LWL	Width (m) HWL	Current Velocity (M/S)	River Dike Existence	Alignment	Present Condition of Access Road	Recommendation: Bridge Length (m)	Bridge Height (m)	Selection of High Priority Bridges: Socio Economic Effect	Urgency	Appropriateness	Judgment	Remarks
64	12-01-01 FARIDPUR	None	-	-	-	50	Farm	Jute	R1	4.0	Earthen	Bad	0	0	0	500	Flat	Silt	4.5	15.0	50.0	120.0	1.5	None	Fixed	Pass-able	120.0	16.0	Yes	Yes	Yes	Yes	• Fairway for small boats
65	12-01-02 FARIDPUR	Yes	Bamboo	70.0	Bad	70	Farm	Jute	R1	4.5	Earthen	Fair	0	0	3,000	0	Flat	Clay	1.0	6.0	15.0	75.0	1.0	None	Fixed	Pass-able	65.0	7.5	Yes	Yes	Yes	Yes	
66	12-02-01 FARIDPUR	Yes	Bamboo	60.0	Bad	70	Farm	Jute	R1	4.0	Bit. Seal	Good	0	0	2,000	0	Flat	Clay	1.0	5.5	10.0	65.0	1.0	None	Fixed	Pass-able	60.0	7.0	Yes	Yes	Yes	Yes	
67	13-01-01 DHAKA	None	-	-	-	40	Farm	Rice	FRB	7.0	Earthen	Fair	0	0	0	1,000	Flat	Clay	1.5	14.0	60.0	142.0	1.0	None	Fixed	Pass-able	140.0	16.0	Yes	Yes	Yes	Yes	
68	13-01-02 DHAKA	None	-	-	-	40	Farm	Rice	FRB	7.0	Earthen	Fair	0	0	0	1,000	Flat	Clay	1.5	4.6	35.0	52.0	2.0	None	Fixed	Pass-able	50.0	6.0	Yes	Yes	Yes	Yes	
69	13-01-03 DHAKA	None	-	-	-	30	Farm	Rice	R2	3.0	Earthen	Fair	0	0	0	500	Flat	Clay	0.5	2.0	12.0	15.0	0.0	None	Fixed	Pass-able	15.0	4.0	Yes	Yes	Yes	Yes	
70	13-02-01 DHAKA	None	-	-	-	100	Farm	Rice	FRB	3.0	HBB	Good	0	0	0	2,000	Flat	Clay	5.5	10.7	64.0	123.0	1.2	None	Fixed	Pass-able	125.0	14.0	Yes	Yes	Yes	Yes	• Fairway for vessels
71	13-02-02 DHAKA	None	-	-	-	25	Farm	Rice	FRB	3.5	Earthen	Fair	0	0	0	500	Flat	Clay	0.5	4.5	15.0	41.0	0.0	None	Fixed	Pass-able	40.0	6.0	Yes	Yes	Yes	Yes	
72	13-03-01 DHAKA	None	-	-	-	100	Farm	Rice	FRB	6.0	Earthen	Bad	0	0	70	2,000	Flat	Clay	5.0	10.7	45.0	122.0	0.5	None	Fixed	Pass-able	115.0	13.0	Yes	Yes	Yes	Yes	• Fairway for vessels
73	13-03-02 DHAKA	Yes	Bamboo	30.0	-	20	Farm	Rice	FRB	2.4	Earthen	Fair	0	0	1,000	0	Flat	Clay	0.3	3.0	15.0	30.0	0.0	None	Fixed	Pass-able	30.0	4.0	Yes	Yes	Yes	Yes	
74	14-01-01 MUNSHIGONJ	Yes	Timber	19.0	Bad	25	Farm	Jute	R2	3.7	HBB	Good	0	150	5,000	0	Flat	Clay	1.3	4.2	18.0	19.0	0.3	None	Fixed	Pass-able	20.0	6.0	Yes	Yes	Yes	Yes	
75	14-01-02 MUNSHIGONJ	Yes	Timber	14.0	Bad	15	Farm	Jute	R2	3.7	Earthen	Fair	0	105	3,000	0	Flat	Clay	1.3	3.4	10.0	14.0	0.0	None	Fixed	Pass-able	20.0	6.0	Yes	Yes	Yes	Yes	
76	14-02-01 MUNSHIGONJ	Yes	Timber	43.0	Damaged	30	Farm	Jute	FRB	6.0	Earthen	Fair	0	170	5,000	0	Flat	Clay	2.3	5.6	40.0	43.0	0.3	None	Fixed	Pass-able	40.0	8.0	Yes	Yes	Yes	Yes	
77	14-02-02 MUNSHIGONJ	Yes	Timber	39.5	Bad	20	Farm	Jute	R2	3.0	Earthen	Fair	0	170	5,000	0	Flat	Clay	2.3	5.6	40.0	43.0	0.3	None	Fixed	Pass-able	40.0	8.0	Yes	Yes	Yes	Yes	
78	14-03-01 MUNSHIGONJ	None	-	-	-	60	Farm	Jute	R1	2.5	Earthen	Bad	0	0	0	500	Flat	Clay	3.0	7.2	65.0	117.0	1.0	None	Fixed	Pass-able	115.0	9.0	Yes	Yes	Yes	Yes	• Fairway for small boats
79	14-04-01 MUNSHIGONJ	Yes	Steel	39.5	Poor	15	Farm	Jute	FRB	5.0	Earthen	Fair	0	135	2,000	0	Flat	Clay	6.5	8.8	35.0	47.0	1.0	None	Fixed	Pass-able	47.0	11.0	Yes	Yes	Yes	Yes	• Fairway for small boats
80	14-05-01 MUNSHIGONJ	Yes	Timber	40.0	Poor	40	Resi-dence	Jute	FRB	5.0	Earthen	Fair	0	160	10,000	0	Flat	Clay	1.5	4.5	25.0	40.0	0.3	None	Fixed	Pass-able	40.0	8.0	Yes	Yes	Yes	Yes	• Fairway for small boats
81	15-01-01 GAZIPUR	Yes	Timber	53.5	Col-lapsed	70	Farm	Rice	R2	4.2	Earthen	Fair	0	0	1,000	500	Moun-tains	Clay	1.5	8.8	28.0	53.0	1.2	None	Fixed	Pass-able	65.0	10.0	Yes	Yes	Yes	Yes	
82	15-02-01 GAZIPUR	Yes	Bamboo	110.0	-	80	Farm	Rice Potato	R1	3.0	Earthen	Fair	0	0	500	200	Flat	Clay	1.5	6.4	100.0	110.0	0.5	None	Fixed	Pass-able	100.0	8.0	Yes	Yes	Yes	Yes	
83	15-03-01 GAZIPUR	Yes	Timber	59.5	Bad	50	Farm	Rice Wheat	R1	4.5	Earthen	Bad	0	0	1,000	0	Flat	Clay	1.5	5.0	20.0	60.0	0.1	None	Fixed	Pass-able	60.0	8.5	Yes	Yes	Yes	Yes	

Note:
- Population in affected area and ADT are estimated based on hearing survey.
- ADT of vehicle includes auto-rickshaw and rickshaw includes motor-cycle.

3.3.2 Technical Evaluation on the Project

The project aims to construct bridges along Type-B feeder roads and rural roads in 15 districts in eastern Bangladesh. The bridge type is portable steel bridge. The Government of Bangladesh is responsible for construction of substructures and approach roads. The superstructures will be procured under this project.

This project will provide portable steel bridge materials for those bridges that the Government of Bangladesh can construct without technical difficulty.

The 79 high priority bridges were evaluated on their foreseen difficulties in construction and bridges having no difficulty in construction were selected for the project.

The evaluation criteria are as follows:

- Bridges can be planned with standard type substructures and foundations.
- Bridges do not need any special machinery or technology in construction including temporary works and erection works.

The evaluation result of each bridge is presented in Table 3-6. To evaluate the bridges, the bridge structures and site topography developed on the bridge general views were employed.

As a result, 74 bridges were evaluated as having no difficulty in construction, and were selected for the project. The other 5 bridges were evaluated as being difficult to construct. The difficulties are as follows:

- The water level of river is deep, even in the dry season, so that construction of the foundation and substructure requires a special construction method.
- When flooded, the water level is very deep and current velocity is fast, so that special structure type piers are required.
- The size of the river is large (wider than 200 m), so that a long span bridge is required.

Table 3-6 SELECTION OF BRIDGES FOR THE PROJECT (1/7)

No.	Bridge No. / Location	Layout of Bridge	Substructure (A : Abutment, P : Pier, H : Height (m))	Engineering Information: Geo. Condition	Topo. Condition	River Hydrogical Condition: Depth (m) LWL	Depth (m) HWL	Width (m) LWL	Width (m) HWL	Current Velocity (M/S)	River Dike Existence	Alignment	Evaluation for Selection (on construction difficulty)	Judgment
1	01-01-01 COX'S BAZAR	A1 25m P1 25m P2 25m A2 L= 75 m、W= 51.5 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 7.5 A_2 : H= 4.5	Flat	Clay	0.8	4.7	36.0	70.0		None	Fixed	● Piers in river can be constructed using cofferdams. ● Construction is not difficult.	Yes
2	01-02-01 COX'S BAZAR	A1 25m P1 25m P2 25m P3 25m P4 25m A2 L=125 m、W= 85.8 t	A_1 : H= 4.5 P_1 : H= 5.0 P_2 ~ P_4 : H= 7.0 A_2 : H= 4.5	Flat	Sand	0.9	4.3	60.0	160.0		None	Fixed	● Construction is easy.	Yes
3	02-01-01 FENI	A1 25m P1 25m P2 25m A2 L= 75 m、W= 51.5 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 9.5 A_2 : H= 4.5	Flat	Clay	2.0	7.0	30.0	80.0	0.3	None	Fixed	● Pile bent type pier can be constructed in deep river. ● Construction is not difficult.	Yes
4	02-02-01 FENI	A1 20m P1 20m A2 L= 40 m、W= 27.4 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	Flat	Clay	1.0	5.4	9.0	31.0	0.3	Yes	Fixed	● Piers in river can be constructed using cofferdams. ● Construction is not difficult.	Yes
5	02-02-02 FENI	A1 20m P1 20m A2 L= 40 m、W= 27.4 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	Flat	Silt	1.0	5.6	8.0	35.0	0.4	Yes	Fixed	● Piers in river can be constructed using cofferdams. ● Construction is not difficult.	Yes
6	03-01-01 CHITTAGONG	A1 15m P1 15m A2 L= 30 m、W= 20.6 t	A_1 : H= 4.5 P_1 : H= 7.5 A_2 : H= 4.5	Flat	Silt	0.8	4.8	14.0	28.0	0.6	None	Fixed	● Damage is very slight. ● No need reconstruction.	No
7	03-01-02 CHITTAGONG	A1 20m P1 20m A2 L= 40 m、W= 27.4 t	A_1 : H= 4.5 P_1 : H= 9.0 A_2 : H= 4.5	Flat	Silt	0.9	6.5	20.0	36.0		None	Fixed	● Replacement of deck slab is needed. ● No need reconstruction.	No
8	03-02-01 CHITTAGONG	A1 25m P1 25m P2 25m A2 L= 75 m、W= 51.5 t	A_1 : H= 4.5 P_1 ~ P_2 : H=10.0 A_2 : H= 4.5	Flat	Sand	2.0	7.5	50.0	70.0		None	Fixed	● Piers in river can be constructed using cofferdams. ● Construction is not difficult.	Yes
9	03-03-01 CHITTAGONG	A1 25m P1 25m P2 25m A2 L= 75 m、W= 51.5 t	A_1 : H= 6.0 P_1 : H= 6.0 P_2 : H= 9.0 A_2 : H= 6.0	Mountains	Clay	0.5	5.8	8.0	62.0	1.0	None	Fixed	● Construction is easy.	Yes
10	03-04-01 CHITTAGONG	A1 20m P1 20m A2 L= 40 m、W= 27.4 t	A_1 : H= 4.5 P_1 : H= 6.5 A_2 : H= 4.5	Flat	Clay	1.9	5.7	25.0	35.0	1.0	None	Fixed	● Pile bent type pier can be constructed in deep river. ● Construction is not difficult.	Yes
11	03-05-01 CHITTAGONG	A1 25m A2 L= 25 m、W= 17.2 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Sand	2.0	4.0	16.0	22.0		None	Fixed	● Construction is very easy due to no pier.	Yes
12	03-06-01 CHITTAGONG	A1 25m P1 25m P2 25m P3 25m P4 25m A2 L=100 m、W= 68.6 t	A_1 : H= 4.5 P_1, P_3 : H= 6.5 P_2 : H=14.0 A_2 : H= 4.5	Flat	Clay	4.5	13.1	37.0	87.0		None	Fixed	● Pile bent type pier can be constructed in deep river. ● Construction is not difficult.	Yes

Table 3-6 SELECTION OF BRIDGES FOR THE PROJECT (2/7)

No.	Bridge No. / Location	Layout of Bridge	Substructure (A : Abutment, P : Pier, H : Height (m))	Engineering Information: Geo. Condition	Topo. Condition	River Hydrogical Condition: Depth (m) LWL	Depth (m) HWL	Width (m) LWL	Width (m) HWL	Current Velocity (M/S)	River Dike Existence	Alignment	Evaluation for Selection (on construction difficulty)	Judgment
13	04-01-01 HABIGONJ	A1 20m P1 25m P2 20m A2 L = 65 m, W = 44.6 t	A_1 : H = 5.5 P_1 ~ P_2 : H = 11.0 A_2 : H = 5.5	Flat	Clay	3.0	10.5	25.0	FLOOD	0.9	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
14	04-02-01 HABIGONJ	A1 25m P1 25m P2 25m A2 L = 75 m, W = 51.5 t	A_1 : H = 4.5 P_1 ~ P_2 : H = 8.0 A_2 : H = 4.5	Flat	Clay	1.0	6.5	10.0	84.0	1.5	None	Fixed	• Construction is easy.	Yes
15	04-03-01 HABIGONJ	A1 20m P1 20m A2 L = 40 m, W = 27.4 t	A_1 : H = 4.5 P_1 : H = 8.0 A_2 : H = 4.5	Flat	Clay	0.8	5.5	20.0	FLOOD	1.0	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
16	04-04-01 HABIGONG	A1 25m P1 25m A2 L = 50 m, W = 34.3 t	A_1 : H = 5.0 P_1 : H = 9.5 A_2 : H = 5.0	Flat	Clay	4.0	8.5	30.0	48.0	1.0	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
17	04-04-02 HABIGONG	A1 25m P1 25m A2 L = 50 m, W = 34.3 t	A_1 : H = 5.0 P_1 : H = 9.5 A_2 : H = 5.0	Flat	Clay	2.5	7.7	35.0	FLOOD	1.0	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
18	05-01-01 MOULVIBAZAR	A1 20m A2 L = 20 m, W = 13.7 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	1.0	2.5	7.3	17.0		None	Fixed	• Construction is very easy due to no pier.	Yes
19	05-01-02 MOULVIBAZAR	A1 20m P1 20m A2 L = 40 m, W = 27.4 t	A_1 : H = 4.5 P_1 : H = 6.0 A_2 : H = 4.5	Rolling	Clay	0.5	3.3	23.0	30.0		None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
20	05-02-01 MOULVIBAZAR	A1 25m A2 L = 25 m, W = 17.2 t	A_1 : H = 4.5 A_2 : H = 4.5	Rolling	Clay	1.0	5.2	15.0	21.0		Yes	Fixed	• Construction is very easy due to no pier.	Yes
21	05-02-02 MOULVIBAZAR	A1 20m P1 20m A2 L = 40 m, W = 27.4 t	A_1 : H = 4.5 P_1 : H = 7.0 A_2 : H = 4.5	Rolling	Silt	1.0	4.3	20.0	32.0		Yes	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
22	05-03-01 MOULVIBAZAR	A1 25m P1 25m A2 L = 50 m, W = 34.3 t	A_1 : H = 4.5 P_1 : H = 13.5 A_2 : H = 4.5	Rolling	Clay	1.3	11.0	13.0	55.0	1.0	Yes	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
23	05-04-01 MOULVIBAZAR	A1 20m A2 L = 20 m, W = 13.7 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	1.0	5.3	8.0	13.0		Yes	Fixed	• Construction is very easy due to no pier.	Yes
24	06-01-01 CHANDOPUR	A1 25m A2 L = 25 m, W = 17.2 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	1.0	5.8	12.0	25.0	0.8	None	Fixed	• Construction is very easy due to no pier.	Yes

Table 3-6 SELECTION OF BRIDGES FOR THE PROJECT (3/7)

No.	Bridge No. / Location	Layout of Bridge	Substructure (A : Abutment, P : Pier, H : Height (m))	Geo. Condition	Topo. Condition	River Hydrogical Condition: Depth (m) LWL	Depth (m) HWL	Width (m) LWL	Width (m) HWL	Current Velocity (M/S)	River Dike Existence	Alignment	Evaluation for Selection (on construction difficulty)	Judgment
25	06-02-01 CHANDOPUR	A1 15m A2 L = 15 m、W = 10.3 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	0.0	4.5	0.0	15.0	0.1	None	Fixed	• Construction is very easy due to no pier.	Yes
26	06-03-01 CHANDOPUR	A1 20m P1 20m A2 L = 40 m、W = 27.4 t	A_1 : H = 4.5 P_1 : H = 10.0 A_2 : H = 4.5	Flat	Clay	2.0	6.0	20.0	40.0	0.5	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
27	06-03-02 CHANDOPUR	A1 25m A2 L = 25 m、W = 17.2 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	1.9	2.5	18.0	25.0	0.1	None	Fixed	• Construction is very easy due to no pier.	Yes
28	06-04-01 CHANDOPUR	A1 15m P1 15m A2 L = 30 m、W = 20.6 t	A_1 : H = 4.5 P_1 : H = 7.0 A_2 : H = 4.5	Flat	Clay	3.0	5.0	28.0	30.0	0.1	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
29	06-04-02 CHANDOPUR	A1 25m A2 L = 25 m、W = 17.2 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	3.0	4.5	24.0	27.0	0.0	None	Fixed	• Construction is very easy due to no pier.	Yes
30	07-01-01 B. BARIA	A1 25m A2 L = 25 m、W = 17.2 t	A_1 : H = 4.0 A_2 : H = 4.0	Flat	Clay	1.0	4.5	10.0	22.0	0.5	None	Fixed	• Construction is very easy due to no pier.	Yes
31	07-01-02 B. BARIA	A1 25m P1 25m P2 25m P3 25m A2 L = 100 m、W = 68.6 t	A_1 : H = 5.0 P_1, P_2 : H = 6.0 P_3 : H = 10.0 A_2 : H = 5.0	Flat	Clay	1.5	6.5	10.0	90.0	0.5	None	Fixed	• Construction is easy.	Yes
32	07-02-01 B. BARIA	A1 15m P1 15m A2 L = 30 m、W = 20.6 t	A_1 : H = 4.5 P_1 : H = 7.0 A_2 : H = 4.5	Flat	Clay	0.5	3.5	5.0	30.0	0.5	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
33	07-02-02 B. BARIA	A1 15m A2 L = 15 m、W = 10.3 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	0.3	2.2	4.0	13.0	0.5	None	Fixed	• Construction is very easy due to no pier.	Yes
34	07-03-01 B. BARIA	A1 20m P1 25m P2 20m A2 L = 65 m、W = 44.6 t	A_1 : H = 4.5 P_1 ~ P_2 : H = 8.0 A_2 : H = 4.0	Flat	Clay	1.5	6.5	25.0	60.0	2.0	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
35	07-03-02 B. BARIA	A1 15m P1 15m A2 L = 30 m、W = 20.6 t	A_1 : H = 4.5 P_1 : H = 7.5 A_2 : H = 4.5	Flat	Silt	3.0	6.5	18.0	30.0	1.8	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
36	07-04-01 B. BARIA	A1 25m A2 L = 25 m、W = 17.2 t	A_1 : H = 4.0 A_2 : H = 4.0	Flat	Clay	0.5	4.5	8.0	27.0	0.8	None	Fixed	• Construction is very easy due to no pier.	Yes

Table 3-6 SELECTION OF BRIDGES FOR THE PROJECT (4/7)

No.	Bridge No. / Location	Layout of Bridge	Substructure (A : Abutment, P : Pier, H : Height (m))	Geo. Condition	Topo. Condition	River Hydrogical Condition: Depth (m) LWL	Depth (m) HWL	Width (m) LWL	Width (m) HWL	Current Velocity (M/S)	River Dike Existence	Alignment	Evaluation for Selection (on construction difficulty)	Judgment
37	08-01-01 COMILLA	A1 25m A2 L = 25 m, W = 17.2 t	A_1 : H = 4.5 A_2 : H = 4.5	Rool-ing	Clay	1.0	3.5	10.0	24.0	0.5	Yes	Fixed	• Construction is very easy due to no pier.	Yes
38	08-01-02 COMILLA	A1 25m A2 L = 25 m, W = 17.2 t	A_1 : H = 4.5 A_2 : H = 4.5	Roll-ing	Clay	0.5	2.5	3.0	18.0	0.2	Yes	Fixed	• Construction is very easy due to no pier.	Yes
39	08-01-03 COMILLA	A1 20m P1 20m A2 L = 40 m, W = 27.4 t	A_1 : H = 4.5 P_1 : H = 8.0 A_2 : H = 4.5	Flat	Clay	1.0	3.7	27.0	43.0	0.3	Yes	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
40	08-02-01 COMILLA	A1 15m P1 15m A2 L = 30 m, W = 20.6 t	A_1 : H = 4.5 P_1 : H = 8.0 A_2 : H = 4.5	Flat	Clay	1.5	5.0	15.0	28.0	0.0	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
41	08-02-02 COMILLA	A1 25m A2 L = 25 m, W = 17.2 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	0.5	1.7	8.0	17.0	0.1	None	Fixed	• Construction is very easy due to no pier.	Yes
42	08-03-01 COMILLA	A1 15m P1 15m A2 L = 30 m, W = 20.6 t	A_1 : H = 4.5 P_1 : H = 7.0 A_2 : H = 4.5	Flat	Clay	0.0	3.7	0.0	28.0	0.2	None	Fixed	• Construction is easy because no water exists during dry season.	Yes
43	08-03-02 COMILLA	A1 25m A2 L = 25 m, W = 17.2 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	1.0	4.3	5.0	25.0	0.5	None	Fixed	• Construction is very easy due to no pier.	Yes
44	08-04-01 COMILLA	A1 25m A2 L = 25 m, W = 17.2 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	0.0	4.5	0.0	25.0	0.5	None	Fixed	• Construction is very easy due to no pier.	Yes
45	08-04-02 COMILLA	A1 15m P1 15m A2 L = 30 m, W = 20.6 t	A_1 : H = 4.5 P_1 : H = 7.5 A_2 : H = 4.5	Flat	Clay	1.0	5.0	4.5	30.0	0.5	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
46	08-04-03 COMILLA	A1 20m P1 25m P2 20m A2 L = 65 m, W = 44.6 t	A_1 : H = 4.5 $P_1 \sim P_2$: H = 7.0 A_2 : H = 4.5	Flat	Clay	2.0	6.0	45.0	60.0	0.7	None	Fixed	• Construction is easy.	Yes
47	09-01-01 NOAKHALI	A1 25m P1 25m A2 L = 50 m, W = 34.3 t	A_1 : H = 5.0 P_1 : H = 7.0 A_2 : H = 5.0	Flat	Clay	1.2	4.0	25.0	60.0	0.4	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
48	09-01-02 NOAKHALI	A1 15m A2 L = 15 m, W = 10.3 t	A_1 : H = 4.5 A_2 : H = 4.5	Flat	Clay	2.0	8.0	10.0	14.0	0.3	None	Fixed	• Construction is very easy due to no pier.	Yes

Table 3-6 SELECTION OF BRIDGES FOR THE PROJECT (5/7)

No.	Bridge No. / Location	Layout of Bridge	Substructure (A : Abutment, P : Pier, H : Height (m))	Geo. Condition	Topo. Condition	Depth (m) LWL	Depth (m) HWL	Width (m) LWL	Width (m) HWL	Current Velocity (M/S)	River Dike Existence	Alignment	Evaluation for Selection (on construction difficulty)	Judgment
49	09-02-01 NOAKHALI	A1 20m A2 L= 20 m, W= 13.7 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Clay	1.0	3.8	17.0	21.0	0.3	None	Fixed	• Construction is very easy due to no pier.	Yes
50	09-02-02 NOAKHALI	A1 15m A2 L= 15 m, W= 10.3 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Clay	1.0	4.0	10.0	16.0	0.3	None	Fixed	• Construction is very easy due to no pier.	Yes
51	09-03-01 NOAKHALI	A1 20m P1 20m A2 L= 40 m, W= 27.4 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	Flat	Clay	1.5	5.0	15.0	35.0	0.4	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
52	09-04-01 NOAKHALI	A1 15m A2 L= 15 m, W= 10.3 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Clay	2.0	4.4	10.0	16.0	0.3	None	Fixed	• Condition of existing RCDG very good. • No need reconstruction.	No
53	09-05-01 NOAKHALI	A1 15m A2 L= 15 m, W= 10.3 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Clay	2.0	4.0	10.0	16.0	0.4	None	Fixed	• Condition of existing RC Arch bridge very good. • No need reconstruction.	No
54	10-01-01 LAXIPUR	A1 15m P1 15m A2 L= 30 m, W= 20.6 t	A_1 : H= 4.5 P_1 : H= 8.5 A_2 : H= 4.5	Flat	Clay	1.8	5.0	20.0	30.0	0.3	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
55	10-02-01 LAXIPUR	A1 25m P1 25m P2 25m A2 L= 75 m, W= 51.5 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 7.0 A_2 : H= 4.5	Flat	Clay	3.0	5.0	75.0	87.0	0.4	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
56	10-03-01 LAXIPUR	A1 20m P1 25m P2 20m A2 L= 65 m, W= 44.6 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 7.0 A_2 : H= 4.5	Flat	Clay	0.6	3.0	30.0	65.0	0.3	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
57	11-01-01 NARSINGDI	A1 25m P1 25m P2 25m A2 L= 75 m, W= 51.5 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 7.0 A_2 : H= 4.5	Flat	Clay	1.0	5.5	73.0	73.0	0.0	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
58	11-02-01 NARSINGDI	A1 25m A2 L= 25 m, W= 17.2 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Clay	1.0	3.0	18.0	18.0	0.3	None	Fixed	• Construction is very easy due to no pier.	Yes
59	11-02-02 NARSINGDI	A1 15m A2 L= 15 m, W= 10.3 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Clay	1.0	3.0	16.0	16.0	0.3	None	Fixed	• Construction is very easy due to no pier.	Yes
60	11-02-03 NARSINGDI	A1 15m A2 L= 15 m, W= 10.3 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Clay	1.0	3.0	15.0	15.0	0.3	None	Fixed	• Construction is very easy due to no pier.	Yes

Table 3-6 SELECTION OF BRIDGES FOR THE PROJECT (6/7)

No.	Bridge No. / Location	Layout of Bridge	Substructure (A : Abutment, P : Pier, H : Height (m))	Engineering Information: Geo. Condition	Topo. Condition	River Hydrogical Condition: Depth (m) LWL	Depth (m) HWL	Width (m) LWL	Width (m) HWL	Current Velocity (M/S)	River Dike Existence	Alignment	Evaluation for Selection (on construction difficulty)	Judgment
61	11-02-04 NARSINGDI	A1 20m P1 25m P2 20m A2 L= 65 m、W= 44.6 t	A_1 : H= 4.5 $P_1 \sim P_2$: H= 9.0 A_2 : H= 4.5	Flat	Clay	1.5	3.5	65.0	65.0	0.3	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
62	11-03-01 NARSINGDI	A1 25m P1 25m P2 … P14 25m P15 25m A2 L =25m×16= 400m、W=274.4 t	A_1 : H= 5.0 P_1 , P_{15} : H= 6.0 $P_2 \sim P_{14}$: H=11.0 A_2 : H= 6.0	Flat	Silt	1.3	10.0	40.0	450.0	0.5	None	Fixed	• Fairway for small boats. • Portable bridge (L max = 25m) is not applicable for such Long bridge (L = 400m). • Long span bridge is needed.	No
63	11-03-02 NARSINGDI	A1 25m P1 25m P2 25m P3 25m P4 25m A2 L =125 m、W= 85.8 t	A_1 : H= 4.5 $P_1 \sim P_4$: H= 7.5 A_2 : H= 4.5	Flat	Silt	0.3	4.5	85.0	150.0	0.3	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
64	12-01-01 FARIDPIR	A1 25m P1 25m P2 25m P3 25m P4 25m A2 L =125 m、W= 85.8 t	A_1 : H= 4.5 P_1 , P_4 : H= 6.0 $P_2 \sim P_3$: H=10.0 A_2 : H= 4.5	Flat	Silt	4.5	15.0	50.0	120.0	1.5	None	Fixed	• Fairway for small boards. • Construction is difficulty because tall piers are required and current velocity is fast.	No
65	12-01-02 FARIDPUR	A1 20m P1 25m P2 20m A2 L= 65 m、W= 44.6 t	A_1 : H= 4.5 $P_1 \sim P_2$: H= 8.0 A_2 : H= 4.5	Flat	Clay	1.0	6.0	15.0	75.0	1.0	None	Fixed	• Construction is easy.	Yes
66	12-02-01 FARIDPUR	A1 20m P1 25m P2 20m A2 L= 65 m、W= 44.6 t	A_1 : H= 4.5 $P_1 \sim P_2$: H= 6.0 A_2 : H= 4.5	Flat	Clay	1.0	5.5	10.0	65.0	1.0	None	Fixed	• Construction is easy.	Yes
67	13-01-01 DHAKA	A1 20m P1 25m P2 25m P3 25m P4 25m P5 20m A2 L =140 m、W= 96.0 t	A_1 : H= 5.5 $P_1 \sim P_5$: H=15.0 A_2 : H= 5.5	Flat	Clay	1.5	14.0	60.0	142.0	1.0	None	Fixed	• Construction is difficult because tall piers are required and current velocity is fast.	No
68	13-01-02 DHAKA	A1 25m P1 25m A2 L= 50 m、W= 34.3 t	A_1 : H= 4.5 P_1 : H= 6.5 A_2 : H= 4.5	Flat	Clay	1.5	4.6	35.0	52.0	2.0	None	Fixed	• This bridge shall not be constructed when 13-01-01 is not constructed because the bridge is adjacent to 13-01-01.	No
69	13-01-03 DHAKA	A1 15m A2 L= 15 m、W= 10.3 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Clay	0.5	2.0	12.0	15.0	0.0	None	Fixed	• Construction is very easy due to no pier.	Yes
70	13-02-01 DHAKA	A1 25m P1 25m P2 25m P3 25m P4 25m A2 L =125 m、W= 85.8 t	A_1 : H= 4.5 $P_1 \sim P_4$: H=16.0 A_2 : H= 4.5	Flat	Clay	5.5	10.7	64.0	123.0	1.2	None	Fixed	• Fairway of vessels • Construction is difficult because tall piers are required and current velocity is fast.	No
71	13-02-02 DHAKA	A1 20m P1 20m A2 L= 40 m、W= 27.4 t	A_1 : H= 4.5 P_1 : H= 7.0 A_2 : H= 4.5	Flat	Clay	0.5	4.5	15.0	41.0	0.0	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes

Table 3-6 SELECTION OF BRIDGES FOR THE PROJECT (7/7)

No.	Bridge No. / Location	Layout of Bridge	Substructure (A : Abutment, P : Pier, H : Height (m))	Geo. Condition	Topo. Condition	River Hydrogical Condition: Depth (m) LWL	Depth (m) HWL	Width (m) LWL	Width (m) HWL	Current Velocity (M/S)	River Dike Existence	Alignment	Evaluation for Selection (on construction difficulty)	Judgment
72	13-03-01 DHAKA	A1 20m P1 25m P2 25m P3 25m P4 20m A2 L=115 m、W= 78.9 t	A_1 : H= 4.5 P_1, P_4 : H= 7.0 P_2 ~ P_3 : H=10.5 A_2 : H= 4.5	Flat	Clay	5.0	10.7	45.0	122.0	0.5	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
73	13-03-02 DHAKA	A1 15m P1 15m A2 L= 30 m、W= 20.6 t	A_1 : H= 4.5 P_1 : H= 6.0 A_2 : H= 4.5	Flat	Clay	0.3	3.0	15.0	30.0	0.0	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
74	14-01-01 MUNSHIGONJ	A1 20m A2 L= 20 m、W= 13.7 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Clay	1.3	4.2	18.0	19.0	0.3	None	Fixed	• Construction is very easy due to no pier.	Yes
75	14-01-02 MUNSHIGONJ	A1 20m A2 L= 20 m、W= 13.7 t	A_1 : H= 4.5 A_2 : H= 4.5	Flat	Clay	1.3	3.4	10.0	14.0	0.0	None	Fixed	• Construction is very easy due to no pier.	Yes
76	14-02-01 MUNSHIGONJ	A1 20m P1 20m A2 L= 40 m、W= 27.4 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	Flat	Clay	2.3	5.6	40.0	43.0	0.3	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
77	14-02-02 MUNSHIGONJ	A1 20m P1 20m A2 L= 40 m、W= 27.4 t	A_1 : H= 4.5 P_1 : H= 5.0 A_2 : H= 4.5	Flat	Clay	2.3	5.6	40.0	43.0	0.3	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
78	14-03-01 MUNSHIGONJ	A1 20m P1 25m P2 25m P3 25m P4 20m A2 L=115 m、W= 78.9 t	A_1 : H= 4.5 P_1, P_4 : H= 7.5 P_2 ~ P_3 : H=11.5 A_2 : H= 4.5	Flat	Clay	3.0	7.2	65.0	117.0	1.0	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
79	14-04-01 MUNSHIGONJ	A1 25m P1 25m A2 L= 50 m、W= 34.3 t	A_1 : H= 5.0 P_1 : H=11.0 A_2 : H= 5.0	Flat	Clay	6.5	8.8	35.0	47.0	1.0	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
80	14-05-01 MUNSHIGONJ	A1 20m P1 20m A2 L= 40 m、W= 27.4 t	A_1 : H= 4.5 P_1 : H= 5.5 A_2 : H= 4.5	Flat	Clay	1.5	4.5	25.0	40.0	0.3	None	Fixed	• Pile bent type pier can be constructed in deep river. • Construction is not difficult.	Yes
81	15-01-01 GAZIPUR	A1 20m P1 25m P2 20m A2 L= 65 m、W= 44.6 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 9.0 A_2 : H= 4.5	Flat	Clay	1.5	8.8	28.0	53.0	1.2	None	Fixed	• Construction is easy.	Yes
82	15-02-01 GAZIPUR	A1 20m P1 25m P2 25m P3 25m P4 20m A2 L=115 m、W= 78.9 t	A_1 : H= 4.5 P_1 ~ P_4 : H= 5.0 A_2 : H= 4.5	Flat	Clay	1.5	6.4	100.0	110.0	0.5	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes
83	15-03-01 GAZIPUR	A1 20m P1 25m P2 20m A2 L= 65 m、W= 44.6 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 7.0 A_2 : H= 4.5	Flat	Clay	1.5	5.0	20.0	60.0	0.1	None	Fixed	• Piers in river can be constructed using cofferdams. • Construction is not difficult.	Yes

3.3.3 Examination of the Request

Through discussions between involved officials of the Government of Bangladesh and the Study Team, the basic specifications of the portable steel bridge have been agreed as follows:

Basic specifications of portable steel bridge

Structure type	:	Pony truss type
Bridge width	:	Single lane carriageway
Design live load	:	AASHTO HS-15
Bridge span length	:	80 ft' (approx. 25 m)
Painting	:	Galvanizing

Engineering discussions on the basic specifications are as follows:

(1) Structure type

The pony truss type bridge used for feeder and rural roads which rarely endure heavy traffic and are used for temporary detour bridges is common in Bangladesh. The features of this bridge type are as follows:

- The structure is simple, so no special technology or tools are required for construction.
- The bridge members are light, so cranes are not required in handling.
- Erection is easy and fast.
- The bridge can be used for long period as it is permanent bridge.

(2) Bridge width

The road design guidelines of LGED specify that the carriageway width for Type-B feeder roads and R1 rural roads be 12 ft' wide. The traffic volume and components along the project roads are being observed, and amounts which do not exceed the capacity of single lane bridges in general are foreseen.

(3) Design live load

The bridge design guidelines of LGED specify that the design live load for a 12 ft' wide feeder load bridge be HS-20 (which is equivalent to an 18 ton truck load). However, applying HS-20, which is used to design trunk highway bridges, seems excessive for the project bridges, taking the design concepts of low cost, safety and durability into consideration. Based on observation and forecast of traffic volume and the size of heavy vehicles along the project roads, it was decided to apply HS-15 (which is equivalent to a 14 ton truck load) to the project bridges.

(4) Bridge span length

The shortest span length is 15 m, which was decided as the shortest bridge length in planned bridges. The longest span length is 25 m, which was based on the following considerations:

- The longest span should not be longer than the truss members needed to change the size. To economize and ease fabrication and erection of the trusses, all trusses of all the bridges need to be composed of the same members.

- The longest span should not be so long as to require a special erection method.

- The longest span should not be so long that each truss member is too heavy to carry by hand.

- The span lengths should be long enough to lower the construction cost of entire bridges including superstructures and substructures.

- The span lengths should be long enough to not obstruct flood discharge except for special rivers.

(5) Painting

Generally, painting on steel needs repainting every 3 to 5 years. Steel galvanized generally does not need maintenance for more than 20 years. Galvanizing in members, for truss members despite being more costly in production, is proposed to eliminate this maintenance work.

CHAPTER 4

BASIC DESIGN

CHAPTER 4

BASIC DESIGN

4.1 DESIGN PRINCIPLES

For the basic design of the project, the following design principles were established:

(1) Principle conditions

- Detailed design of the superstructures will be made by the Japanese consultant. Detailed design and construction of the substructures and other necessary works will be the responsibility of the Government of Bangladesh.

- Basic specifications for the superstructures are specified as described in the Minutes of Discussions, which concerned officials of the Government of Bangladesh and the Study Team discussed and agreed. (The Minutes of Discussion are attached in Appendix-2.)

- The Government of Bangladesh will carry out detailed design of the substructures based on detailed topographic and geological surveys and hydrological analyses in the implementation stage. In the course of detailed design of the substructures, the bridge locations and dimensions of the substructures will be finally concluded.

(2) Design concept

The portable steel bridge should be designed so as to be:

- Low-cost, safe and reliable
- Easy to erect
- Able to be erected by hand

- Durable and requiring little maintenance
- The design criteria should be reflect the local conditions and traffic.
- The substructures and approach roads should be designed to be able to be constructed with local materials and technology.

(3) Consideration on a past similar project

In 1985, the Government of Bangladesh procured portable steel bridge materials necessary for the "Upazila Connection Road Project" under Japan's Grant Aid, which project is similar to this project. The basic design of the project should learn from a past similar project.

Regarding the former project, the following matters were noted for improvement in a report related to the former project and the Study Team's site investigation of the bridges constructed under the former project.

a) To examine the optimum span length for the portable steel bridge

In the former project, the span length of the portable steel bridge was 9 m to 48 m. Bridges longer than a 30 m span consisted of too many members and of too large members. The resulting bridges were not economical and were not easy to erect. Therefore, a range of optimum span lengths for the portable steel bridge should be examined in terms of cost, construction ease and safety against flooding.

b) To provide the necessary erection tools

In the former project, a shortage of erection tools resulted in erection of the portable steel bridges not being executed as well as planned in quality and speed. Therefore, the items and quantities of tools necessary for bridge erection should be examined based on the implementation schedule of this project.

c) To provide erection training

In the former project, a lack of technology of erection of portable steel bridges caused to be difficult in assembly and erection. Therefore, a technical manual and on-the-job training should be planned for this project.

(4) Coordination with LGED's implementation schedule

LGED plans to implement construction of the project bridges over a 2-year period, which is divided into 3 phases. The implementation schedule of this project should be based on LGED's schedule.

The list of bridges subject to each phase is listed in Table 4-1.

Table 4-1 LIST OF BRIDGES BY IMPLEMENTATION PHASE

Phase 1			Phase 2			Phase 3		
No.	Bridge No.	District	No.	Bridge No.	District	No.	Bridge No.	District
1	01-01-01	COX'S BAZAR	1	02-01-01	FENI	1	03-05-01	CHITTAGONG
2	01-02-01	COX'S BAZAR	2	03-03-01	CHITTAGONG	2	03-06-01	CHITTAGONG
3	02-02-01	FENI	3	03-04-01	CHITTAGONG	3	04-04-01	HABIGONJ
4	02-02-02	FENI	4	04-02-01	HABIGONJ	4	04-04-02	HABIGONJ
5	03-02-01	CHITTAGONG	5	04-03-01	HABIGONJ	5	05-03-01	MOULVIBAZAR
6	04-01-01	HABIGONJ	6	05-02-01	MOULVIBAZAR	6	05-04-01	MOULVIBAZAR
7	05-01-01	MOULVIBAZAR	7	05-02-02	MOULVIBAZAR	7	06-04-01	CHANDPUR
8	05-01-02	MOULVIBAZAR	8	06-01-01	CHANDPUR	8	06-04-02	CHANDPUR
9	06-03-01	CHANDPUR	9	06-02-01	CHANDPUR	9	07-03-02	B. BARIA
10	06-03-02	CHANDPUR	10	07-02-01	B. BARIA	10	07-04-01	B. BARIA
11	07-01-01	B. BARIA	11	07-02-02	B. BARIA	11	08-02-01	COMILLA
12	07-01-02	B. BARIA	12	07-03-01	B. BARIA	12	08-02-02	COMILLA
13	08-03-01	COMILLA	13	08-01-01	COMILLA	13	09-01-01	NOAKHAL
14	08-03-02	COMILLA	14	08-01-02	COMILLA	14	09-01-02	NOAKHAL
15	08-04-01	COMILLA	15	08-01-03	COMILLA	15	10-03-01	LAXMIPUR
16	08-04-02	COMILLA	16	09-03-01	NOAKHAL	16	11-03-02	NARSINGDI
17	08-04-03	COMILLA	17	10-01-01	LAXMIPUR	17	13-01-03	DHAKA
18	09-02-01	NOAKHALI	18	11-01-01	NARSINGDI	18	14-04-01	MUNSHIGONJ
19	09-02-02	NOAKHALI	19	12-01-02	FARIDPUR	19	14-05-01	MUNSHIGONJ
20	10-02-01	LAXMIPUR	20	13-02-02	DHAKA	20	15-01-01	GAZIPUR
21	11-02-01	NARSINGDI	21	14-03-01	MUNSHIGONJ			
22	11-02-02	NARSINGDI	22	15-02-01	GAZIPUR			
23	11-02-03	NARSINGDI						
23	11-02-03	NARSINGDI						
24	11-02-04	NARSINGDI						
25	12-02-01	FARIDPUR						
26	13-03-01	DHAKA						
27	13-03-02	DHAKA						
28	14-01-01	MUNSHIGONJ						
29	14-01-02	MUNSHIGONJ						
30	14-02-01	MUNSHIGONJ						
31	14-02-02	MUNSHIGONJ						
32	15-03-01	GAZIPUR						
Sub-total: 32 Bridges			Sub-total: 22 Bridges			Sub-total: 20 Bridges		
Total: 74 Bridges								

4.2 DESIGN CRITERIA

Based on the design principles in Section 4.1, the design criteria for designing the portable steel bridge were developed as follows:

(1) Basic specifications

The basic specifications of the portable steel bridge as agreed between Bangladesh officials involved and the Study Team are as follows:

Structure type	:	Pony truss type
Design live load	:	AASHTO HS-15
Bridge span length	:	80 ft' (approx. 25 m)
Painting	:	Galvanized

(2) Design standard specification

AASHTO (the American Association of State Highway and Transportation Officials) Standard Specification for Highway Bridges, 15th Edition, 1992 is applied to the project as commonly used for designing road bridges in Bangladesh. In addition, Japan Road Association's Highway Bridge Standard Specification is applied to provisions which AASHTO does not specify.

(3) Standard design

The following standard designs prepared by LGED are used in planning substructures and approach roads:

- Road Structure Manual, Part A Standard Design
- Road Structure Manual, Part B Guidelines and Design Criteria
- Standard Specifications and Schedule Rates

(4) Site conditions

Topographic surveys, geological surveys and hydrological analyses for bridge design were not done in the site investigation. In the Basic Design Study, the bridges will be planned based on following collected site condition data:

- Existing bridge length and river width measured by tape
- Water depth measured by tape
- Topographic sketch (plan and profile)
- Soil type observed at river bed
- Low water level (LWL) and High water level (HWL) surveyed by hearing
- Current velocity measured by ocular survey
- Traffic conditions of roads and rivers

(5) Design criteria governed by local conditions

a) Width of bridge

The width of bridge is 3.35 m (11 ft') which comes from the width of heavy vehicles (2.75 m) plus a side allowance (0.3 m) on both sides of the vehicle. The side allowance is minimized to 0.3 m since heavy vehicles will rarely pass over the project bridges.

b) Earthquake force

No provision for earthquake force is given for designing portable bridges. Earthquake coefficients specified in design guidelines for highway bridges and buildings are applied to the project. The following earthquake coefficients are given in the guidelines:

Northern Bangladesh	: F = 0.08
Central and eastern Bangladesh	: F = 0.05
Central and southern Bangladesh	: F = 0.04

Since the project area is in central, eastern and southern Bangladesh, a earthquake coefficient of F=0.05 is applied to the design of all the bridges of the project.

c) Wind force

Despite the prevalence of destructive cyclones, no provision for wind force is given in Bangladesh design guidelines. The wind force specified in AASHTO, equivalent to Japan's, is applied to the project. The wind force W is as follows:

W = 75 lb/sq.ft (for truss type structures)

d) Temperature range

Based on local climate data, a temperature range between +10°C and +50°C is applied for designing bearing shoes.

e) Freeboard

To prevent the bridges from being hit by drifting objects and obstructing flood discharge, 1.0 m high spaces between HWLs and the bottom of bridges are given in planning bridge heights. Where the rivers have boat traffic, the size of free-board is decided based on the height of the boats.

4.3 STRUCTURE OF BRIDGES

4.3.1 Superstructure (Portable Steel Bridge)

The structures of the portable steel bridges developed based on the design principals and the design criteria are as follows:

(1) Bridge member size

No member is designed toweigh more than 250 kg so as to be carried by hand.

(2) Strength of the materials

Common and inexpensive materials such as SS400 and SM490Y are designed to be used in major parts of the portable steel bridges.

(3) Tightening

High tension bolts (HTB) are designed to be used to connect truss members. Tightening with HTBs is commonly used for structural connection since it is reliable.

(4) Painting

The truss members are designed to be galvanized to be maintenance free, and the steel deck panels are designed to be painted because they can be disassembled for repainting.

(5) Deck slab

Steel panel type deck slabs are designed to lighten the bridge weight and to shorten the construction period.

(6) Pony truss

Pony truss structures were discussed by comparing several truss types as shown in Table 4-2. In the table, truss type Nos. 1 to 4 are ready-made trusses, while truss type Nos. 5 and 6 were newly proposed in this Study. Costs (which depend on steel weight), structural features and ease of construction were evaluated. As a result, Scheme No. 6 was selected for this project.

4.3.2 Substructures

In the Basic Design Study, standard types of substructures which are suitable for this project were developed for basic bridge planning. The standard substructures are proposed for detailed design of the substructures which will be conducted by LGED.

(1) Substructure types

The standard types of substructures given in LGED design guidelines are as follows:

Abutment : Inverted-T wall type abutment
Pier : Inverted-T column type pier

Where piers are located but the LWL is too deep to construct pier foundations, pile-bent type piers constructed with cast-in-place concrete piles are proposed.

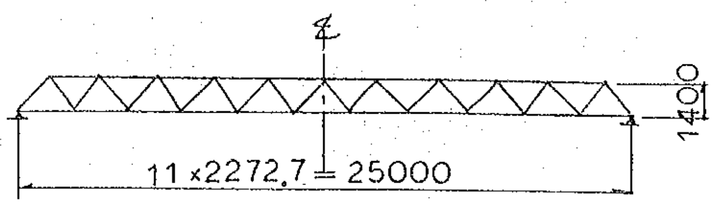
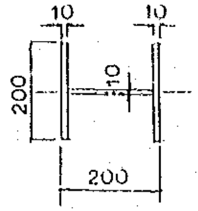
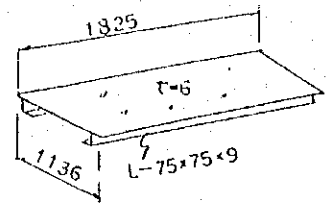
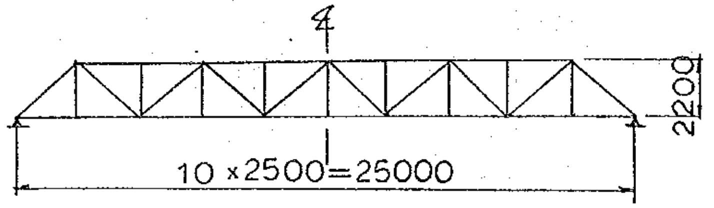
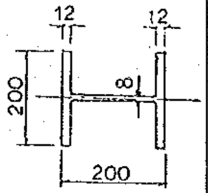
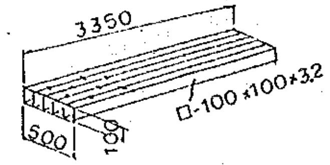
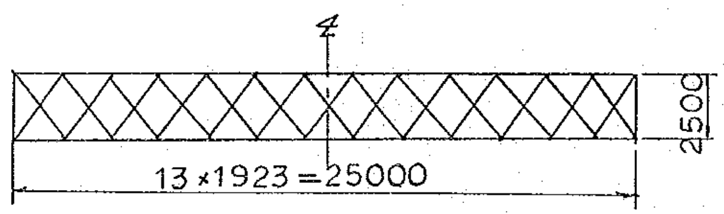
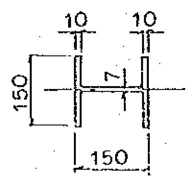
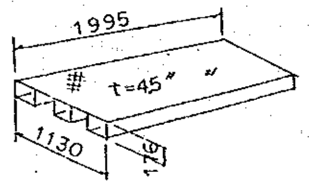
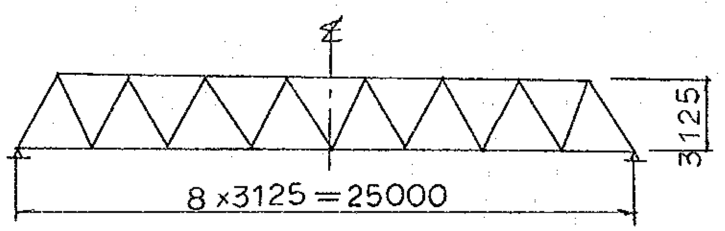
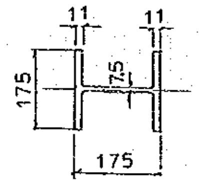
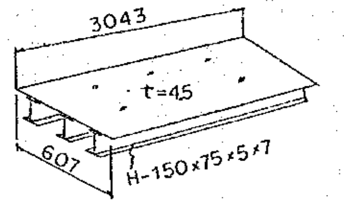
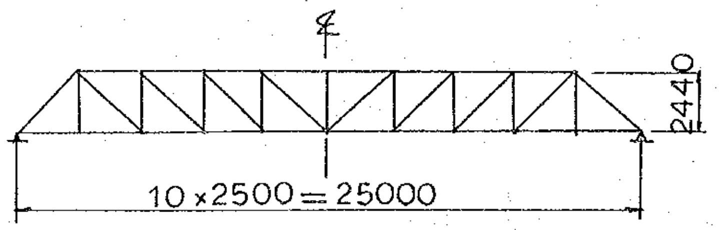
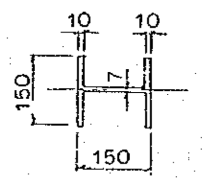
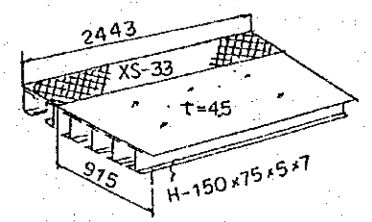
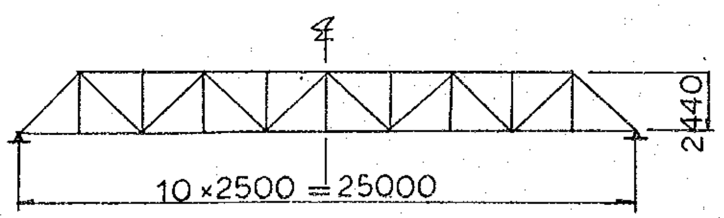
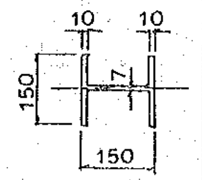
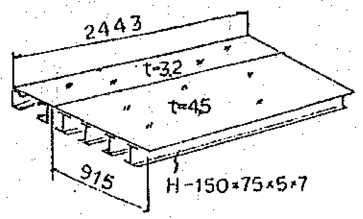
The proposed standard abutments and piers are presented in Figures 4-1 to 4-3.

(2) Height of substructures

The height of the substructures "H" is given by the following formula:

H = "Elevation of HWL" + "Freeboard" - "Elevation of footing"

Table 4-2 COMPARATIVE STUDY ON PONY TRUSS STRUCTURE

No.	Type of Truss	Section of Chord Member	Steel Deck Panel	Bridge Weight (t/m)	Max. Weight per Member (kg)	Structural Feature	Construction Easiness	Evaluation
1.				Girder 0.423 Slab 0.291 Total 0.714	Slab 170 Chord 140 Diagonal 35 Cross Beam 65	• Chord is welded H-beam. Gusset plates are welded. • Flexural rigidity of slab is lower than other schemes. (I = 220 cm⁴)	• Members are light. • Members are short. • Erection is easy.	• Deformation of the members may occur during transportation because gussets are incorporated into chord member.
2.				Girder 0.708 Slab 0.366 Total 1.074	Slab 160 Chord 170 Diagonal 65 Cross Beam 215	• All members are rolled steel. • Bridge is comparatively heavy because stringer members are required due to slab structure. (I = 935 cm⁴)	• Members are light. • Members are short. • Erection is easy.	• This scheme is economically inferior to other schemes due to weight of bridge.
3.				Girder 0.564 Slab 0.420 Total 0.984	Slab 260 Chord 277 Diagonal 34 Cross Beam 612	• All members are rolled steel. • Bridge is composed of many members. • Truss panel unit is heavy. (I = 7,500 cm⁴)	• Slab unit is heavy. • Erection is relatively difficult.	• Erection is not easy as other schemes, since members are comparatively heavy and long.
4.				Girder 0.499 Slab 0.472 Total 0.971	Slab 237 Chord 125 Diagonal 120 Cross Beam 200	• All members are rolled steel. • Steel slab is heavy because panel is comparatively long. (I = 3,077 cm⁴)	• Slab unit is little heavy. • Erection is relatively difficult.	• Erection is not easy as other schemes, since members are comparatively heavy and long.
5.				Girder 0.348 Slab 0.199 Total 0.547	Slab 187 Chord 79 Diagonal 65 Cross Beam 200	• All members are rolled steel. • Chord member is smaller than No.1 scheme due to hight-er truss. • Bridge is comparatively light because all web members are tensioned. (I = 2,700 cm⁴)	• Members are light. • Some members are little long. • Erection is easy.	• Flexural rigidity of bridge and erection easiness of this scheme is inferior to Scheme No.6.
6.				Girder 0.380 Slab 0.306 Total 0.686	Slab 187 Chord 79 Diagonal 110 Cross Beam 200	• All members are rolled steel. • Chord member is as small as No.5. • Flexural rigidity of bridge is higher than No.5 because of warren truss type. (I = 2,700 cm⁴)	• Members are light. • Diagonal member is little long. • Erection is easy.	• This plan is economical and very superior for erection. • Modification of span length is very easy due to simple truss structure. Likewise, this plan is far superior to other plans.

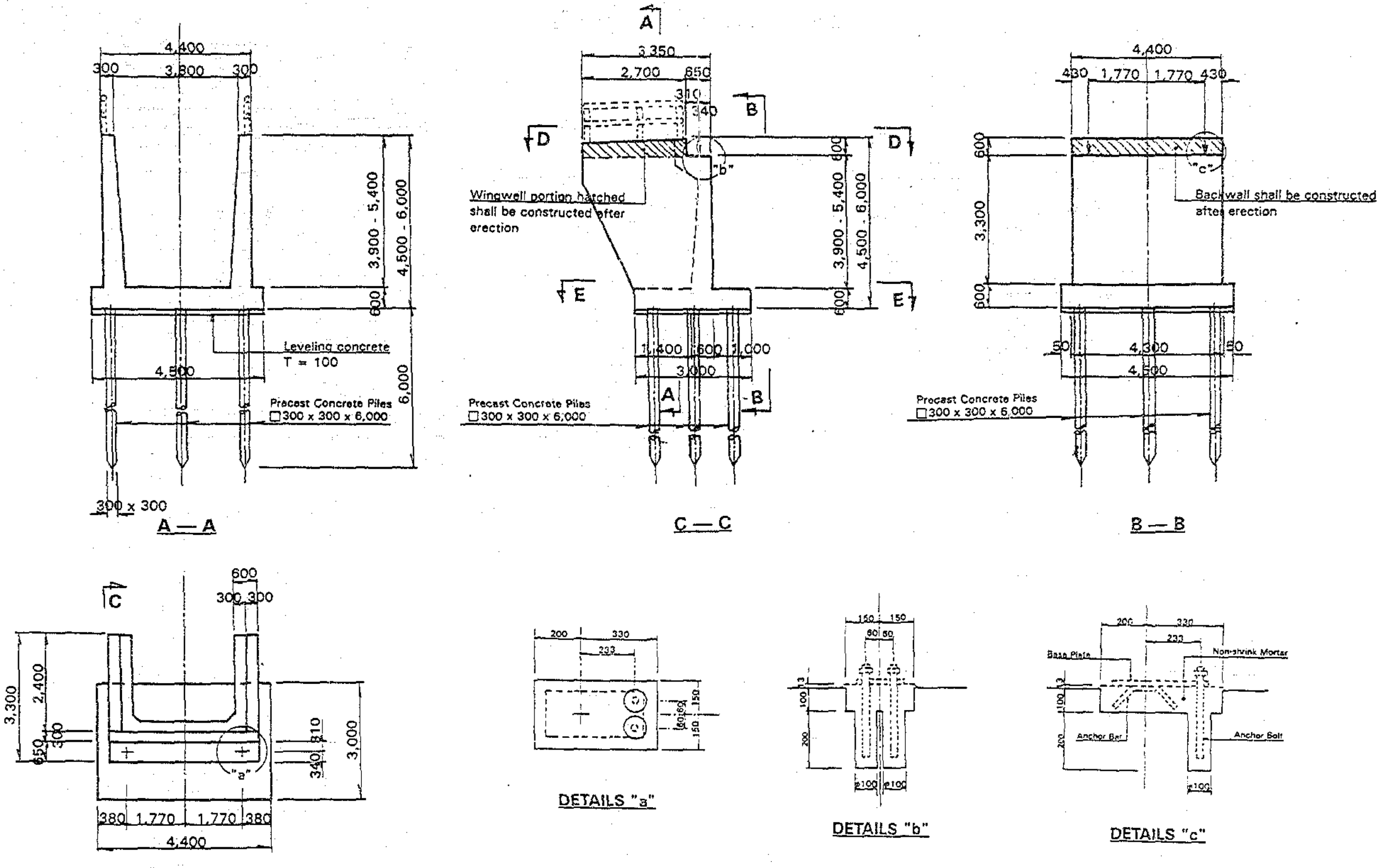


Figure 4-1 STANDARD ABUTMENT

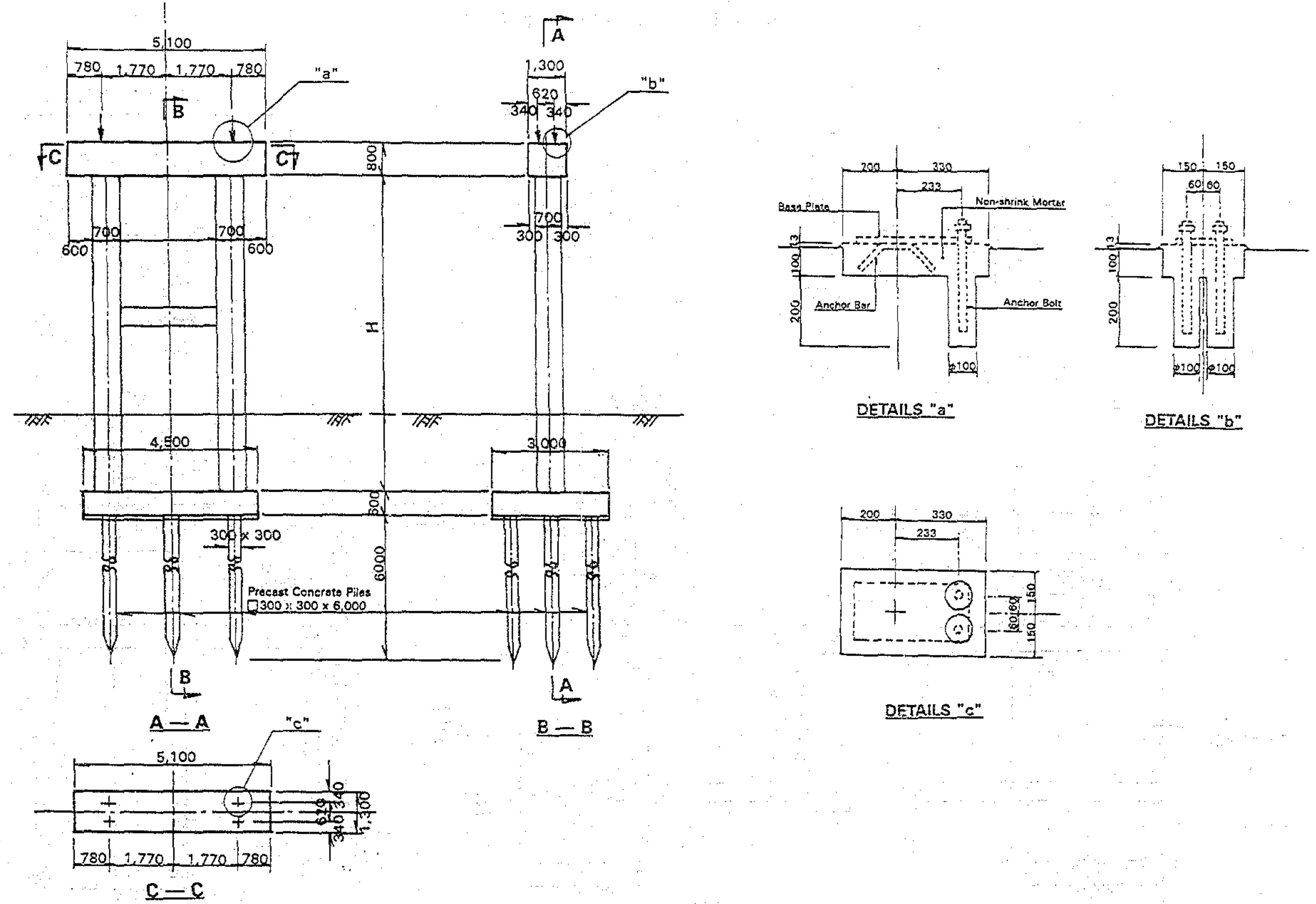


Figure 4-2 STANDARD PIER

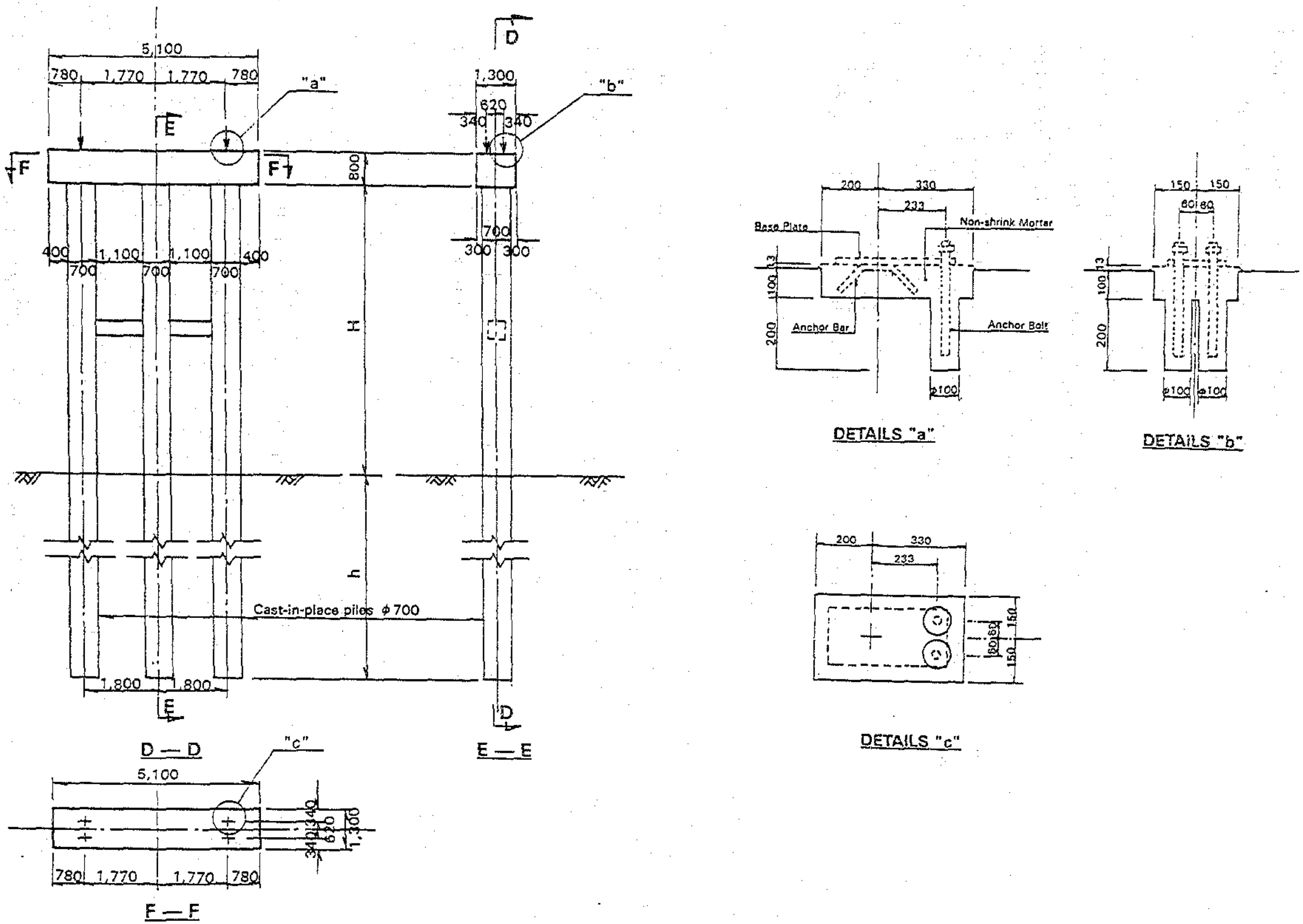


Figure 4-3 STANDARD PILE-BENT PIER

The elevation of footings should be planned deep enough into the ground so that the footings will never be damaged by scouring.

(3) Piles

Pile foundations are required for most project substructures, since the project area is covered with clayey soil. For driving pre-cast concrete piles, drop-hammers are expected to be used because diesel hammer driving machines are difficult to procure. The size of the pre-cast concrete piles are 0.3 m x 0.3 m x 6.0 m which decided based on the capacity of the driving hammers.

0.7 m diameter cast-in-place concrete piles constructed by the reverse circulation method are planned for the pile-bent type piers.

4.3.3 Approach Roads

Approach roads are planned to connect between the project bridges and existing roads. The typical cross section is proposed as shown in Figure 4-4 which is based on standard Type-B feeder roads in LGED design guidelines.

The vertical alignment of the approach roads should be planned to be smooth and to provide enough sight distance. The slope grade should not be greater than 6%.

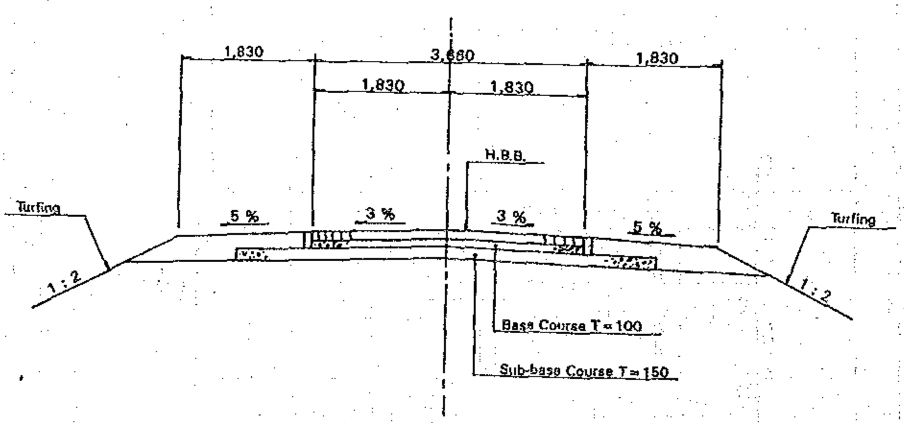


Figure 4-4 TYPICAL CROSS SECTION OF APPROACH ROADS

4.3.4 River Protection

River protections is planned where scouring at abutment foundations and approach embankments is foreseen.

The proposed structure of river protection is shown in Figure 4-5. The backfill of the river protection may be replaced by crushed bricks which are commonly available in Bangladesh.

The footings of the river protections should be embedded deep enough into the ground to be safe against future scouring.

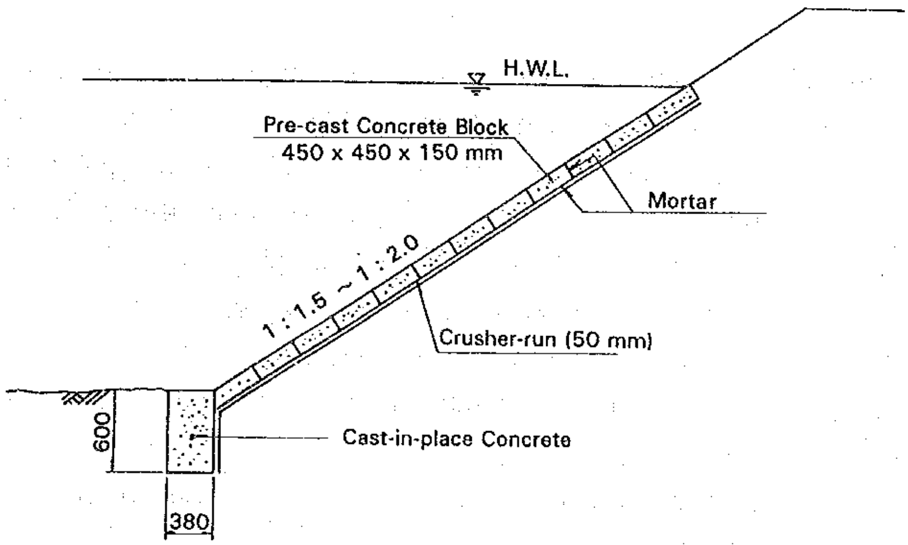


Figure 4-5 TYPICAL CROSS SECTION OF RIVER PROTECTION

4.4 BASIC DESIGN OF BRIDGES

4.4.1 Basic Bridge Planning

(1) Planning of bridge length

Almost all the rivers crossing the project bridge sites have neither river dikes nor plans for river dike construction. Imaginary river dikes were planned based on site investigation data to find the optimum location of abutments.

The bridge lengths were decided by the distances between abutments as shown in Figure 4-6.

To examine the locations of the imaginary river dikes, the following were taken into consideration:

- River widths between imaginary dikes are wide enough to discharge floods.
- Floods flow smoothly and do not endanger abutments and approach embankments by scouring.
- Countermeasures can be taken against changes in river alignment.
- Bridge lengths are not so long as to be unnecessary or uneconomical.

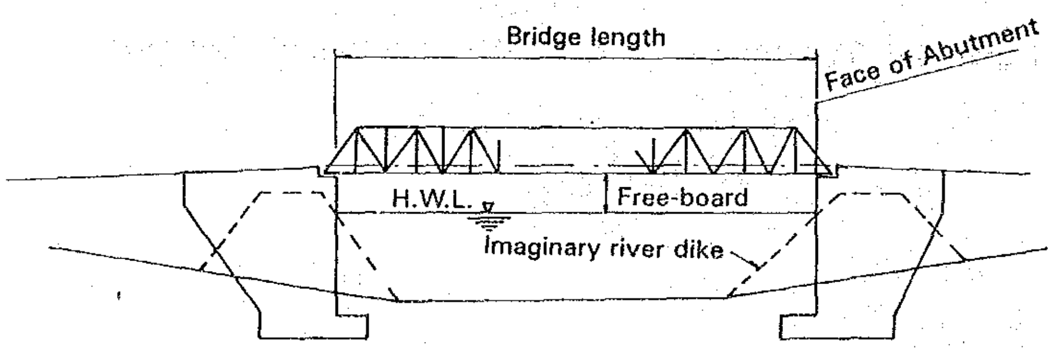


Figure 4-6 PLANNING OF BRIDGE LENGTH

(2) Planning of span length

The longest span is 25 m as decided in Section 4.2. The shortest span is 15 m which was decided as the shortest bridge length. The spans of the portable steel bridge were planned to be of 3 types, that is, 15 m, 20 m and 25 m. (Refer to Figure 4-7 Span Type of Portable Steel Bridge.)

To arrange the spans to compose the planned bridge lengths, the 25 m span was the maximum applied, because the longer the span the lower the cost for substructure construction and the less obstruction against flood discharge.

(3) Basic bridge planning

Based on the standard structures and the planning method developed herein, basic bridge planning of the project bridges was conducted and general views of the bridges were drawn.

The summary of basic bridge planning of the project bridges compiled by each phase is presented in Tables 4-3 to 4-5.

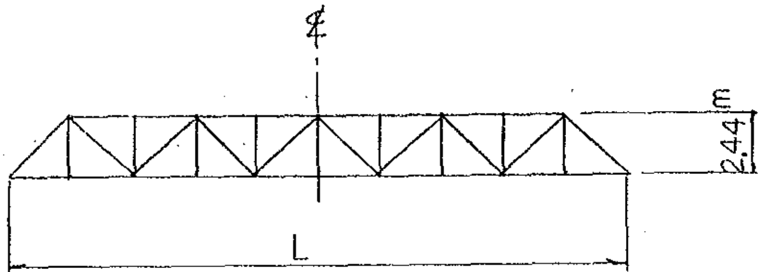
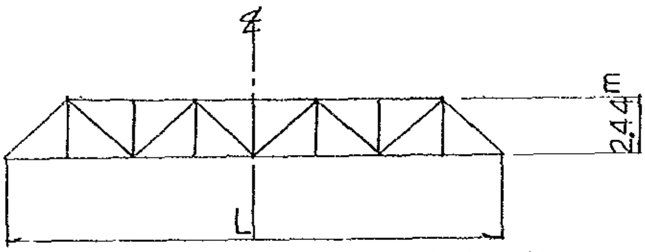
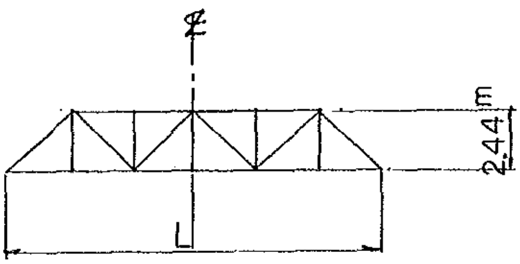
Span L = 25 m	 Span L = 10 × 2,438 = 24,384 m (80'-00')
Span L = 20 m	 Span L = 8 × 2,438 = 19,507 m (64'-00')
Span L = 15 m	 Span L = 6 × 2,438 = 14,630 m (48'-00')

Figure 4-7 SPAN TYPE OF PORTABLE STEEL BRIDGE

Table 4-3 SUMMARY OF BASIC BRIDGE PLANNING (PHASE 1 BRIDGES) (1/2)

No.	Bridge No. / Location	Layout of Bridge	Substructure A : Abutment P : Pier H : Height (m)	Piles Pre-cast (Length x Nos.) (Cast-in-place (Length x Nos.))	Approach Roads Up : Right bank Dn : Left bank (Length)	River Protection Up : Right bank Dn : Left bank (Height x Length)
1	01-01-01 COX'S BAZAR	A1 25m P1 25m P2 25m A2 L= 75 m, W=50.8 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 7.5 A_2 : H= 4.5	6.0×36	10.0 10.0	4.5 ×10.0 4.5 ×10.0
2	01-02-01 COX'S BAZAR	A1 25m P1 25m P2 25m P3 25m P4 25m A2 L=125 m, W=84.6 t	A_1 : H= 4.5 P_1 : H= 5.0 P_2 ~ P_4 : H= 7.0 A_2 : H= 4.5	6.0×54	15.0 15.0	4.5 ×10.0 4.5 ×10.0
3	02-02-01 FENI	A1 20m P1 20m A2 L= 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	6.0×27	10.0 10.0	4.5 ×10.0 4.5 ×10.0
4	02-02-02 FENI	A1 20m P1 20m A2 L= 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	6.0×27	10.0 10.0	4.5 ×10.0 4.5 ×10.0
5	03-02-01 CHITTAGONG	A1 25m P1 25m P2 25m A2 L= 75 m, W=50.8 t	A_1 : H= 4.5 P_1 ~ P_2 : H=10.0 A_2 : H= 4.5	6.0×27	15.0 10.0	4.5 ×10.0 4.5 ×10.0
6	04-01-01 HABIGONJ	A1 20m P1 25m P2 20m A2 L= 65 m, W=44.1 t	A_1 : H= 5.5 P_1 ~ P_2 : H=11.0 A_2 : H= 5.5	6.0×50	15.0 15.0	4.0 ×10.0 4.0 ×10.0
7	05-01-01 MOULVIBAZAR	A1 20m A2 L= 20 m, W=13.6 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
8	05-01-02 MOULVIBAZAR	A1 20m P1 20m A2 L= 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H= 6.0 A_2 : H= 4.5	6.0×27	10.0 10.0	3.5 ×10.0 3.5 ×10.0
9	06-03-01 CHANDPUR	A1 20m P1 20m A2 L= 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H=10.0 A_2 : H= 4.5	6.0×27	10.0 10.0	3.5 ×10.0 3.5 ×10.0
10	06-03-02 CHANDPUR	A1 25m A2 L= 25 m, W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
11	07-01-01 B.BARIA	A1 25m A2 L= 25 m, W=16.9 t	A_1 : H= 4.0 A_2 : H= 4.0	6.0×18	10.0 10.0	3.0 ×10.0 3.0 ×10.0
12	07-01-02 B.BARIA	A1 25m P1 25m P2 25m P3 25m A2 L=100 m, W=67.7 t	A_1 : H= 5.0 P_1 , P_2 : H= 6.0 P_3 : H=10.0 A_2 : H= 5.0	6.0×45	10.0 10.0	4.0 ×10.0 4.0 ×10.0
13	08-03-01 COMILLA	A1 15m P1 15m A2 L= 30 m, W=20.5 t	A_1 : H= 4.5 P_1 : H= 7.0 A_2 : H= 4.5	6.0×27	10.0 10.0	3.5 ×10.0 3.5 ×10.0
14	08-03-02 COMILLA	A1 25m A2 L= 25 m, W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
15	08-04-01 COMILLA	A1 25m A2 L= 25 m, W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
16	08-04-02 COMILLA	A1 15m P1 15m A2 L= 30 m, W=20.5 t	A_1 : H= 4.5 P_1 : H= 7.5 A_2 : H= 4.5	6.0×27	10.0 10.0	3.5 ×10.0 3.5 ×10.0

Table 4-3 SUMMARY OF BASIC BRIDGE PLANNING (PHASE 1 BRIDGES) (2/2)

No.	Bridge No. / Location	Layout of Bridge	Substructure A : Abutment P : Pier H : Height (m)	Piles Pre-cast (Length x Nos.) [Cast-in-place (Length x Nos.)]	Approach Roads Up : Right bank Dn : Left bank (Length)	River Protection Up : Right bank Dn : Left bank (Height x Length)
17	08-04-03 COMILLA	A1 20m P1 25m P2 20m A2 L= 65 m、W=44.1 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 7.0 A_2 : H= 4.5	6.0×36	10.0 10.0	3.5 ×10.0 3.5 ×10.0
18	09-02-01 NOAKHALI	A1 20m A2 L= 20 m、W=13.6 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
19	09-02-02 NOAKHALI	A1 15m A2 L= 15 m、W=10.2 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
20	10-02-01 LAXIPUR	A1 25m P1 25m P2 25m A2 L= 75 m、W=50.8 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 7.0 A_2 : H= 4.5	6.0×18 [22.0×6]	10.0 10.0	3.5 ×10.0 3.5 ×10.0
21	11-02-01 NARSINGDI	A1 25m A2 L= 25 m、W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
22	11-02-02 NARSINGDI	A1 15m A2 L= 15 m、W=10.2 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
23	11-02-03 NARSINGDI	A1 15m A2 L= 15 m、W=10.2 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
24	11-02-04 NARSINGDI	A1 20m P1 25m P2 20m A2 L= 65 m、W=44.1 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 9.0 A_2 : H= 4.5	6.0×36	15.0 15.0	3.5 ×10.0 3.5 ×10.0
25	12-02-01 FARIDPUR	A1 20m P1 25m P2 20m A2 L= 65 m、W=44.1 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 6.0 A_2 : H= 4.5	6.0×36	10.0 10.0	3.5 ×10.0 3.5 ×10.0
26	13-03-01 DHAKA	A1 20m P1 25m P2 25m P3 25m P4 20m A2 L=115 m、W=77.9 t	A_1 : H= 4.5 P_1, P_4 : H= 7.0 P_2 ~ P_3 : H=10.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
27	13-03-02 DHAKA	A1 15m P1 15m A2 L= 30 m、W=20.5 t	A_1 : H= 4.5 P_1 : H= 6.0 A_2 : H= 4.5	6.0×27	10.0 10.0	3.5 ×10.0 3.5 ×10.0
28	14-01-01 MUNSHIGONJ	A1 20m A2 L= 20 m、W=13.6 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
29	14-01-02 MUNSHIGONJ	A1 20m A2 L= 20 m、W=13.6 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
30	14-02-01 MUNSHIGONJ	A1 20m P1 20m A2 L= 40 m、W=27.1 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	6.0×18 [23.0×3]	10.0 10.0	3.5 ×10.0 3.5 ×10.0
31	14-02-02 MUNSHIGONJ	A1 20m P1 20m A2 L= 40 m、W=27.1 t	A_1 : H= 4.5 P_1 : H= 5.0 A_2 : H= 4.5	6.0×18 [20.0×3]	10.0 10.0	3.5 ×10.0 3.5 ×10.0
32	15-03-01 GAZIPUR	A1 20m P1 25m P2 20m A2 L= 65 m、W=44.1 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 7.0 A_2 : H= 4.5	6.0×36	10.0 10.0	3.5 ×10.0 3.5 ×10.0

Table 4-4 SUMMARY OF BASIC BRIDGE PLANNING (PHASE 2 BRIDGES) (1/2)

No.	Bridge No. / Location	Layout of Bridge	Substructure A : Abutment P : Pier H : Height (m)	Piles Pre-cast (Length x Nos.) [Cast-in-place (Length x Nos.)]	Approach Roads Up : Right bank Dn : Left bank (Length)	River Protection Up : Right bank Dn : Left bank (Height x Length)
1	02-01-01 CHITTAGONG	A1 25m P1 25m P2 25m A2 L = 75 m, W=50.8 t	A_1 : H= 6.0 P_1 ~ P_2 : H= 9.5 A_2 : H= 6.0	6.0×18 [25.0×6]	10.0 10.0	5.0 ×10.0 5.0 ×10.0
2	03-03-01 CHITTAGONG	A1 25m P1 25m P2 25m A2 L = 75 m, W=50.8 t	A_1 : H= 4.5 P_1 : H= 6.5 P_2 : H= 9.0 A_2 : H= 4.5	6.0×36	10.0 10.0	4.5 ×10.0 4.5 ×10.0
3	03-04-01 FENI	A1 20m P1 20m A2 L = 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H= 6.5 A_2 : H= 4.5	6.0×18 [25.0×3]	15.0 15.0	4.5 ×10.0 4.5 ×10.0
4	04-02-01 HABIGONJ	A1 25m P1 25m P2 25m A2 L = 75 m, W=50.8 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 8.0 A_2 : H= 4.5	6.0×36	10.0 10.0	3.5 ×10.0 3.5 ×10.0
5	04-03-01 HABIGONJ	A1 20m P1 20m A2 L = 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	6.0×27	15.0 15.0	3.5 ×10.0 3.5 ×10.0
6	05-02-01 MOULVIBAZAR	A1 25m A2 L = 25 m, W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
7	05-02-02 MOULVIBAZAR	A1 20m P1 20m A2 L = 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H= 7.0 A_2 : H= 4.5	6.0×27	10.0 10.0	3.5 ×10.0 3.5 ×10.0
8	06-01-01 CHANDOPUR	A1 25m A2 L = 25 m, W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
9	06-02-01 CHANDOPUR	A1 15m A2 L = 15 m, W=10.2 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
10	07-02-01 B. BARIA	A1 15m P1 15m A2 L = 30 m, W=20.5 t	A_1 : H= 4.5 P_1 : H= 7.0 A_2 : H= 4.5	6.0×27	10.0 10.0	3.5 ×10.0 3.5 ×10.0
11	07-02-02 B. BARIA	A1 15m A2 L = 15 m, W=10.2 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
12	07-03-01 B. BARIA	A1 20m P1 25m P2 20m A2 L = 65 m, W=44.1 t	A_1 : H= 4.5 P_1 ~ P_2 : H= 8.0 A_2 : H= 4.0	6.0×36	10.0 10.0	3.0 ×10.0 3.0 ×10.0
13	08-01-01 COMILLA	A1 25m A2 L = 25 m, W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
14	08-01-02 COMILLA	A1 25m A2 L = 25 m, W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
15	08-01-03 COMILLA	A1 20m P1 20m A2 L = 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	6.0×27	10.0 10.0	3.5 ×10.0 3.5 ×10.0
16	09-03-01 NOAKHALI	A1 20m P1 20m A2 L = 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	6.0×27	15.0 15.0	3.5 ×10.0 3.5 ×10.0

Table 4-4 SUMMARY OF BASIC BRIDGE PLANNING (PHASE 2 BRIDGES) (2/2)

No.	Bridge No. / Location	Layout of Bridge	Substructure A : Abutment P : Pier H : Height (m)	Piles Pre-cast (Length x Nos.) [Cast-in-place (Length x Nos.)]	Approach Roads Up: Right bank Dn: Left bank (Length)	River Protection Up: Right bank Dn: Left bank (Height x Length)
17	10-01-01 LAXIPUR	A1 15m P1 15m A2 L= 30 m, W=20.5 t	A_1 : H= 4.5 P_1 : H= 8.5 A_2 : H= 4.5	6.0×27	15.0 15.0	3.5×10.0 3.5×10.0
18	11-01-01 NARSINGDI	A1 25m P1 25m P2 25m A2 L= 75 m, W=50.8 t	A_1 : H= 4.5 P_1 ~P_2 : H= 7.0 A_2 : H= 4.5	6.0×36	10.0 10.0	3.5×10.0 3.5×10.0
19	12-01-02 FARIDPUR	A1 20m P1 25m P2 20m A2 L= 65 m, W=44.1 t	A_1 : H= 4.5 P_1 ~P_2 : H= 8.0 A_2 : H= 4.5	6.0×36	10.0 10.0	3.5×10.0 3.5×10.0
20	13-02-02 DHAKA	A1 20m P1 20m A2 L= 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H= 7.0 A_2 : H= 4.5	6.0×27	10.0 10.0	3.5×10.0 3.5×10.0
21	14-03-01 MUNSHIGONJ	A1 20m P1 25m P2 25m P3 25m P4 20m A2 L=115 m, W=77.9 t	A_1 : H= 4.5 P_1, P_4 : H= 7.5 P_2 ~P_3 : H=11.5 A_2 : H= 4.5	6.0×18 [27.0×6]	10.0 10.0	3.5×10.0 3.5×10.0
22	15-02-01 GAZIPUR	A1 20m P1 25m P2 25m P3 25m P4 20m A2 L=115 m, W=77.9 t	A_1 : H= 4.5 P_1 ~P_4 : H= 5.0 A_2 : H= 4.5	6.0×54	10.0 10.0	3.5×10.0 3.5×10.0

Table 4-5 SUMMARY OF BASIC BRIDGE PLANNING (PHASE 3 BRIDGES) (1/2)

No.	Bridge No. / Location	Layout of Bridge	Substructure A : Abutment P : Pier H : Height (m)	Piles Pre-cast (Length x Nos.) [Cast-in-place (Length x Nos.)]	Approach Roads Up : Right bank Dn : Left bank (Length)	River Protection Up : Right bank Dn : Left bank (Height x Length)
1	03-05-01 CHITTAGONG	A1 25m A2 L= 25 m、W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	4.5 ×10.0 4.5 ×10.0
2	03-06-01 CHITTAGONG	A1 25m P1 25m P2 25m P3 25m A2 L=100 m、W=67.7 t	A_1 : H= 4.5 P_1 , P_3 : H= 6.5 P_2 : H=14.0 A_2 : H= 4.5	6.0×18 [22.0×6] [42.0×3]	10.0 10.0	4.5 ×10.0 4.5 ×10.0
3	04-04-01 HABIGONG	A1 25m P1 25m A2 L= 50 m、W=33.8 t	A_1 : H= 5.0 P_1 : H= 9.5 A_2 : H= 5.0	6.0×18 [25.0×3]	10.0 10.0	4.0 ×10.0 4.0 ×10.0
4	04-04-02 HABIGONG	A1 25m P1 25m A2 L= 50 m、W=33.8 t	A_1 : H= 5.0 P_1 : H= 9.5 A_2 : H= 5.0	6.0×18 [25.0×3]	15.0 15.0	4.0 ×10.0 4.0 ×10.0
5	05-03-01 MOULVIBAZAR	A1 25m P1 25m A2 L= 50 m、W=33.8 t	A_1 : H= 4.5 P_1 : H=13.5 A_2 : H= 4.5	6.0×34	10.0 10.0	3.5 ×10.0 3.5 ×10.0
6	05-04-01 MOULVIBAZAR	A1 20m A2 L= 20 m、W=13.6 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
7	06-04-01 CHANDOPUR	A1 15m P1 15m A2 L= 30 m、W=20.5 t	A_1 : H= 4.5 P_1 : H= 7.0 A_2 : H= 4.5	6.0×18 [22.0×3]	10.0 10.0	3.5 ×10.0 3.5 ×10.0
8	06-04-02 CHANDOPUR	A1 25m A2 L= 25 m、W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
9	07-03-02 B. BARIA	A1 15m P1 15m A2 L= 30 m、W=20.5 t	A_1 : H= 4.5 P_1 : H= 7.5 A_2 : H= 4.5	6.0×18 [23.0×2]	15.0 10.0	3.5 ×10.0 3.5 ×10.0
10	07-04-01 B. BARIA	A1 25m A2 L= 25 m、W=16.9 t	A_1 : H= 4.0 A_2 : H= 4.0	6.0×18	10.0 10.0	3.0 ×10.0 3.0 ×10.0
11	08-02-01 COMILLA	A1 15m P1 15m A2 L= 30 m、W=20.5 t	A_1 : H= 4.5 P_1 : H= 8.0 A_2 : H= 4.5	6.0×27	10.0 10.0	3.5 ×10.0 3.5 ×10.0
12	08-02-02 COMILLA	A1 25m A2 L= 25 m、W=16.9 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
13	09-01-01 NOAKHALI	A1 25m P1 25m A2 L= 50 m、W=33.8 t	A_1 : H= 5.0 P_1 : H= 7.0 A_2 : H= 5.0	6.0×27	10.0 10.0	4.0 ×10.0 4.0 ×10.0
14	09-01-02 NOAKHALI	A1 15m A2 L= 15 m、W=10.2 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
15	10-03-01 LAXIPUR	A1 20m P1 25m P2 20m A2 L= 65 m、W=44.1 t	A_1 : H= 4.5 P_1 ~P_2 : H= 7.0 A_2 : H= 4.5	6.0×36	10.0 10.0	3.5 ×10.0 3.5 ×10.0
16	11-03-02 NARSINGDI	A1 25m P1 25m P2 25m P3 25m P4 25m A2 L=125 m、W=84.6 t	A_1 : H= 4.5 P_1 ~P_4 : H= 7.5 A_2 : H= 4.5	6.0×18 [23.0×26]	15.0 15.0	3.5 ×10.0 3.5 ×10.0

Table 4-5 SUMMARY OF BASIC BRIDGE PLANNING (PHASE 3 BRIDGES) (2/2)

No.	Bridge No. / Location	Layout of Bridge	Substructure A : Abutment P : Pier H : Height (m)	Piles Pre-cast (Length x Nos.) [Cast-in-place (Length x Nos.)]	Approach Roads Up : Right bank Dn : Left bank (Length)	River Protection Up : Right bank Dn : Left bank (Height x Length)
17	13-01-03 DHAKA	A1 15m A2 L= 15 m, W=10.2 t	A_1 : H= 4.5 A_2 : H= 4.5	6.0×18	10.0 10.0	3.5 ×10.0 3.5 ×10.0
18	14-04-01 MUNSHIGONJ	A1 25m P1 25m A2 L= 50 m, W=33.8 t	A_1 : H= 5.0 P_1 : H=11.0 A_2 : H= 5.0	6.0×18 [26.0×3]	10.0 10.0	4.0 ×10.0 4.0 ×10.0
19	14-05-01 MUNSHIGONJ	A1 20m P1 20m A2 L= 40 m, W=27.1 t	A_1 : H= 4.5 P_1 : H= 5.5 A_2 : H= 4.5	6.0×18 [21.0×3]	10.0 10.0	3.5 ×10.0 3.5 ×10.0
20	15-01-01 GAZIPUR	A1 20m P1 25m P2 20m A2 L= 65 m, W=44.1 t	A_1 : H= 4.5 P_1 ~P_2 : H= 9.0 A_2 : H= 4.5	6.0×36	10.0 10.0	3.5 ×10.0 3.5 ×10.0

4.4.2 Basic Design of Superstructure (Portable Steel Bridge)

(1) Design criteria

The design criteria for designing the superstructure are as follows:

Design live load	:	AASHTO HS-15
Bridge (carriageway) width	:	11 ft' (3.35 m)
Superstructure type	:	Pony warren truss
Span length	:	80 ft' (24.38 m), 64 ft' (19.507 m) and 48 ft' (14.630 m)
Height of truss	:	8 ft' (2.44 m)
Tightening bolts	:	HTB (F8T) M22
Deck slab	:	Steel deck panel
Painting	:	Galvanizing (truss members) Painting (deck slabs)
Steel materials	:	Rolled H-beam (SS400 and SM490Y) plates and others (SS400)

(2) Design Calculation

A structural analysis of the superstructure (portable steel bridge) was conducted and the stability of the truss members was checked. The result of the design calculation of the 25 m span case is presented in Table 4-6. As shown in the Table, the stress of all the members of the truss under design loads is not greater than their allowable stress, and the bridge deflection by live load is not greater than the allowable deflection.

The truss members of the 25 m span bridge were designed to be used for 15 m and 20 m span bridges.

The deflection by dead loads is negligibly small (8 mm), so that no camber is required.

Table 4-6 RESULTS OF DESIGN CALCULATION OF SUPERSTRUCTURE

	Top Chord	Bottom Chord	Diagonal Member	Vertical Member
Shape	H-150x150x7/10	H-150x150x7/10	H-150x150x7/10	H-150x150x7/10
Designation	SM490Y	SM490Y	SS400	SS400
Radius of gyration of area (cm)	3.75	3.75	3.75	3.75
Sectional area (cm^2)	40.14	40.14	40.14	40.14
Axial force (ton)	-40.20	42.80	-18.10	7.40
Axial stress (kg/cm^2)	1,001	1,420	451	246
Allowable axial stress (kg/cm^2)	1,346	2,100	926	1,400
Deflection	Live load deflection δ_l = 20mm (= L / 1504) Dead load deflection δ_d = 8mm			
Allowable deflection	Allowable live load deflection δa = 42mm (= L / 600)			

(3) Drawings of superstructure

Based on the design calculation, the drawings of the superstructure (portable steel bridge) were developed as shown in Figures 4-8 to 4-12.

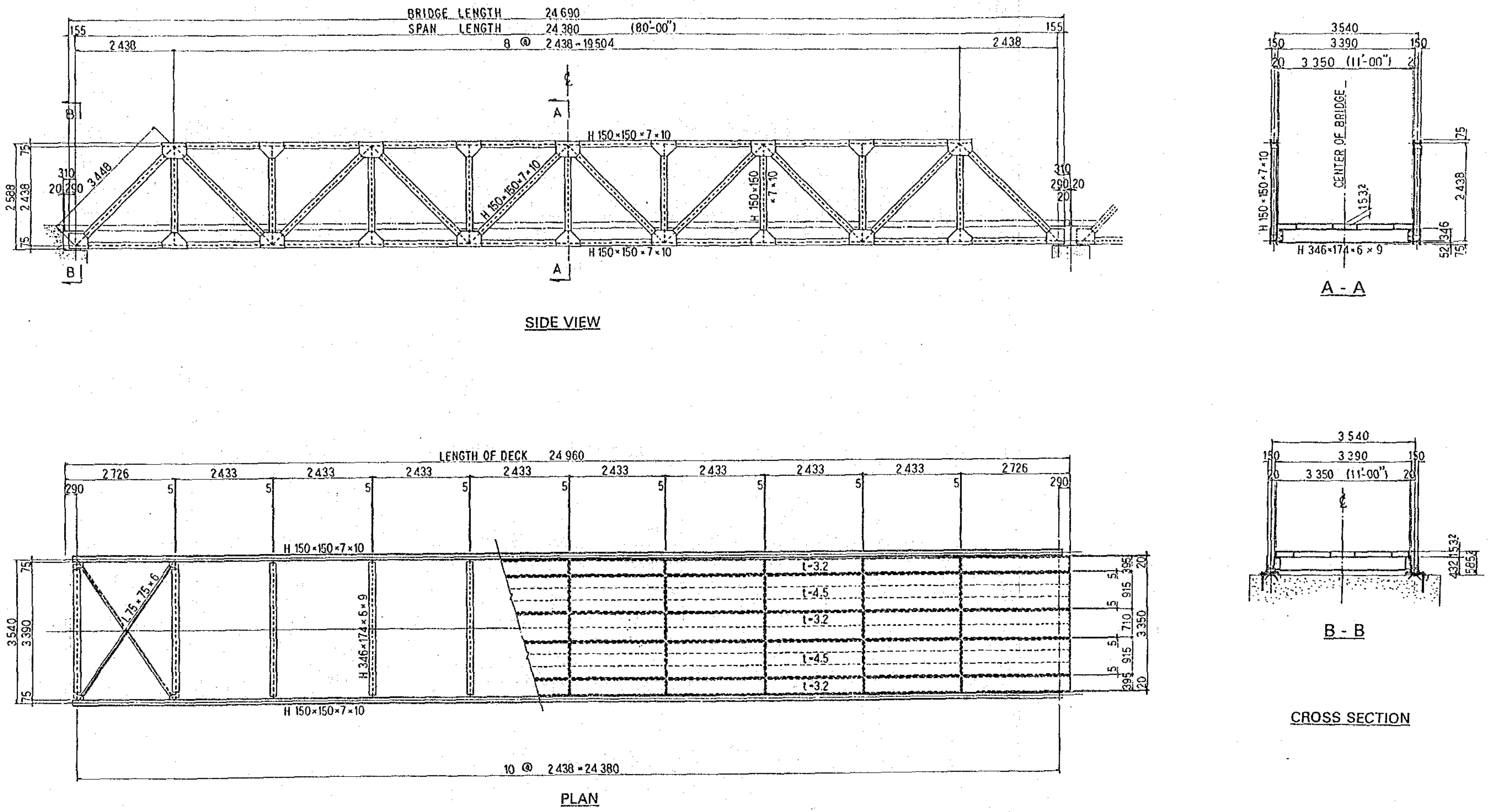


Figure 4-8 GENERAL ARRANGEMENT OF SUPERSTRUCTURE (80 ft. SPAN)

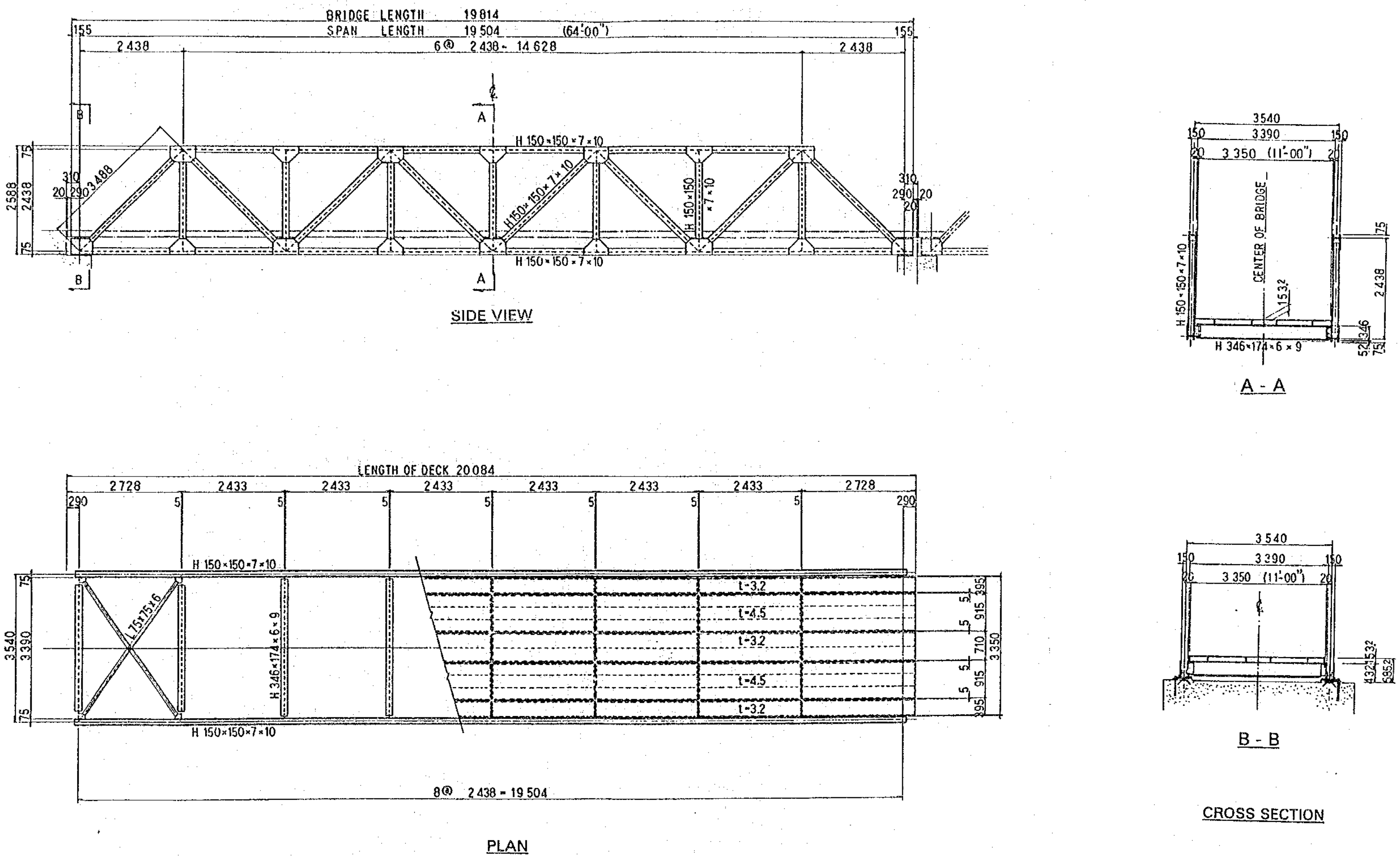


Figure 4-9 GENERAL ARRANGEMENT OF SUPERSTRUCTURE (64 ft. SPAN)

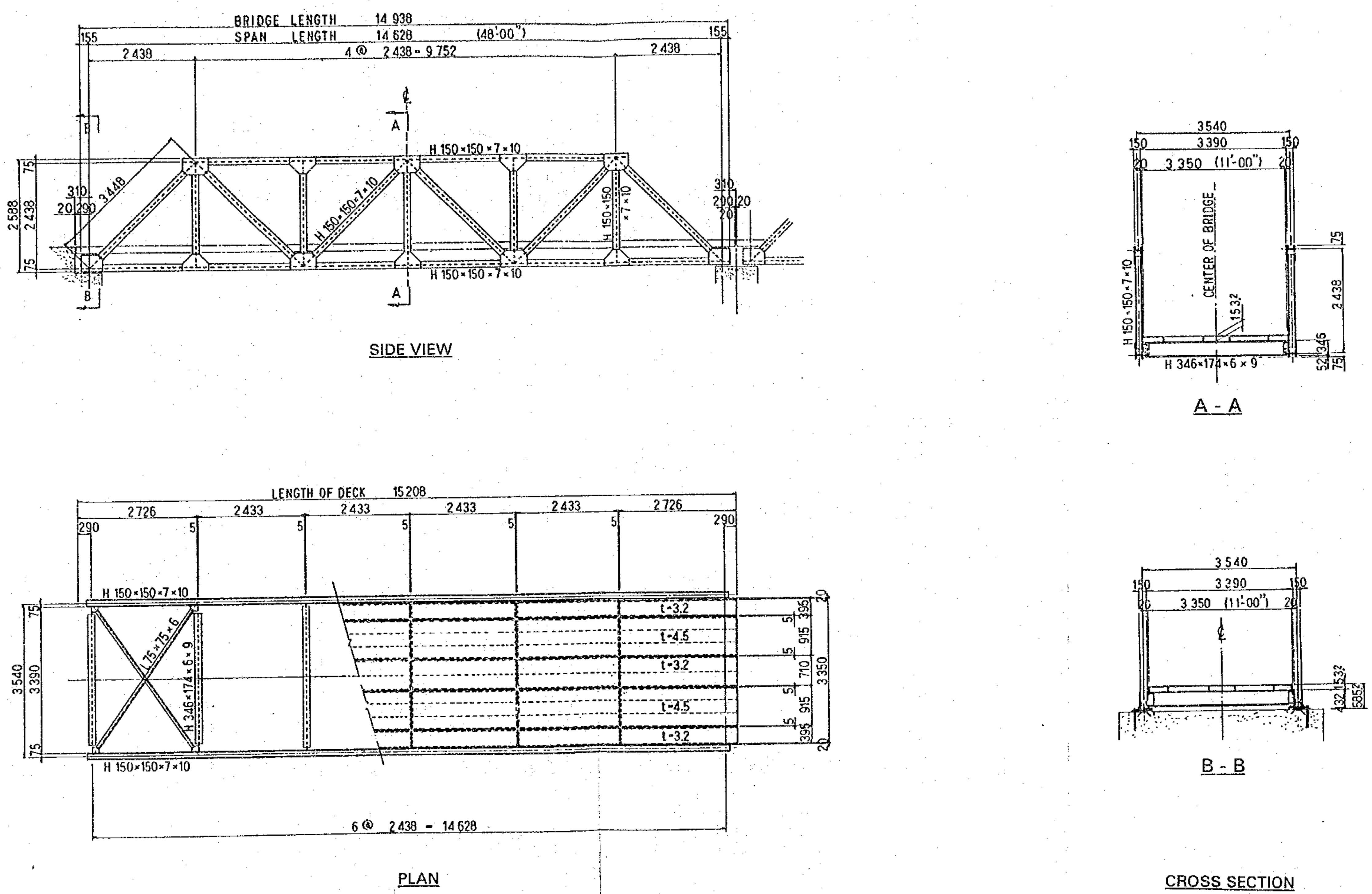
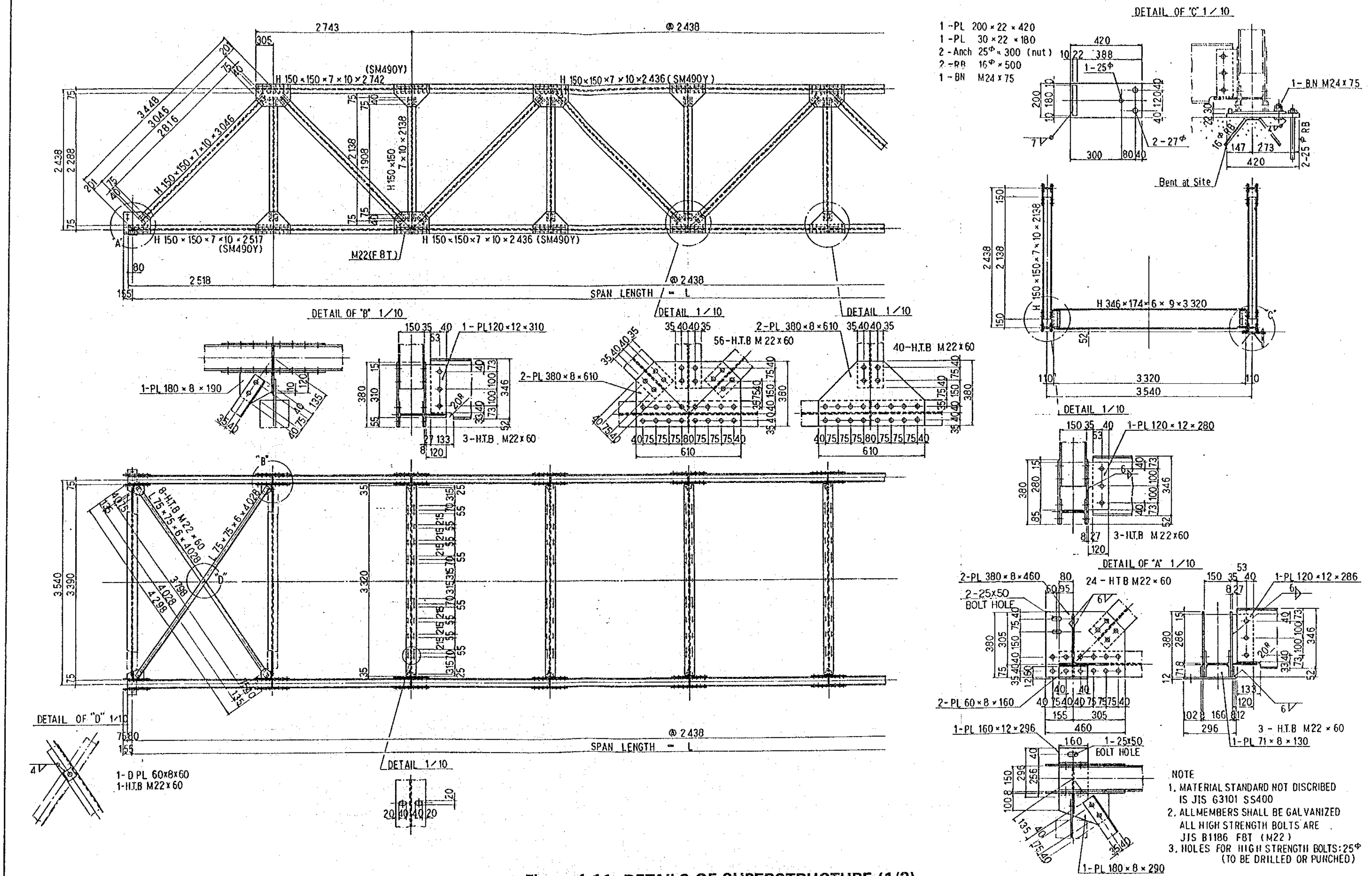


Figure 4-10 GENERAL ARRANGEMENT OF SUPERSTRUCTURE (48 ft. SPAN)



NOTE
1. MATERIAL STANDARD NOT DISCRIBED IS JIS G3101 SS400
2. ALLMEMBERS SHALL BE GALVANIZED ALL HIGH STRENGTH BOLTS ARE JIS B1186 F8T (M22)
3. HOLES FOR HIGH STRENGTH BOLTS:25$^{\Phi}$ (TO BE DRILLED OR PUNCHED)

Figure 4-11 DETAILS OF SUPERSTRUCTURE (1/2)

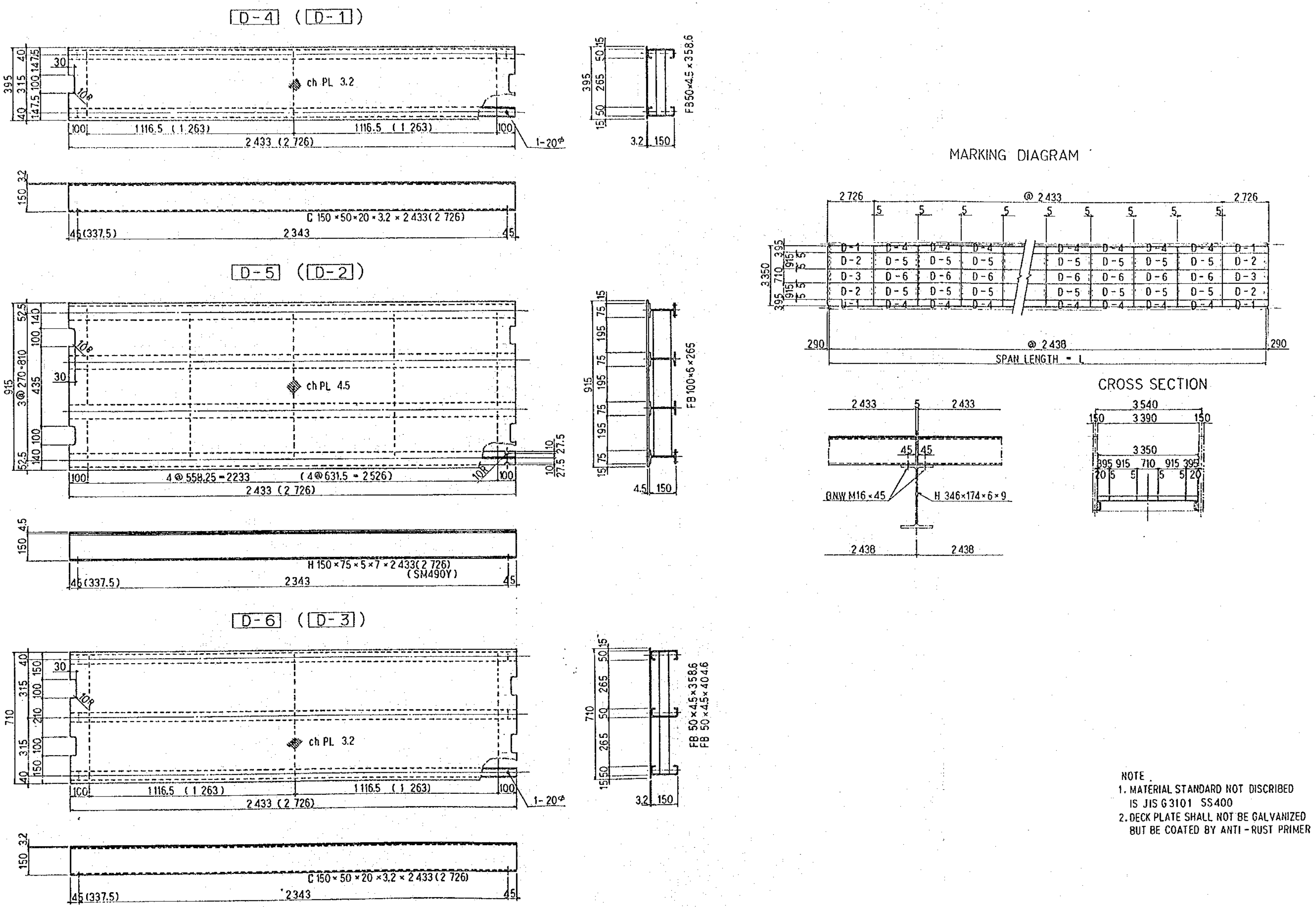


Figure 4-12 DETAILS OF SUPERSTRUCTURE (2/2)

4.4.3 Quantities of Bridge Construction Works

The quantities of bridge construction works for the project bridges are estimated based on the Summary of Basic Bridge Planning given in Tables 4-3 to 4-5. The summary of quantities of bridge construction works are presented in Table 4-7.

Table 4-7 SUMMARY OF QUANTITIES OF BRIDGE CONSTRUCTION WORKS

Works			Unit	Phase 1	Phase 2	Phase 3	Total
Number of Bridges			Bridge	32	22	20	74
Super-structures	No. of 15m Spans		Span	9 (135m)	6 (90m)	8 (120m)	23 (345m)
	No. of 20m Spans		Span	28 (560m)	20 (400m)	7 (140m)	55 (1100m)
	No. of 25m Spans		Span	31 (775m)	24 (600m)	25 (625m)	80 (2000m)
	Total		Span	68 (1470m)	50 (1090m)	40 (885m)	158 (3445m)
	Transportation		Ton	997	739	600	2,335
	Erection		Ton	997	739	600	2,335
Sub-structures	Abutments	H= 4.5m	Unit	62	42	36	140
		H= 5.0- 6.0m	Unit	2	2	4	8
		Total	Unit	64	44	40	148
	Piers	H= 5.0- 7.5m	Unit	20	12	3	35
		H= 8.0- 9.5m	Unit	4	11	3	18
		H=10.0-13.5m	Unit	6	0	1	7
		Pile-bent Type	Unit	6	5	13	24
		Total	Unit	36	28	20	84
	Piles	Precast	Each	860	603	430	1,893
		Cast-in-Place	m	417	378	960	1,755
Approach Roads			m	675	480	425	1,580
River Protection			m²	2,350	1,600	1,470	5,420

4.4.4 Quantities of Superstructure (Portable Steel Bridge) Materials

The quantities of superstructure materials is estimated based on the drawings of the superstructure. The summary of the quantities of superstructure materials which will be procured under this project is presented in Table 4-8.

Other than these superstructure materials, tools for erection will be procured under this project. The details of the tools are described in Section 4.5.2.

Table 4-8 SUMMARY OF QUANTITY OF SUPERSTRUCTURE (PORTABLE STEEL BRIDGE) MATERIALS

(Unit : ton)

Materials			Phase 1	Phase 2	Phase 3	Total	Remarks
Shape	Designation	Size					
H-Beam	SM490Y	150x150x7x10	169.972	120.952	98.358	382.282	Truss chord
		150x74x5x7	164.560	121.992	99.008	385.560	Deck plate
	SS400	364x170x6x9	90.135	66.776	54.130	211.041	Cross beam
		150x150x7x10	182.774	135.584	110.174	428.532	Diagonal member
	Sub-total		600.441	445.304	361.670	428.532	
L-Beam	SS400	75x75x6	7.480	5.500	4.400	17.380	Cross beam
LIP-CH	SS400	150x50x20x3.2	69.524	51.540	41.830	162.894	Deck plate
Flat Bar	SS400	100x6	21.164	15.696	12.744	49.608	Deck plate
		50x4.5	4.704	3.488	2.832	11.024	Deck plate
	Sub-total		25.872	19.184	15.576	60.632	
Check Plate	SS400	t = 4.5	99.152	73.504	59.656	232.312	Deck plate
	SS400	t = 3.2	59.256	43.928	35.652	138.836	Deck plate
	Sub-total		158.408	117.432	95.308	371.148	
Plate	SS400	t = 22	4.420	3.250	2.600	10.270	Shoe
		t = 12	5.639	4.162	3.405	13.206	Gusset
		t = 8	58.366	43/287	35.142	136.784	Gusset
	Sub-total		68.425	50.688	41.147	160.260	
High Tension Bolt	F8T	M22 (kg)	64.048	47.478	38.469	149.995	For truss
		M22 (set)	121,766.000	90,265.000	73,115.000	285,146.000	
Bolt, Nut, Washer	SS400	M16 (kg)	5.662	4.199	3.409	13.270	For deck plate
		M16 (set)	28,941.000	21,460.000	17,424.000	67,825.000	
Anchor Bar	SS400	M24	0.884	0.650	0.520	2.054	Shoe anchor
Round Bar	SS400	φ16mm	0.408	0.300	0.240	0.948	Shoe anchor
Total weight of steel materials			996.592	733.894	599.829	2,335.315	
Paint	Middle Coat		2.619	1.942	1.576	6.137	For field painting
	Finish Coat		2.401	1.780	1.445	5.625	For field painting
	Thinner		0.502	0.372	0.302	1.176	For field painting

4.5 Construction Plan

4.5.1 Bridge Materials Transportation Plan

The steel materials and the erection tools for the project (the items) which will be procured under this project will be delivered from Japan to Chittagong International Seaport. The items will be handed over to LGED after landing at Chittagong. Then the items will be transported to the storage yards of the involved LGED district offices for storage until erection.

4.5.2 Bridge Erection Plan

Erection of the portable steel bridges will be executed by local constructors under the responsibility of LGED. The erection method and tools necessary are planned as follows:

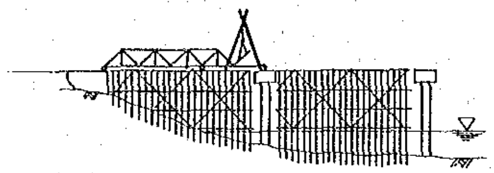
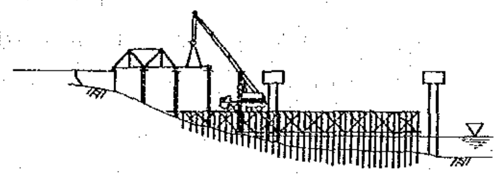
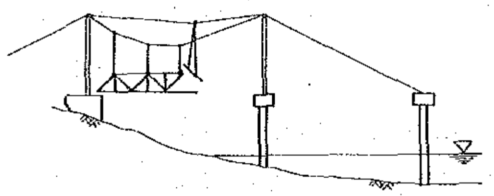
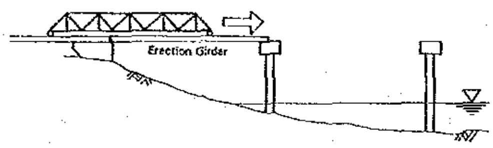
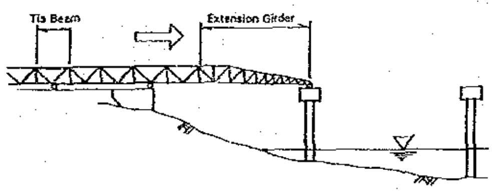
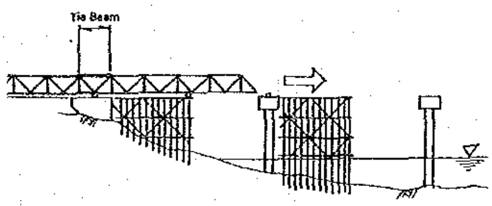
(1) Erection method

Comparative schemes of erection methods and evaluations are shown in Table 4-9. As a result, the launching on staging method is proposed. The features of this method are as follows:

- The bridge can be assembled on the approach road, so, assembly will be efficient and accurate.
- No special machines or skilled techniques are required, so, the erection cost is low.
- For erection of portable steel bridges, assembly on staging is the common method in Bangladesh. This method was introduced to improve the speed and accuracy of the assembly on staging method.

Conceptual figures of the launching on staging method are presented in Appendix 5.

Table 4-9 COMPARATIVE STUDY OF ERECTION METHODS

Comparative Erection Schemes		Evaluation	Easi-ness	Cost	Speed	Conclu-sion
Assembly on staging		•impossible during flood season •difficult where river is deep •need small tools only •no need skill	B	A	C	B
Truck crane & bent		•impossible during flood season •need access road for truck crane •need staging for truck crane •no need skill •fast execution	C	B	A	C
Cable suspension		•no need large machine •need skill	C	A	B	C
Erection girder		•erection girder is large •no need skill •fast, easy and accurate assembly	A	C	A	B
Extension girder		•extension girder is large •no need skill •fast, easy and accurate assembly	A	C	A	B
Assembly on staging		•impossible in flood season •tools are small •no need skill •fast, easy and accurate assembly	B	A	A	A

Note) A : good
B : fair
C : poor

(2) Erection tools

The items and quantities of assembly and launching tools necessary with the launching on staging method were studied.

The proposed items and quantities per set of assembly tools and launching tools are presented in Tables 4-10 and 4-11, respectively.

According to the implementation schedule of the project proposed by LGED, the erection of the bridges in each phase is schedule for 6 months. Based on a study of the implementation schedule in each phase, the necessary quantities of tool sets are proposed as follows:

Proposed quantities of tool sets

Assembly tools : 12 sets
Launching tools (2 span continuous type) : 6 sets
Launching tools (3 span continuous type) : 6 sets

Table 4-10 ASSEMBLY TOOL LIST

(Per set)

Tool	Designation	Quantity
[Survey Tools]		
● Level Gauge	ST900	1 pcs.
● Steel Measuring Tape	50m	1 pcs.
[Election Tools]		
● Torque Wrench	7500QLE	4 pcs.
● Socket	36mm	6 pcs.
● 60° Single Offset Wrench	60° x 22mm	10 pcs.
● Sledge Hammer, Double Face	#8 (3.5kg)	2 pcs.
● Hand Hammer, Double Face	#3 (1.3kg)	10 pcs.
● Lever Block	1 ton	2 pcs.
● Bolt Clipper	KKW-2	1 pc.
● Wire Clip	10 ϕ	20 pcs.
● Crow Bar	L = 1.0m	1 pc.
● Crow Bar	L - 1.5m	1 pc.
● Election Bolt	M22 x 50	300 pcs.
● Drift Pin	ϕ 24.5	150 pcs.
[Lifting Equipment]		
● Three Pronged Lift	2 ton	2 pcs.
● Pulley Block	IS-Hooktype	4 pcs.
● Shackle	5/8	4 pcs.
● Pipe	60.5 x 7m	6 pcs.
● Nylon Sling	1.5ton x 3m	8 pcs.
● Portable Winch	NPW2000	2 units
● Steel Wire Rope	9 ϕ x 45m	2 rolls
● Stay Wire Rope	9 ϕ x 3m	2 pcs.
● Base Beam	H1-150 x 1.5m	2 pcs.
[Scaffolding]		
● Scaffolding	KA3055A	4 set
● Stage Plank	HPS5183	2 pcs.
● Jack Base	KA752	1 pc.
● Ladder	KA3055S	8 pcs.
● Brace	KA14	4 pcs.

Table 4-11 LAUNCHING TOOL LIST

(Per set)

Tool	Designation	Type of Bridge		
		One Span Type	Two Span Continuous Type	Three Span Continuous Type
[Erection Truss]				
● Tie Beam	H150	-	1 set (0.53 ton)	2 sets (1.06 ton)
[Launching Rail]				
● Launching Rail	73.8kg/m	39 m	39m + 12m = 51m	39m + 12m x 2 = 63m
● Base Plate	t = 25mm	0.50 ton	0.67 ton	0.85 ton
[Launching Equipment]				
● Roller	TIL-TANK25	4 pcs.	6 pcs.	8 pcs.
● Screw Clamp	T-10	16 pcs.	24 pcs.	32 pcs.
● Portable Winch	NPW2000	2 units	2 units	2 units
● Pulley Block	3S-Hook	-	2 pcs.	2 pcs.
● Pulley Block	2S-Hook	2 pcs.	2 pcs.	2 pcs.
● Pulley Block	1S-Hook	2 pcs.	-	-
● Stay Wire Rope	9φ x 2m	6 pcs.	6 pcs.	6 pcs.
● Steel Wire Rope	9φ	150m x 2 rolls	200m x 2 rolls	200m x 2 rolls
● Roller Staging Beam	H150 x 4m	4 pcs.	6 pcs.	12 pcs.
● Filler Plate	200x 6x200	16 pcs.	24 pcs.	32 pcs.
● Filler Plate	200x25x200	8 pcs.	12 pcs.	24 pcs.
● Filler Plate	200x10x200	8 pcs.	12 pcs.	24 pcs.
● Winch Staging Beam	H150 x 1.5m	6 pcs.	6 pcs.	6 pcs.
[Jack Up/Down Equipment]				
● Mechanical Jack	15t SLIDE	4 pcs.	4 pcs.	4 pcs.
● Mechanical Jack	30t	2 pcs.	2 pcs.	2 pcs.
● Saddle	H150x0.5mR	32 pcs.	32 pcs.	32 pcs.

4.6 Project Implementation Plan

4.6.1 Basic Concept

The following are the basic concepts for implementing this project after the Exchange of Notes between Japan and Bangladesh:

- The Japanese Consultant (the Consultant) will implement the project under the Consultant Agreement between LGED and the Consultant.

- The Consultant will carry out detailed design, tendering works and supervision for procurement of portable steel bridge materials (the Materials) and erection tools (the Tools).

- The supervision works include training Bangladesh engineers and staff involved in erection of the bridges

- LGED will execute detailed design and construction of substructures, approach roads and other necessary works for the project, including erection of the project bridges.

- The tenderer for supplying the Materials will be qualified Japanese contractors.

- Supply of the Materials will be contracted by the successful Japanese contractor under the contract agreement between LGED and the contractor.

For the project, the undertakings of the two countries are as follows:

<u>Scope of the project by the Government of Japan</u>

The undertakings of the Government of Japan for the project are as follows:

- Materials of portable steel bridges
- Tools necessary for erection of the bridges
- Training for erection of the bridges

Japan's undertakings include delivery of the Materials and Tools from Japan to Chittagong International Seaport.

The Materials list of portable steel bridges is presented in Table 4-8 in Section 4.4.4 and the Tools list is presented in Tables 4-10 and 4-11 in Section 4.5.2.

Undertakings of the Government of Bangladesh

The undertakings of the Government of Bangladesh are as follows:

- Detailed design and construction of substructures, approach roads, river protection and other necessary works for the project.

- Customs clearance and inland transportation of the Materials and the Tools.

- Erection of the bridges.

The Government of Bangladesh is responsible for constructing the bridges within a 2-year period after the delivery of the Materials at Chittagong, and for reporting the progress of construction of the project bridges to JICA Bangladesh Office every one year until the completion, as well as to take the necessary measures stated in the Minutes of Discussions.

The quantities of the bridge construction works are presented in Table 4-7 in Section 4.4.3.

4.6.2 Implementation Supervisory Plan

(1) Detailed design

Related to procurement of the Materials and Tools, the following items will be prepared in detailed design by the Consultant:

- Detailed design report
- Drawings and specifications
- Procurement plan and cost estimation report
- Tender and contract documents
- Bridge erection training plan

(2) Tendering

Relevant to tendering for procurement of the Materials and Tools, the following services will be provided by the Consultant:

- Tender notice
- Tender pre-qualification
- Tendering
- Tender evaluation

(3) Supervision

The Consultant will execute the following services in supervision:

- Inspection of shop assembly of the portable steel bridges
- Inspection of delivery and handover of the Materials and Tools
- Training for bridge erection

4.6.3 Procurement Plan

Considering quality control and the time for delivery of the Materials and Tools for implementation of the project, the Materials and Tools will be procured in Japan.

4.6.4 Bridge Erection Training Plan

Training of Bangladesh engineers and staff involved in erection of the portable steel bridges is planned as follows:

<u>Preparation of bridge erection manual</u>

An erection manual for training in erection of the portable steel bridges will be prepared in the detailed design of the bridges. The manual will consist of explanations of erection planning and execution.

<u>On-the-job training</u>

Training teams will be sent from Japan to the project sites in Bangladesh to conduct on-the-job training in erection of the project bridges. Bangladesh engineers and staff involved in the erection will be trained directly by the bridge erection experts.

The training teams will be comprised of the following steel bridge erection members:

- Expert (1 person)
- Foreman (1 person)
- Skilled worker (2 persons)

On-the-job training is planned to be held at the following types of phase 1 bridges when erection is started:

- One span type (1 bridge)
- Two span type (1 bridge)
- Three span type (1 bridge)

4.6.5 Implementation Schedule

LGED plans implementation of the undertakings of the Government of Bangladesh over a 2-year period, which is divided into 3 phases.

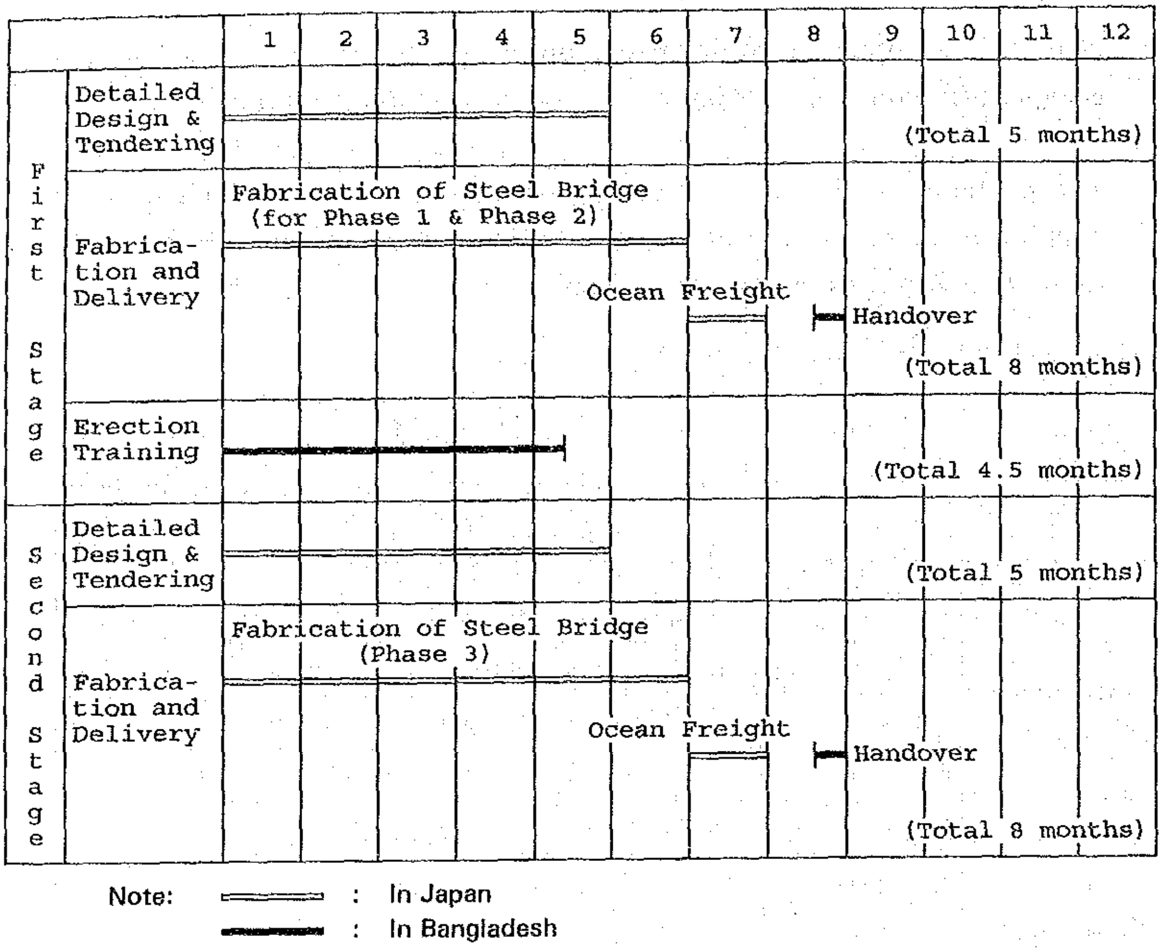
The portable steel bridge materials, erection tools and bridge erection training to be procured under Japan's Grant Aid is planned to be implemented in 2 stages as shown in Table 4-12.

Table 4-12 PROCUREMENT PLAN

Procurement Stage (Japan Side)		First Stage		Second Stage	Total
Construction Phase (Bangladesh Side)		Phase 1	Phase 2	Phase 3	
Portable Steel Bridge Materials	For 15m spans	9 spans	6 spans	8 spans	23 spans
	For 20m spans	28 spans	20 spans	7 spans	55 spans
	For 25m spans	31 spans	24 spans	25 spans	80 spans
Erection Tools	Assembly tools	12 sets	0	0	12 sets
	2 span continuous launching tools	6 sets	0	0	6 sets
	3 span continuous launching tools	6 sets	0	0	6 sets
Erection Training		3 bridges	0	0	3 bridges

The implementation schedule of the project is shown in Figure 4-13.

Table 4-13 IMPLEMENTATION SCHEDULE



4.6.6 Construction Cost

The construction cost borne by the Government of Bangladesh is roughly estimated at 1,906.7 Lakh Taka, as shown in Table 4-14 and Appendix 7.

Table 4-14 COST BORNE BY THE GOVERNMENT OF BANGLADESH

(Take in Lakh)

Item	Phase 1	Phase 2	Phase 3	Total
Construction	765.1	558.0	498.5	1,821.6
Inland Transportation	36.2	26.7	20.5	83.4
Custom Clearance Fee	0.8	0.5	0.4	1.7
Total	802.1	585.2	519.4	1,906.7