CHAPTER VII

STUDY OF ACCESS HIGHWAY

1. Progress of Working.

The access highway study team has carried out the field survey, collected useful data and exchanged opinions with R & H engineers during a period from January 18, 1974 to February 22, 1974 in People's Republic of Bangladesh.

The existing road map is shown in Fig. 7-1; the table of inventory of existing approach road facilities is shown in Table 7-2.

In addition, the study team has compiled the report of Japanese version about the above survey which the study team had submitted to Japan International Cooperation Agency (former "O.T.C.A."). Some additional discussion and reviews among the study teams have resulted in compiling progress study report of English version for Tokyo Meeting.

In order to compile the Interim Report, the access highway study team, after the Tokyo Meeting, has revised the study report as much as possible according to suggestion of Mr. Shafiullah.

2. Purpose of Access Highway Study.

This study has designed and made an estimate of capital cost of access highway at every four proposed site to connect the Jamuna bridge with the existing all-weather road, including Tangail-Bhuapur-Gopalgonj and Sirajganj-Hatikampul Roads on the right and left side of the Jamuna.

However, without the sufficient result of data analysis the economic and traffic study team could not brought any decision regarding the number of lanes required according to design hourly volume forecasting.

The study team has, therefore, planned the phasing and estimated the capital cost, for the road construction for the two-lane (each eleven feet wide) undivided highway which will be extended to a four-lane divided highway in the future.

The Government of the People's Republic of Bangladesh shall take an appropriate actions to reserve sufficient land for two additional lane for the future extension on the other side of the borrow pit and the road. The typical cross section is shown in Fig.7-2 and geometric design standards is shown in Table 7-3.

3. Definition of Access Highway.

The definition of access highway by the study team corresponds to the all-weather road including Tangail-Bhuapur-Gopalgonj and Sirajganj-Hatikampul roads, on the both sides of the Jamuna to approach road of the Jamuna Bridge.

All-weather Road on Left Side	Proposed Bridge Site	All-weather Road on Right Side
Jamapul-Madhupur Road	Bahadurabad Site	Nagarbari-Saidpur Road (Asian Highway A-2)
Jamapul-Madhupur Road	Gabargaon Site	Nagarbari-Saidpur Road
Tangil-Bhuapur-Gopalgonj Road	Sirajganj Site	Sirajganj-Hatikumpul Road
Dacca-Anicha Road (Asian Highway A-1, A-2)	Nagarbari Site	Nagarbari-Saidpur Road

4. Outline of Horizontal Alignment.

(1) Taking account of the result of the field survey and regional speciality of Bangladesh in to consideration, the study team has planned Horizontal Alignment, giving priority to the (1) retention of existing road facilities and the (2) selection of river stability crossing sites at tributaries and distributaries according to the principle that (3) access highway must be straight. The proposed alignment passes through principal villages because of the above mentioned.

Besides, there are many marshes in the project area. Therefore, the access highway study team has designed the route with detours and

meanders so as to dodge the marshes on the left sides of Bahadurabad and Gabargaon.

(2) *Proposed Route.*

Access Highway Type B: Dist. bew. guide banks 4.2 km
Type C: Dist. bew. guide banks 5.2 - 5.6 km

1) Bahadurabad Site B = 67,500 m, C = 67,000 m

Right side B, C = 25,000 m

The proposed route follows the existing kacha road, improving and widening the section from Kamar on the Asian Highway to Shahapur where there is a sugar mill at present, and the existing brick road for the section from Shahapur to Mahimaganj. Thereafter it turns south following the existing road from Gobaripara to Muhammadpur, which will be widened and improved, eliminating the present heavy erosion. The route to the bridge site was planned as above.

Left Side B = 42,500 m, C = 42,000 m

From Jamalpur to northeast up to Dharmakara the proposed Highway was planned on the left side of Jamalpur - Bahadurabad Railway and in parallel thereto and to Old Jamuna. Westward from Dharmakara to Ghilabari the present route will be followed, improving and widening the existing Kacha road. The new alignment was planned from Ghilabari south to the proposed bridge site at Rajapur.

Due to the low and marshy ground in this area, it was necessary to lead the route in a large round-about curve to the north.

Proposed Access Highway Route Location is shown in Fig. 7-3.

2) Gabargaon Site B, C = 65,100 m

Right side B, C = 31,100 m

The proposed route followed the existing brick road from Bogra on the Asian Highway eastward to Gabtali, and the present Kacha

road from Gabtali to Phurbari improving and widening them. The new alignment was planned from Phurbari southeast to the proposed bridge site at Chandanbaisa.

Left side B, C = 34,000 m

The proposed route goes westward from Kochagar, about 5 kilometer to the south of Jamalpur, crossing the Chatal River, up to the proposed bridge site. As there are many marshes and river crossings in this area, like the left bank area of Bahadurabad, almost the whole route is new construction except for a portion between Kochgar and the Chatal River where the existing Kacha road is improved and widened.

Proposed Access Highway Route Location is shown in Fig. 7-5.

3) Sirajganj Site B, C = 29,750 m

Right side B, C = 15,500 m

From Hatikumrul on the Asian Highway to Slalkal, the Hatikumrul-Sirajganj Highway, now under re-construction for completion in 1978 is wholly used. From Slalkol the new road was planned toward southeast, passing the railway and bypassing Sirajganj Town, up to Banbaria. From Banbaria the route turns southward following the existing partly paved 1-lane road, widening it, up to Tengrail. From Tengrail the new alignment follows the shortest route to the proposed bridge site.

Left side B, C = 14,250 m

New road construction goes westward straight from Elenga on the Tangail - Bhuapur - Gopalgonj Road, crossing the Dhaleswari River, to the proposed bridge site.

Proposed Access Highway Route Location is shown in Fig. 7-7.

4) Nagarbari Site B, C = 35,250 m

Right side B, C = 6,500 m

To northeast from Bangram on the Asian Highway to the Hurasagar River, the existing road was followed and widened, and henceforth the new alignment follows the shortest route to the proposed bridge site.

Left side B, C = 28,750 m

The proposed route starts from Mahadebpur, about 10 kilometer from Aricha on the Dacca-Aricha Road, and extends northwards to Tebaria, widening and improving the existing Kacha road now badly eroded. From there on the new alignment was planned to go westward from Tebaria to the proposed bridge site via Haparikatra.

Proposed Access Highway Route Location is shown in Fig. 7-9.

5. Outline of Vertical Alignment.

Decision making in Design High Flood Level (D.H.F.L.) is reauired prior to the design of vertical alignment. Regarding the decision of D.H.F.L., for the left side, the study team has adopted the maximum flood height which was recorded last in July, 1970. And it is also said that 1970 recorded the largest numbers of flood in the recent years.

In relation to the right side, on the other hand, study team has decided on the figures by the hearings at sites for Bahadurabad (Gobindganj) and Gabargaon (Bogra) sites, and the study team has decided the D.H.F.L., which is from the Stream Gaging Data for Right Embankment Project at Sirajganj (Ulapara) and Nagarbari (Bagabari) sites. The whole alignment will be built with a minimum free-board of three feet above D.H.F.L.

The data of 1974 were unavailable for our study this time, therefor, the study team has been preparing D.H.F.L., in accordance with the data of 1970. Upon gating the latest data of 1974, the study team will study further in detail.

Each proposed Vertical Alignment is shown in Fig. 7-4, 7-6, 7-8, & 7-10.

6. Design of Structures.

The study team has prepared for the site selection for long bridges which are longer than 100 m after the study of the data collected at sites and 1:50,000 photo-mosaic map.

In relation to spillway and a bridge opening shorter than 100 m, the study team has adopted the value of 4% of opening ratio of the structure to total road length, the data of which is from the inventory of existing spillway and bridge openings for Kaliganga-Aricha Road, which is only all-weather road in Bangladesh at a right angle to the Jamuna.
The calculated figure is shown in Table 7-4.

7. Outline of Road Structure.

The access highway study team has carried out the road structure design referring to Geometric Design Standards of Rural Road in Bangladesh.

However, more integrated investigation and detail design will be required in the future for the purpose of the design of total pavement thickness and embankment side slope. The adopted pavement section is shown in Fig. 7-11.

8. Technical Aspect.

The recommend access highway has a large number of river and canal crossing. The access highway study team suggests that a considerable portion of the total opening should be closed or reduced in accordance with detail investigation of drainage.

The construction should be divided into two works at least, one for the road and the other for the bridge in pursuit of better result.
Any topographic survey and soil investigation have not been carried out in this study. The above works will have to be done for the detail design.

	Total Length of Emb't	Total Length of Bridge 100m < L	Total Length of Spillway & Bridge Openings 100m > L
Bahadurabad site	64 km	600 m	2,600 m
Gabargaon site	61.5 km	1,000 m	2,600 m
Sirajganj site	28.5 km	-	1,190 m
Nagarbari site	32.5 km	1,200 m	1,400 m

9. Construction Cost.

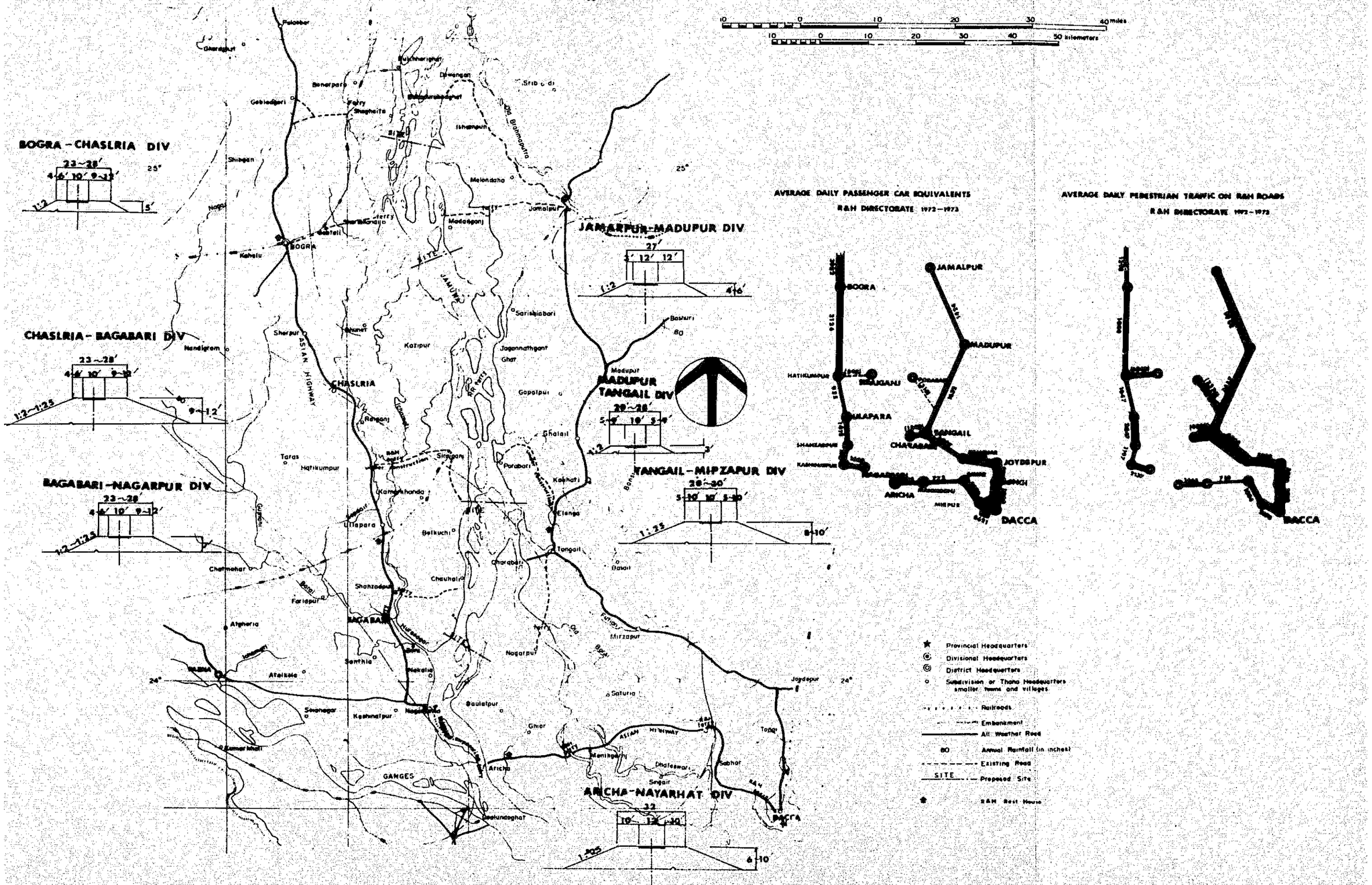
The estimated construction cost,including the cost of bridge and spillway. The Rough Estimate of Construction Costs of Access Highway is shown in Table 7-1.

Table 7-1 ROUGH ESTIMATE OF CONSTRUCTION COSTS OF ACCESS HIGHWAY

Unit: Crore Taka

Bridge site	Dist. bew. guide banks km (mile)	Total route length km (mile)	Earthwork	Bridge & spillway	Dhaleswari river Causeway	Pavement work	Miscella-neous work	Total Causeway
Bahadurabad	4.2(2.6)	67(42)	8	9		5	1	23
	5.6(3.5)		8	9		5	1	23
Gabargaon	4.2(2.6)	65(41)	8	12		5	1	26
	5.2(3.3)		8	12		5	1	26
Sirajganj	4.2(2.6)	30(19)	5	3	18	2	0	28
	5.6(3.5)		5	3	18	2	0	28
Nagarbari	4.2(2.6)	35(22)	4	9		3	0	16
	5.2(3.3)		4	9		3	0	16

Fig. 7-1 **ROAD MAP OF PROJECT AREA**



AVERAGE DAILY PASSENGER CAR EQUIVALENTS
R&H DIRECTORATE 1972–1973

AVERAGE DAILY PEDESTRIAN TRAFFIC ON R&H ROADS
R&H DIRECTORATE 1972–1973

Table 7-2 INVENTORY OF ROAD FACILITIES

EXISTING APPROACH ROADS

ROUTE & SECTION	DISTANCE	ALL-WEATHER ROAD		FAIR WEATHER JEEPABLE	NO ACCESS	STRUCTURE		FERRY CLOSSING	FORD	LINIOR-METER-OF-SPILLWAY OPENING-PER-KILOMETER
		1 LANE PAVEMENT	GRAVEL SURFACED			BOX-CUL	SPILLWAY BRIDGE			
BAHADURABAD SITE										
JAMALPUR — BAHADURABAD	42.0km			42.0km		6	9		1	$\frac{89^m}{42.0^{km}} = 0.002$
GOBINDGANJ — BAHADURABAD SITE	20.0km	16.5km		3.5km		3	7	PRIVATE 1		$\frac{92^m}{16.5^{km}} = 0.006$
GABARGAON SITE										
JAMALPUR — GABARGAON	32.5km			32.5km		4	2	PRIVATE 2		$\frac{22.5^m}{32.5^{km}} = 0.001$
BOGRA — GABARGAON SITE	20.5km	BRICK 9.2km		11.3km			17	PRIVATE 1	1	$\frac{313^m}{20.5^{km}} = 0.015$
SERAJGANJ SITE										
ELENGA — GOPALGONJ	26.0km			UNDER CONST 19.0km	7.0km	5	12		2	$\frac{358^m}{19.0^{km}}$ INCLUDING TWO FORDS $= 0.019$
TANGAIL — CHARABARI	6.0km	1.6km		UNDER CONST 4.4km			5			$\frac{75^m}{6.0^{km}} = 0.013$
HATIKAMPUL—SIRAJGANJ	17.0km			UNDER CONST 17.0km		6	4	R&H 1	4	$\frac{92^m}{17.0^{km}} = 0.005$
SIRAJGANJ—SIRAJGANJ	13.8km	9.0km	2.8km		RIGHT EMB'T 2.0km				1	$\frac{24^m}{11.8^{km}} = 0.002$
NAGARBARI SITE										
TANGAIL - NAGARPUR (NAGARBARI SITE)	19.5km	BRICK 5.8km		13.7km				PRIVATE 1		$\frac{264^m}{19.5^{km}} = 0.013$
ULAPARA — NAGARBARI SITE	21.0km			16.0km	RIGHT EMB'T 5.0km	2	7	PRIVATE 1	8	$\frac{111^m}{16.0^{km}} = 0.007$

Fig. 7-2 TYPICAL CROSS SECTION

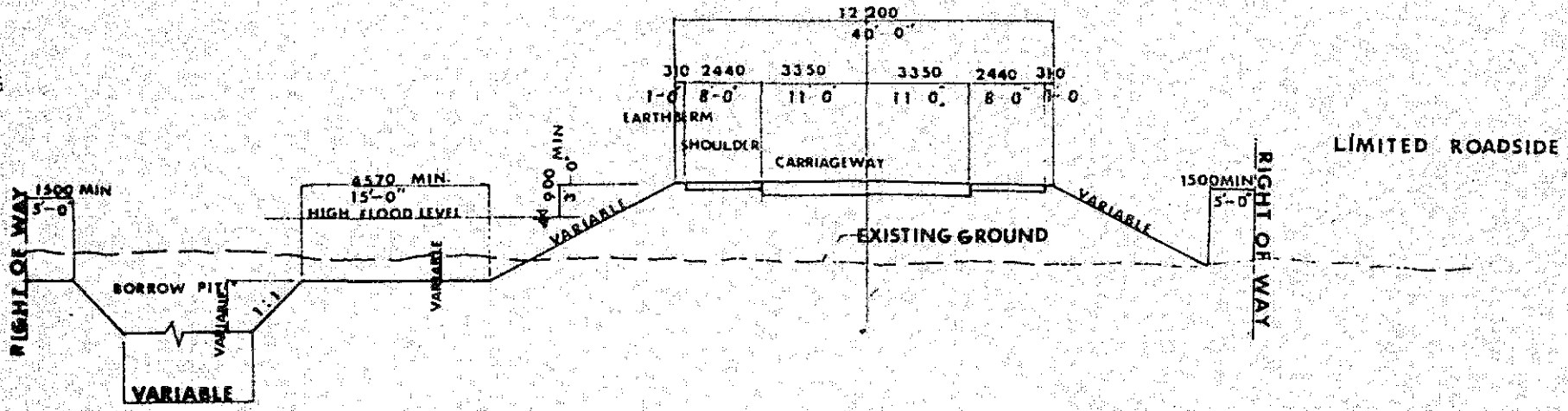
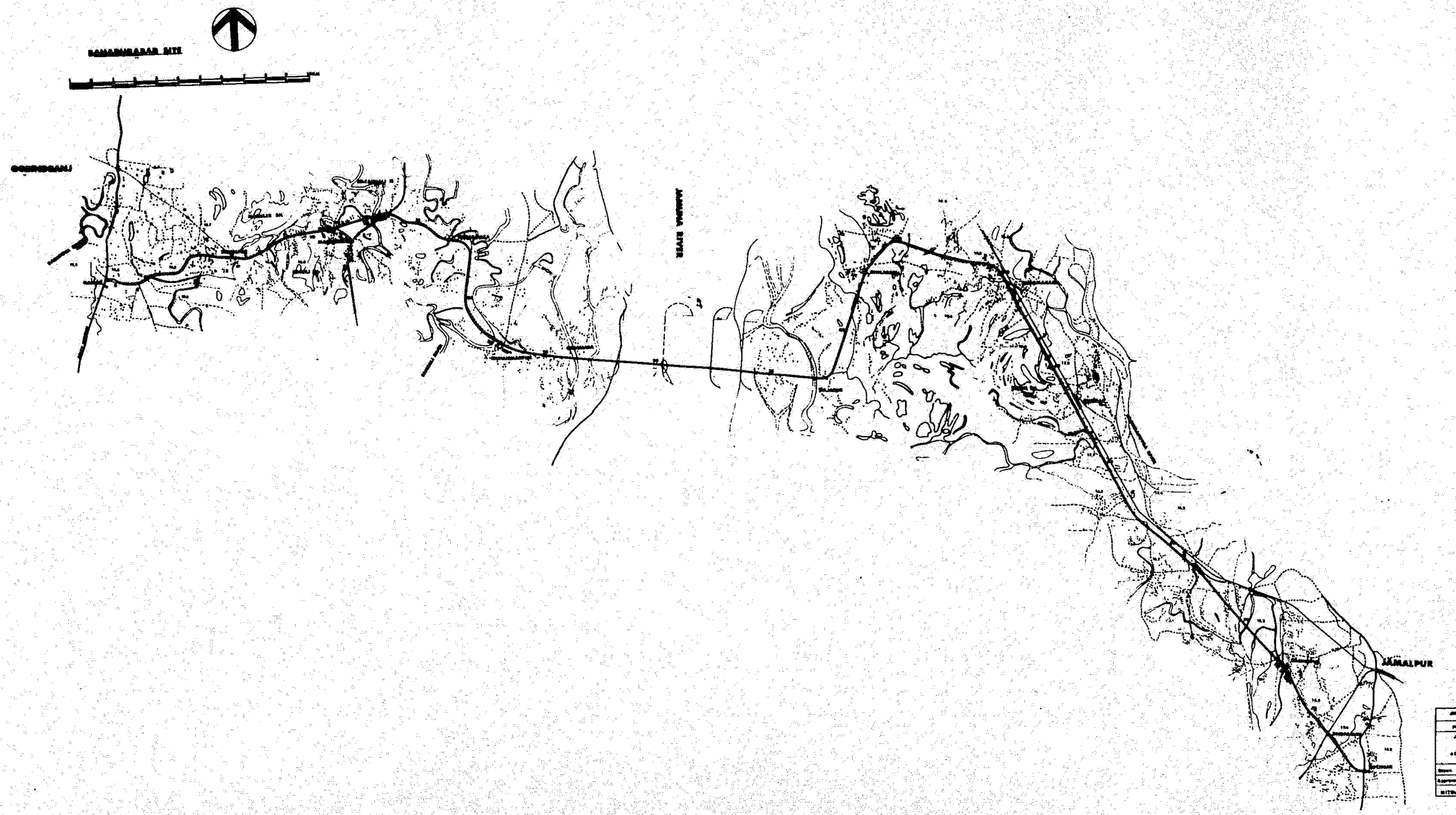


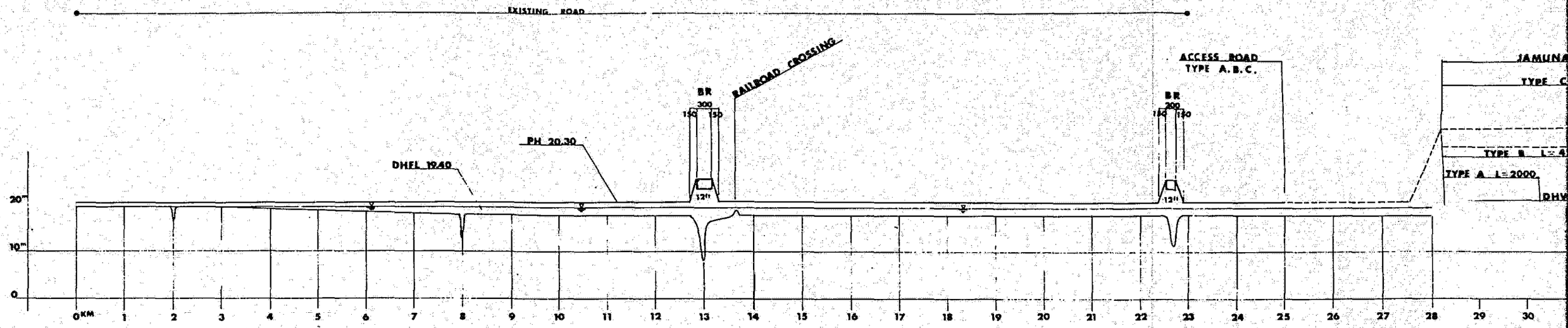
Table 7-3 GEOMETRIC DESIGN STANDARDS

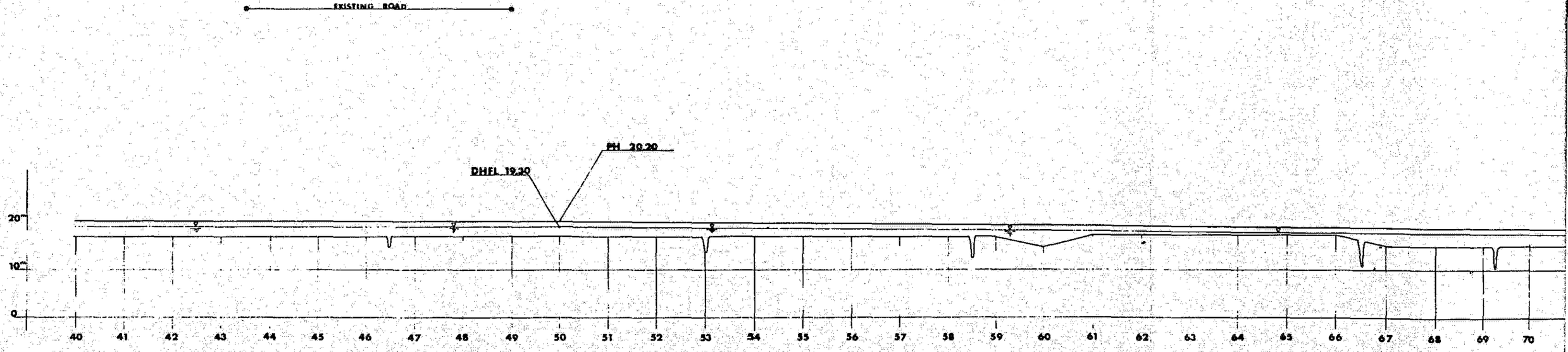
		2-LANE TWO-WAY HIGHWAY
ROADBED		12.200m (40'-0")
LANE		3.355m (11'-0")
SHOULDER		2.440m (8'-0")
EARTHBERM		0.305m (1'-0")
DESIGN SPEEDS	RURAL	96.5 km (60mph)
	URBAN	80.5 km (50mph)
RUNNING SPEEDS	RURAL	72.5 km (45mph)
	URBAN	64.5 km (40mph)
RADIUS OF CURVATURE	60mph	350m (1,146')
	50mph	230m (754')
GRADES		3.0 % MAX
PASSING SIGHT DISTANCE	60mph	610m (2,000')
	50mph	520m (1,700')
STOPPING SIGHT DISTANCE	60mph	145m (475')
	50mph	107m (350')
SUPERELEVATION		8.0 % MAX

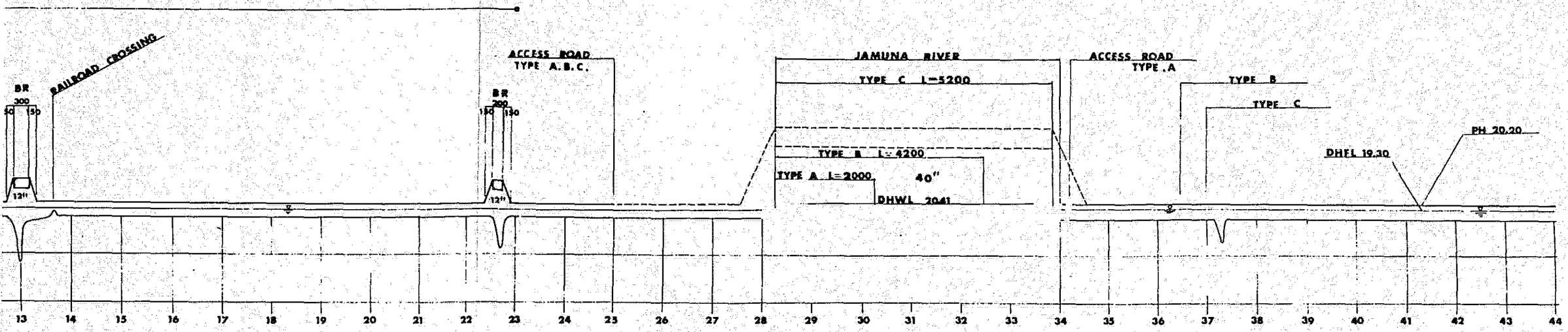

JAMALPUR

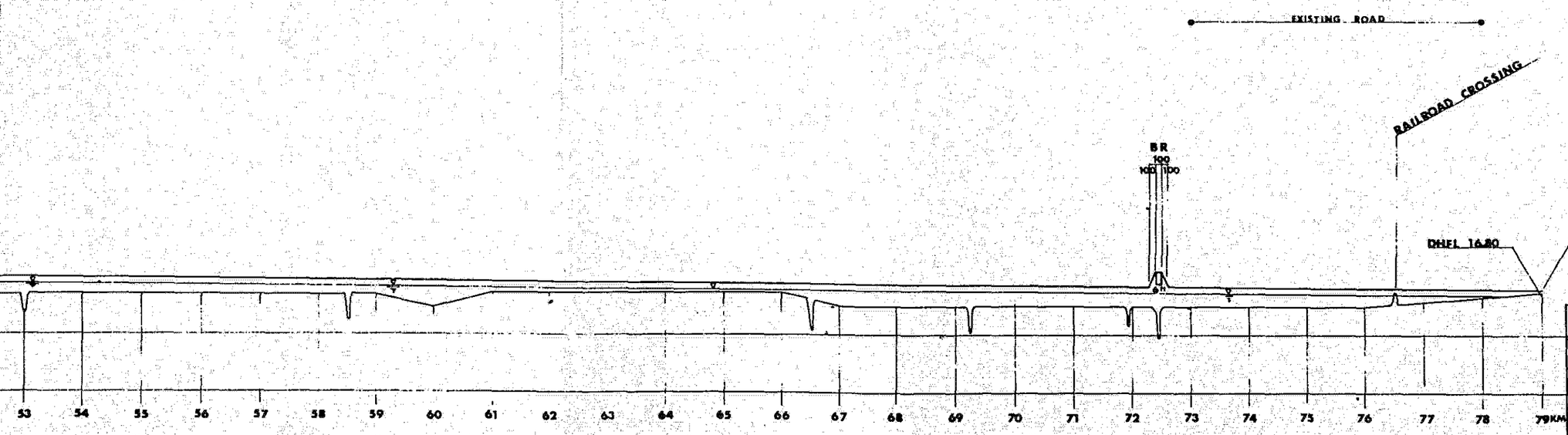

JAMUNA RIVER
JAMALPUR

BAHADURABAD SITE









JAPAN INTERNATIONAL COOPERATION AGENCY	
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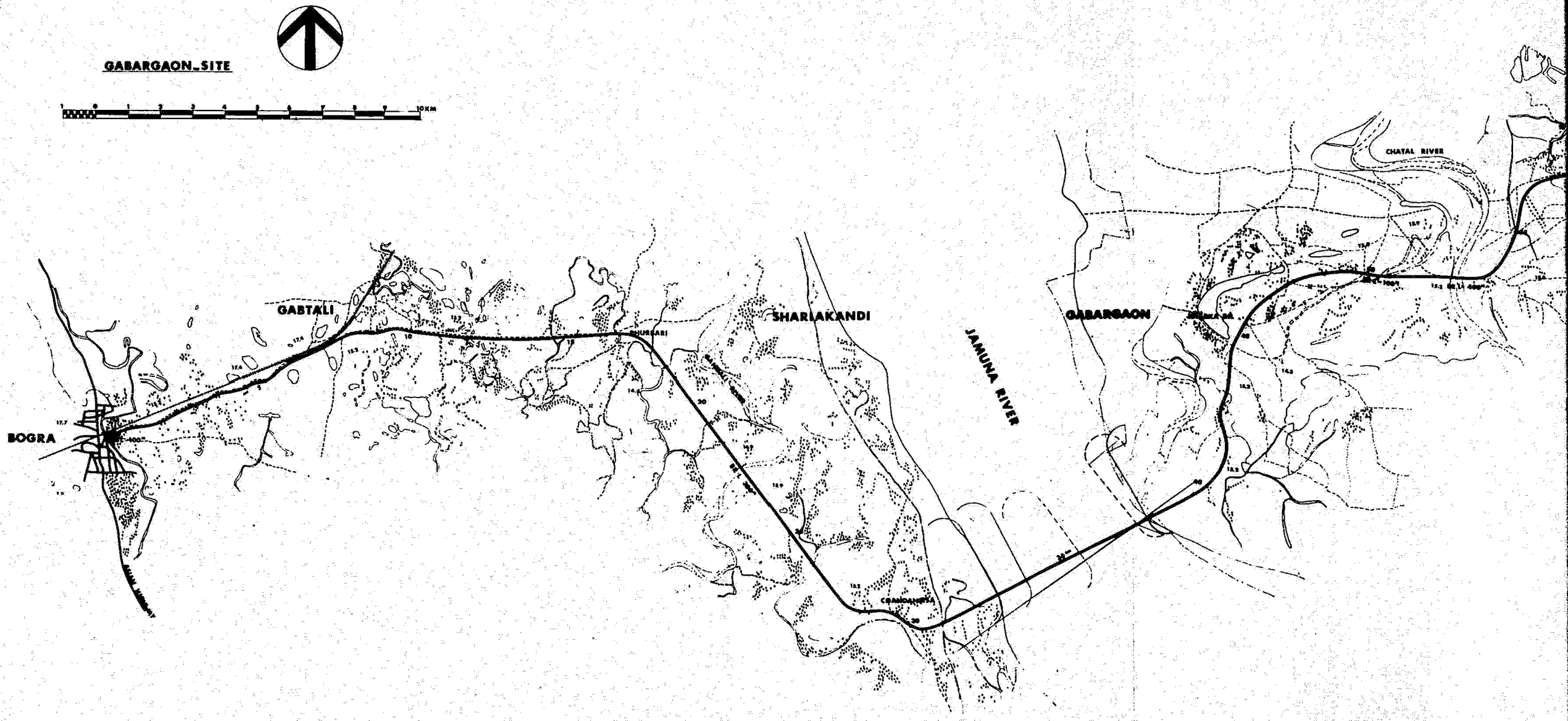
JAMUNA RIVER BRIDGE PROJECT BAHADURABAD SITE ACCESS ROAD VERTICAL ALIGNMENT	
Drawn	Date
Approved	Date
MITSUI CONSULTANTS CO., LTD.	Fig. 7-4


GABARGAON - SITE
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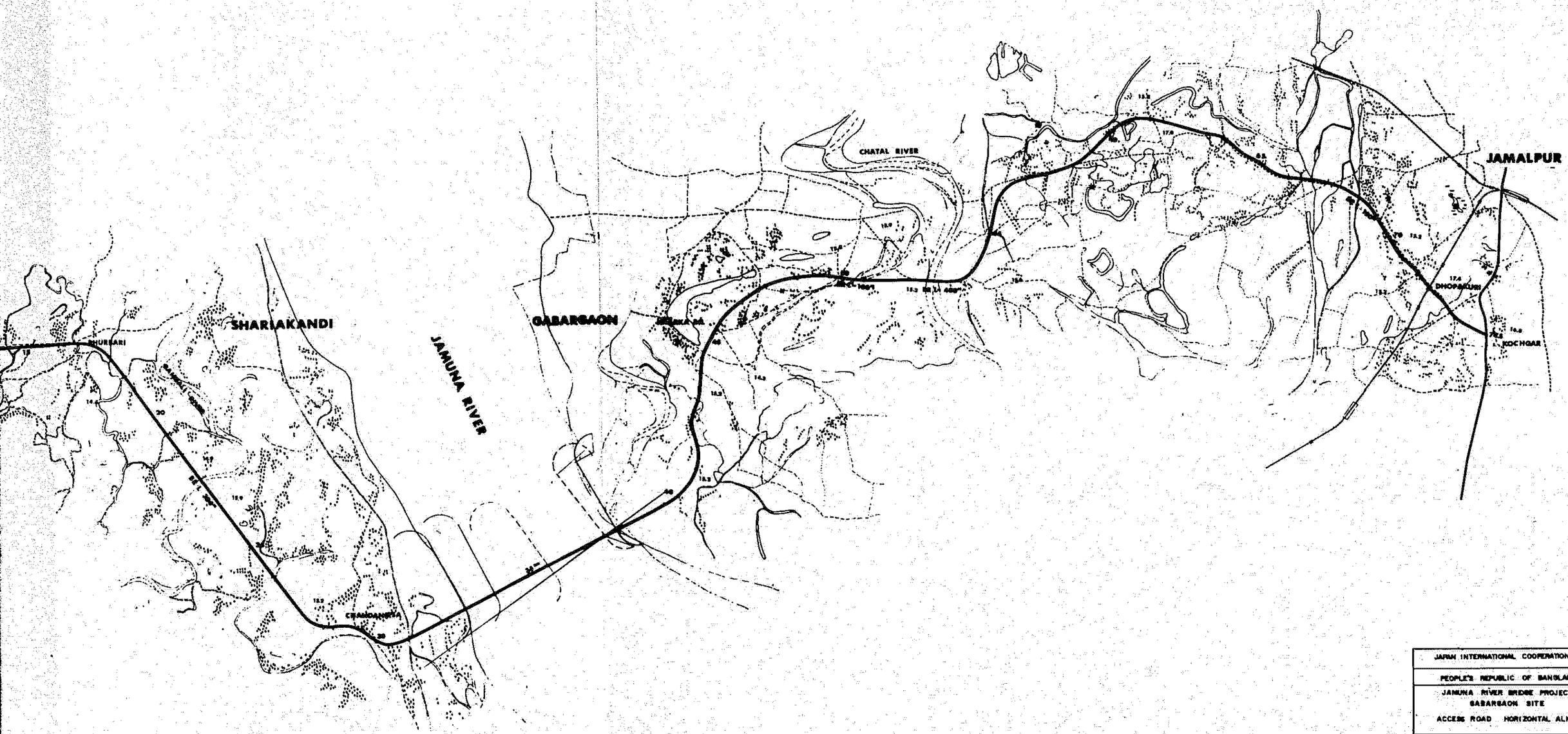
BOGRA
GABTALI
SHARIAKANDI
JAMUNA RIVER
GABARGAON
CHATAL RIVER



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JAMUNA RIVER BRIDGE PROJECT GABARGAON SITE ACCESS ROAD HORIZONTAL ALIGNMENT	
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Approved	Date
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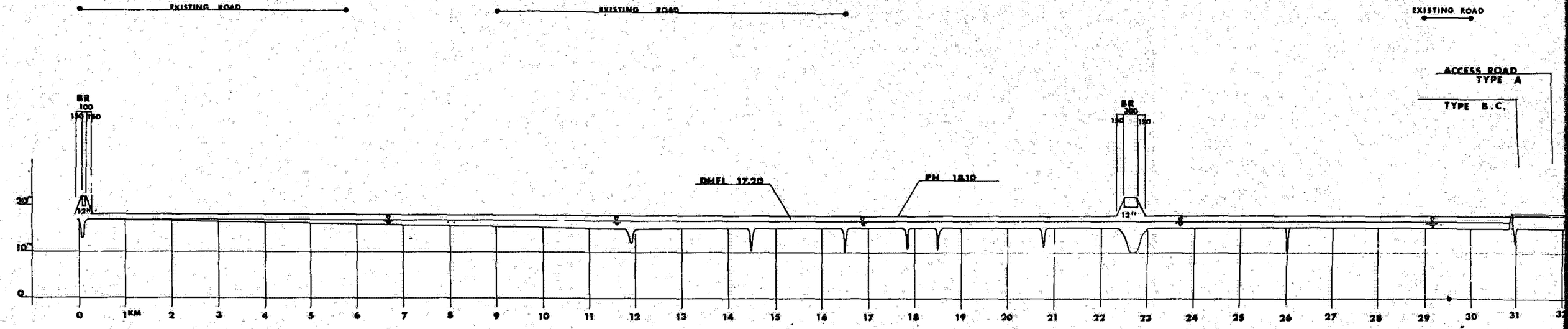
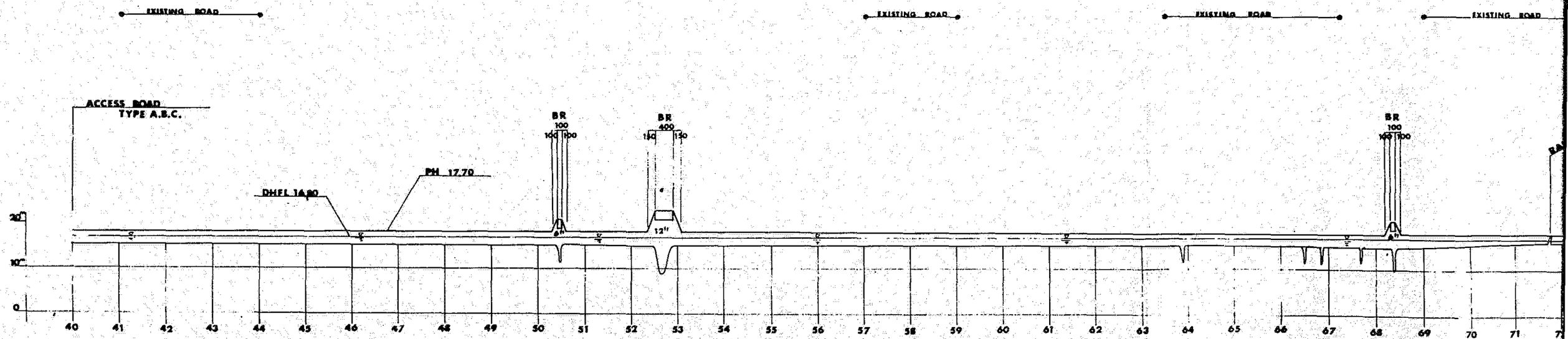
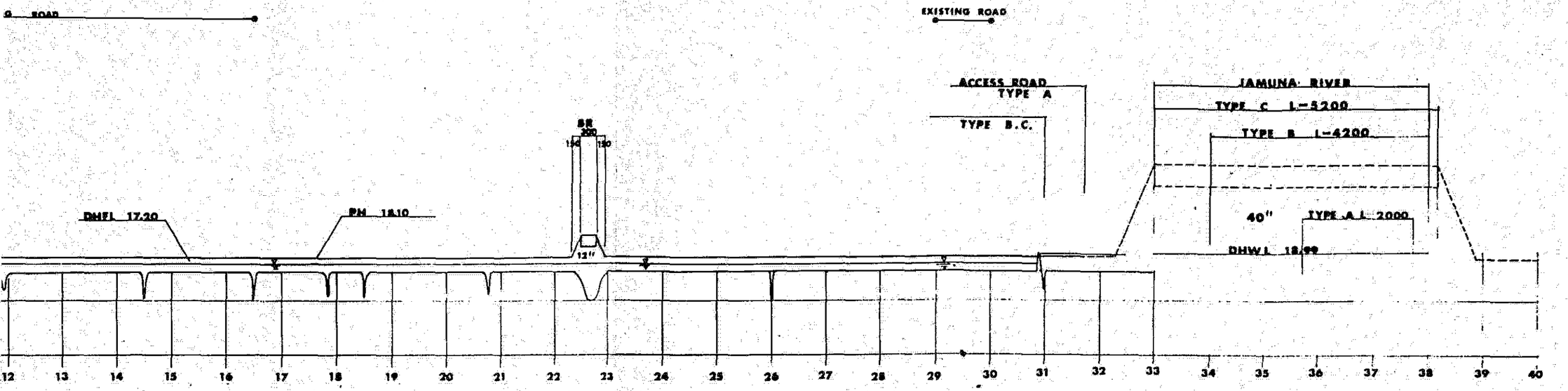
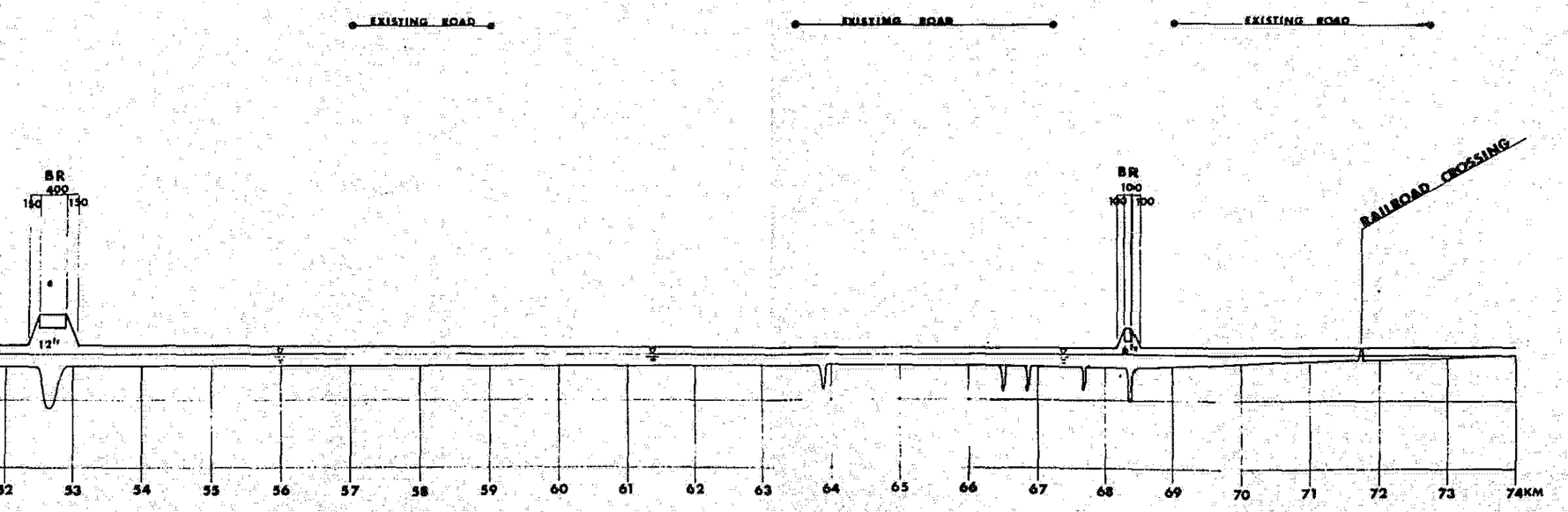
GABARGAON SITE









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Approved	Date
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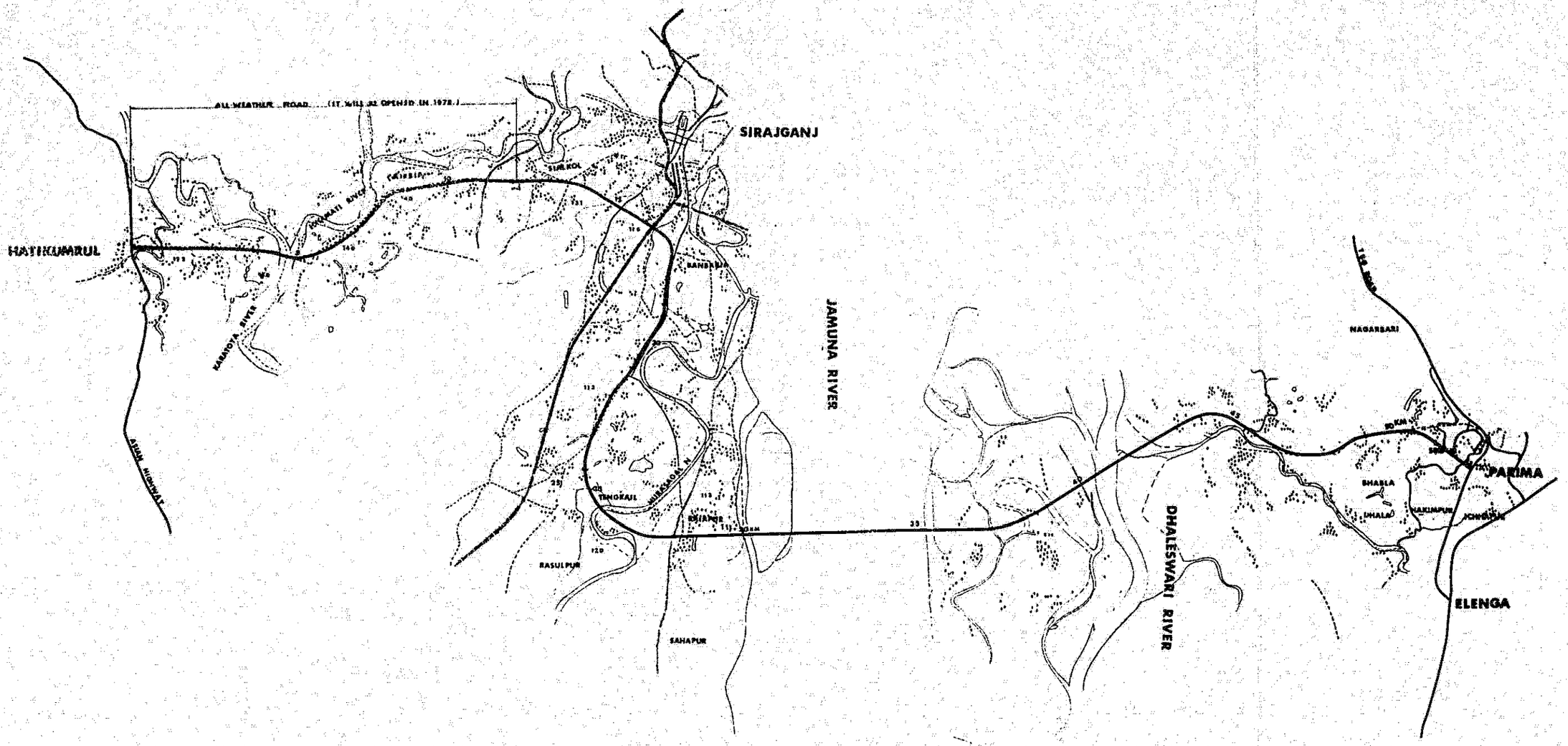

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JAMUNA RIVER BRIDGE PROJECT SIRAJGANJ SITE ACCES ROAD VERTICAL ALIGNMENT	
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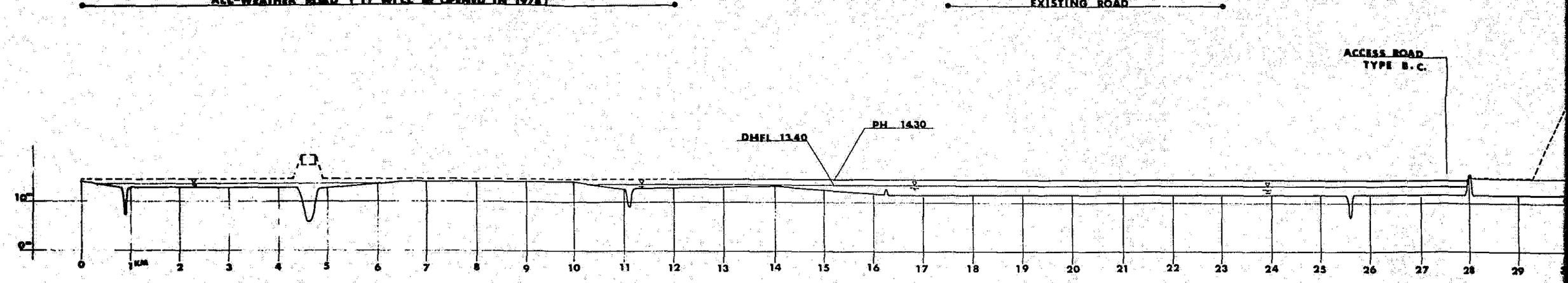
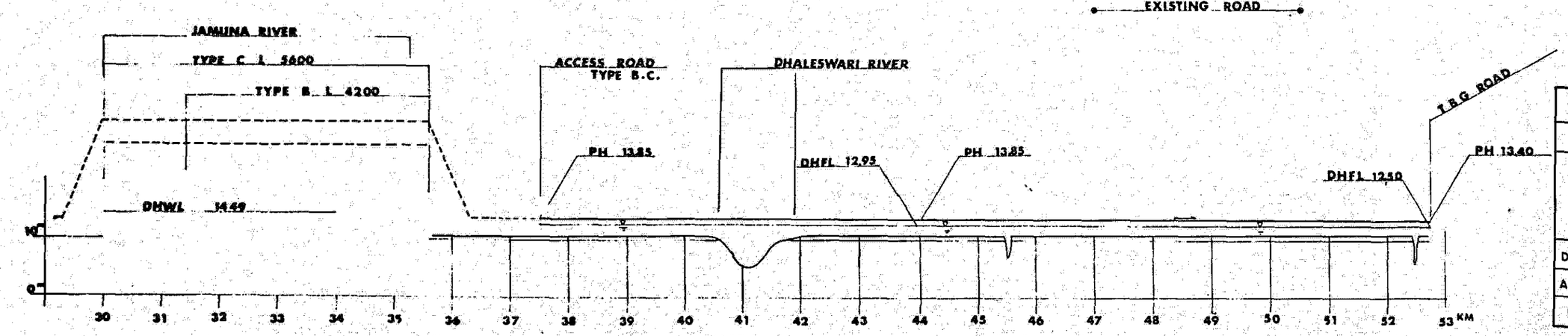
SIRAJGANJ SITE
TYPE B.C.





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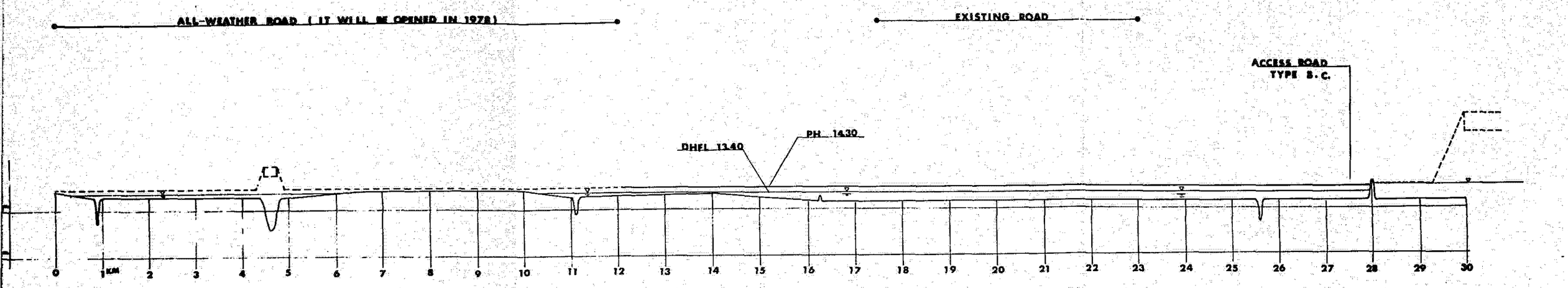
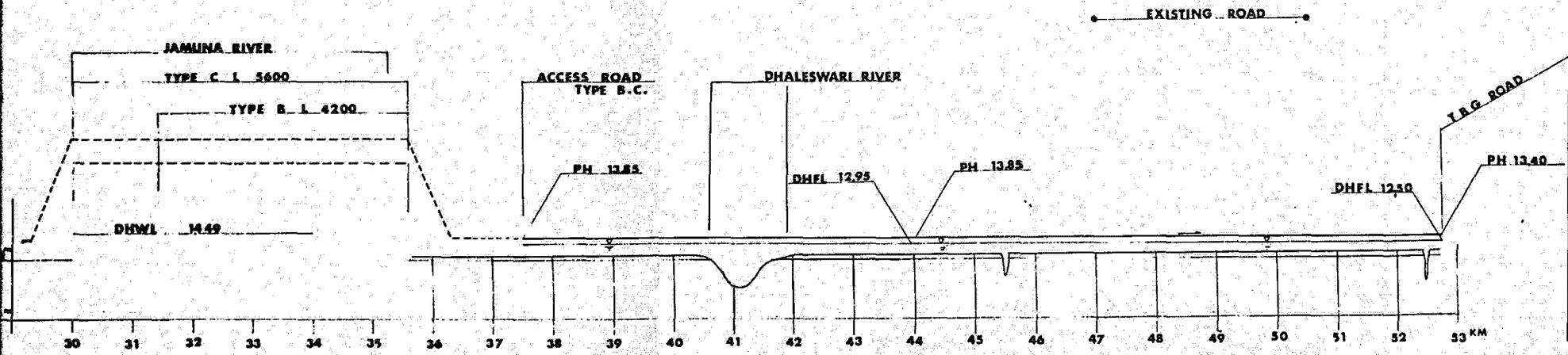
MITSUI CONSULTANTS CO., LTD.	F

SIRAJGANJ SITE
TYPE B.C.





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PEOPLE'S REPUBLIC OF BANGLADESH	
JAMUNA RIVER BRIDGE PROJECT SIRAJGANJ SITE ACCESS ROAD VERTICAL ALIGNMENT	
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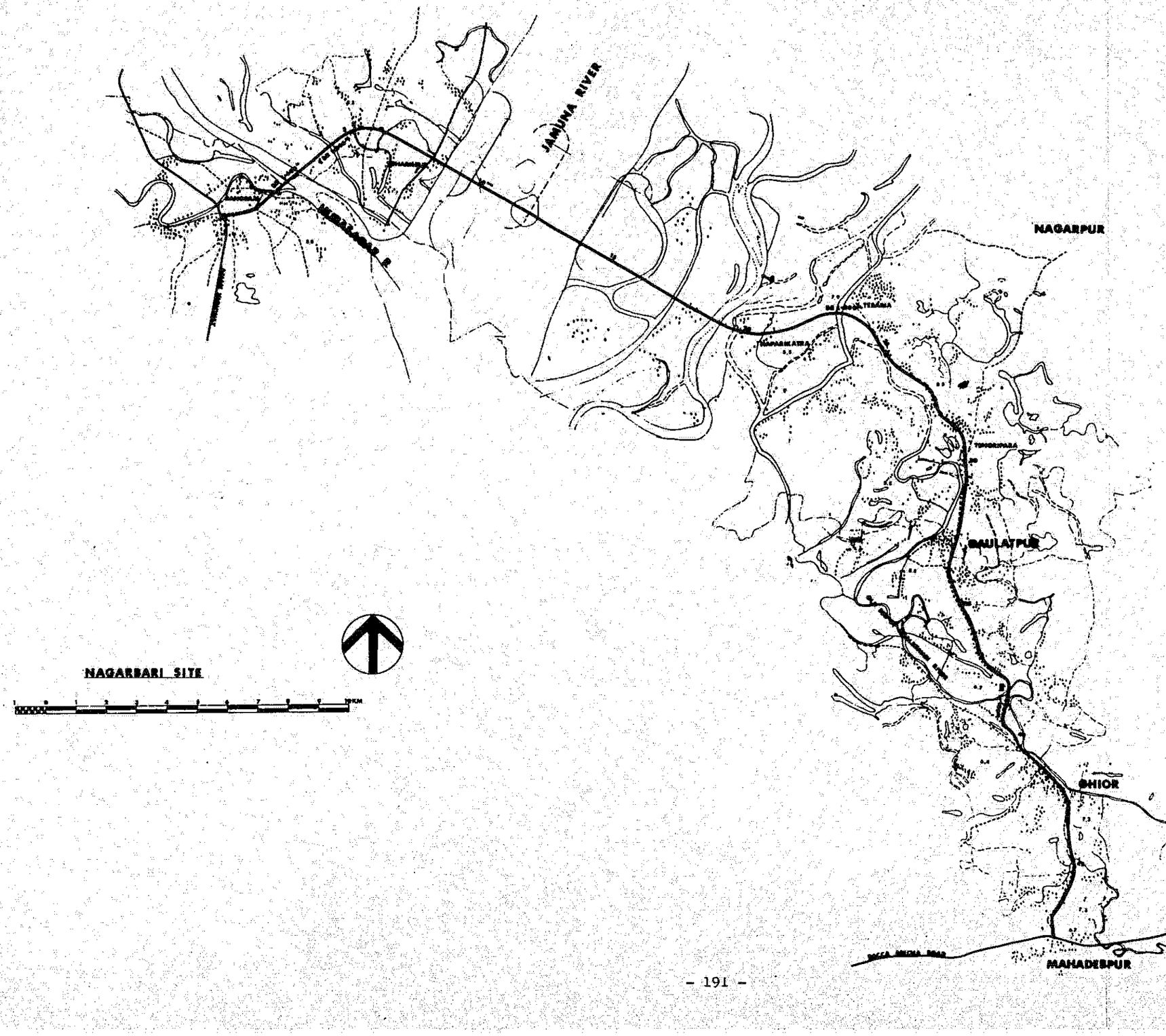
JAMUNA RIVER
NAGARPUR
DAULATPUR
SHIOR
MAHADEBPUR
NAGARBARI SITE
0 1 2 3 4 5 6 7 8 9 10KM
JAPAN INTERNATIONAL COOPERATION AGENCY
PEOPLE'S REPUBLIC OF BANGLADESH
JAMUNA RIVER BRIDGE PROJECT
NAGARBARI SITE
ACCESS ROAD HORIZONTAL ALIGNMENT
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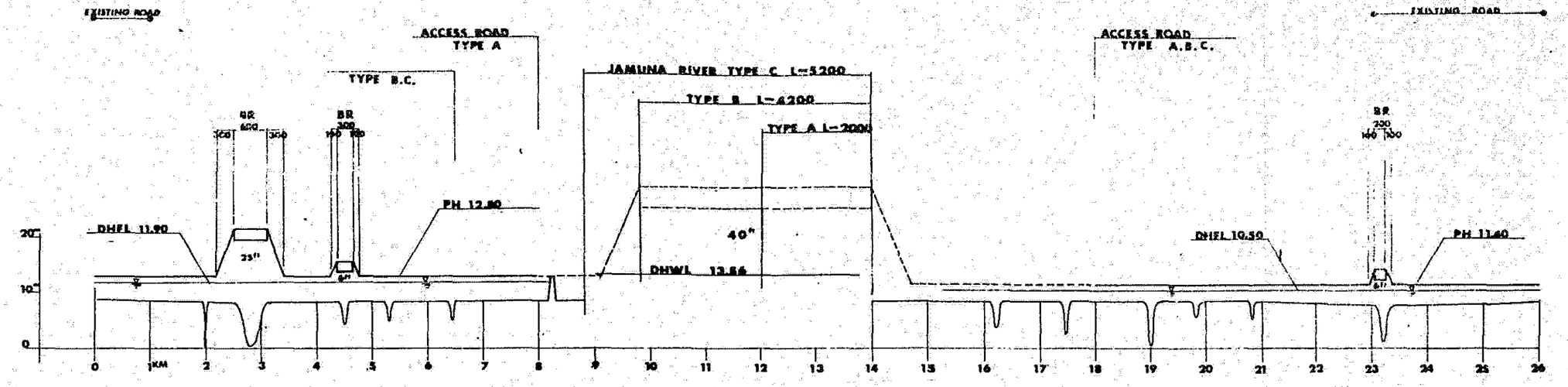
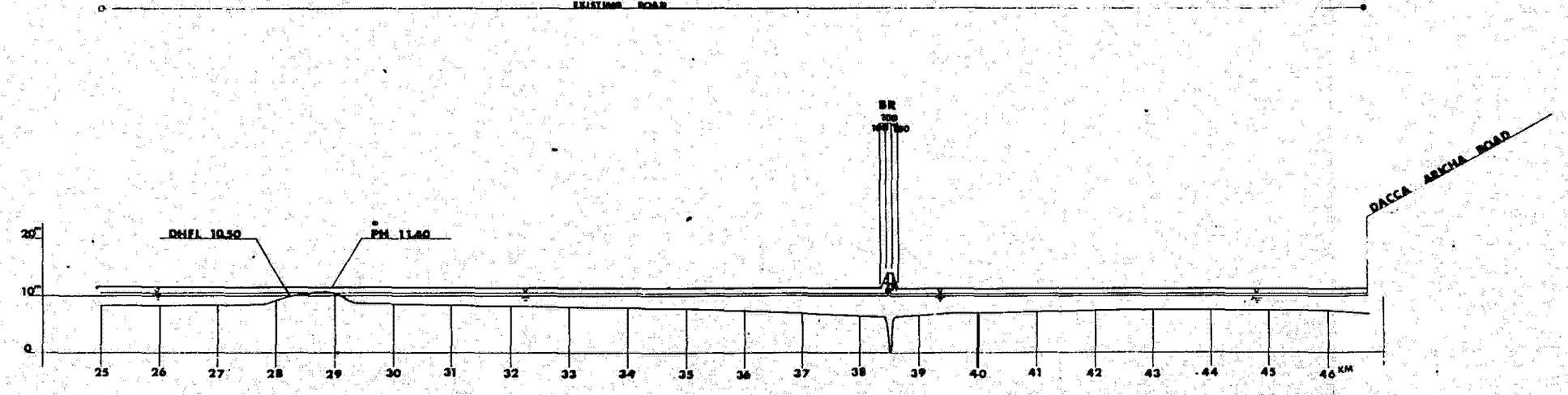
No.7-9

NAGARBARI SITE





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PEOPLE'S REPUB	
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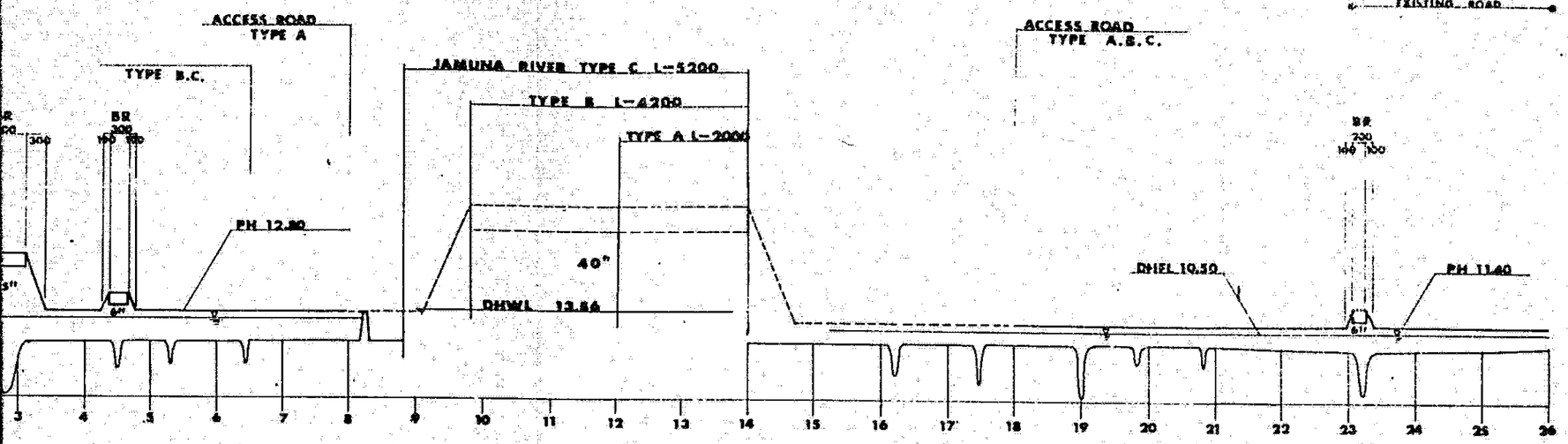
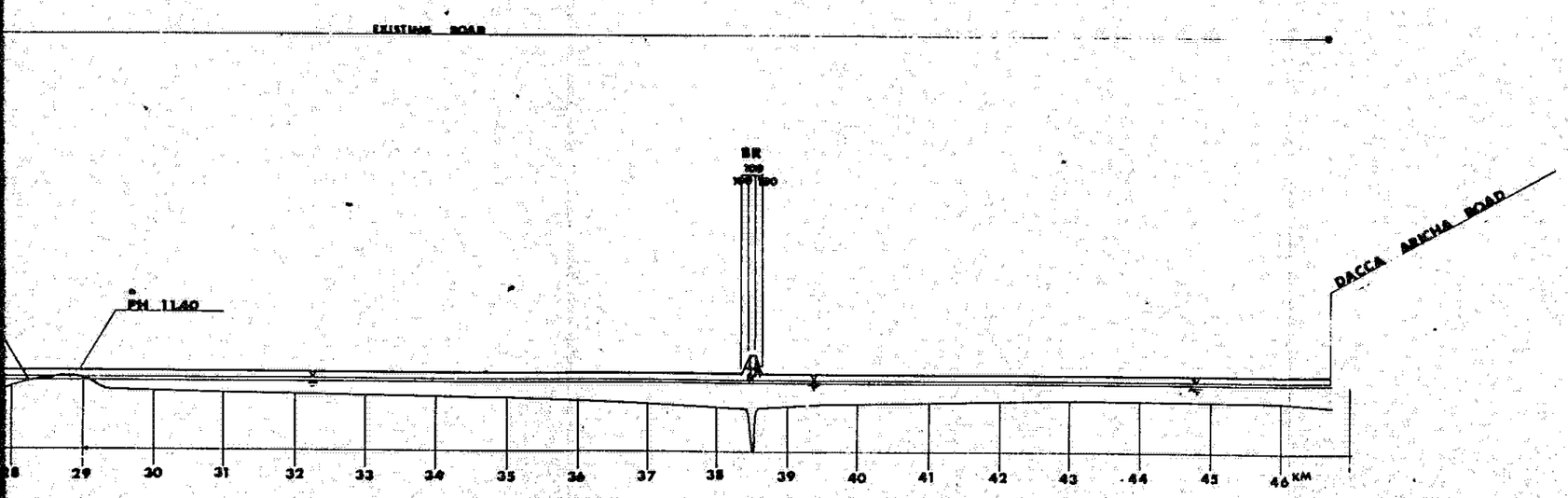
MITSUI CONSULTAN	





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Approved	Date
MITSUI CONSULTANTS CO., LTD.	Fig. 7-10

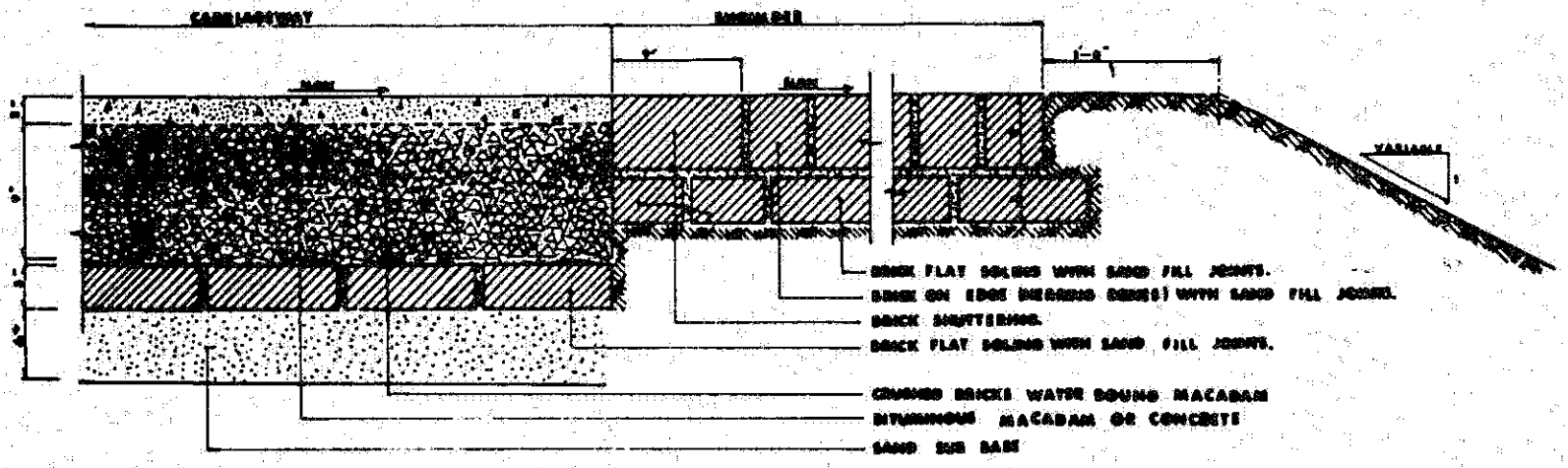
Table 7-4 LIST OF SPILLWAY & BRIDGE OPENINGS

KALIGANGA RIVER — ARICHA ROAD

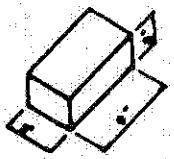
DISTANCE	EXISTING & PROPOSED STRUCTURE LENGTH	
	SPILLWAY & BRIDGE L<100 m	REMARKS
0 – 1.6km	FERRY CROSSING	666.0m UNDER CONSTRUCTION KALIGANGA BRIDGE
〃	18.3m TEE – BM	
1.6 – 3.2km	24.4m 2 SPAN TEE – BM	
3.2 – 4.8km	36.6m 3 SPAN TEE – BM	
〃	24.4m MULTI-SPAN BOX CUL	
〃	90.0m	PROPOSED SINGLE UNIT "OVERLAND FLOW"
4.8 – 6.4km	24.4m 2 SPAN TEE – BM	
〃	30.5m MULTI-SPAN BOX CUL	
6.4 – 8.0km	18.3m TEE – BM	
8.0 – 9.6km	50.0m 3 SPAN TEE – BM	PROPOSED SINGLE UNIT "OVERLAND FLOW"
〃	90.0m	
9.6 – 11.2km	18.3m TEE – BM	
〃	36.6m MULTI-SPAN BOX CUL	
11.2 – 12.8km	50.0m 3 SPAN TEE – BM	
12.8 – 14.4km	18.3m TEE – BM	
14.4 – 16.0km	50.0m 3 SPAN TEE – BM	
16.0 – 17.6km	42.7m MULTI-SPAN BOX CUL	
〃	18.3m TEE – BM	
17.6 – 19.2km	30.0m MULTI-SPAN BOX CUL	
〃	50.0m 3 SPAN TEE – BM	
〃	24.3m MULTI-SPAN BOX CUL	
TOTAL	745.4m	

$$\frac{745.4\ m}{19.2\ km} = 0.039 \doteqdot 4\ \%$$

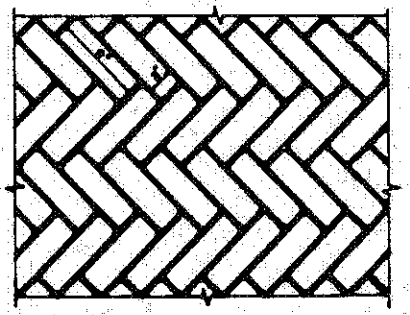
Fig. 7 – 11 TYPICAL PAVEMENT SECTION



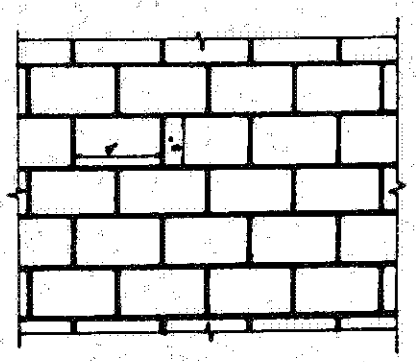
BRICK



BRICK ON EDGE (HERRING BONE)



BRICK FLAT SOLING



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CHAPTER VIII

STUDY OF FERRY

1. Ferry Crossing Routes and Points.

The many ferries that are operated over the main rivers and the tributaries of the Jamuna River may be classified by the operating bodies as follows:

Bangladesh Inland Water Transport Corporation ferry

Road and Highway Directorate road ferry

Private party road ferry

Bangladesh railway river ferry

Others

These ferries cater to the domestic trunk route transportation as well as local transportation. The locations of the routes and the crossing points of these ferries are as shown in Fig. 8-1.

(1) Bangladesh Inland Water Transport Corporation ferry.

The Jamuna River confluences with the Ganges River, which flows down from the west, in the vicinity of Aricha, from where the river flows in a southeasterly course in the name of Padma River.

The trunk roads which lead from the capital city of Dacca to the northwest and the southwest region of Bangladesh are connected with the ferries operated from Aricha by the Bangladesh Inland Water Transport Corporation, as the Jamuna River and the Padma River route ferries.

1) Jamuna River route .

   a. Aricha - Nagarbari route

2) Padma River route .

   a. Aricha - Goalundo (Doulatdia) route

   b. Aricha - Tepurakaadi route

FIG.8-1 MAP OF ROUTES AND CROSSING POINTS OF FERRIES

SCALE

Miles 5 4 3 2 1 0 5 10 Miles

Metres 5000 0 5000 10000 15000 Metres

89°15' 89°30' 89°45' 90°0' 90°15' 90°30'

25°15' 25°0' 24°45' 24°30' 24°15' 24°0' 23°45'

To Rangpur

Phulchari Ghat

Bahadurabad Ghat

KARATOA R

Gabindganj

Shaghatta

Mahimagani

Tistamukh Ghat

Diwanganj

BRAHMAPUTRA R

JAMALPUR

BANGALI R

CHATAL R

Char Adjapara

Char Chandra

Sharakandi

Gabtali

Gunaritala

Sabargaon

BOGRA

JAMUNA RIVER

MYMENSINGH

Sarishabari

Sherpur

ICHAMATI R

Jagannathganj Ghat

To Dacca

Sirajganj Ghat

Nalkasen Gant (under construction)

SIRAJGANJ

Gopalganj (under construction)

Hatikumrul

KARATOYA R

Kalibati

Ulapara

TANGAIL

Porabari

Charban (under construction)

To Mymensingh

To Ishurdi

BARAL R

GOHALA R

Shan-zadpur

Sonatani

Baghabari Crossing

HURASAGAR R

Nagarpur

DHALESWARI R

BANSI R

Nayarhat Crossing

To Chittagon

Kasinathpur

Nagarbari Ghat

Aricha Ghat

Ghazikhali

TUNGI

TURAG R

Uthali

Manikganj

Sibalay

Taraghat Crossing

Sabhar

GANGES RIVER

Goalundo Ghat

Mirpur

Mirpur Crossing

RAJBARI

KALIGANGA R

DACCA

To Chittagon

GANGES OR PADMA RIVER

DHALESWARI RIVER

Tepurakandi Ghat

FARIDPUR

To Jessore

To Barisal

LEGEND

Rail Way (broad gauge)

—do— (meter gauge)

Road (paved, all weather)

—do— (unpaved)

B.I.W.T Corporation Ferry Ghat

R&H Directorate Ferry Crossing

Private Party Ferry Crossing

Bangladesh Rail Way Ferry Ghat

(2) Road and Highway Directorate Road ferry.

In August 1973, there were about 40 ferry crossing points of various sizes for the national highway network under the control of the Road and Highway Directorate.

The Road and Highway Directorate ferry crossing other than the Jamuna River crossing are on the Dacca - Aricha and the Nagarbari - Bogra trunk roads.

The locations of the routes and ferry crossing are as follows:

1) Dacca - Aricha trunk road.

a. Mirpur crossing (Turag River)

b. Nayarhat crossing (Bangshi River)

c. Taraghat crossing (Kaligana River)

2) Nagarbari - Bogra trunk road.

a. Bagabari crossing (Baral River and Gohala River)

(3) Private Party ferry.

The access to the Jamuna River bank depends almost on either the District Council or the Kutcha roads. The road bed and road surface conditions of almost all of these roads are such that vehicle traffic is difficult even during the dry season. Consequently almost all ferry crossing on these local roads are operated on a small scale by private parties and the objective is no more than serving bullock cart and pedestrian traffic.

The points of ferry operation on the east bank of the Jamuna River are limited to the Dhaleswari River and the Chatal River, while those on the west bank are the Karatoa River, the Bangali River and the Katakari River, all of these being medium size rivers.

(4) Bangladesh Railway ferry.

The railway routes of the Bangladesh Railway may be classified by the gauge of track into two classes.

The railway system is separated by the Jamuna River into east and west, and generally the west side is of broad gauge while the east side is of meter gauge.

These two completely divided regions are connected by railway ferries at the following routes.

1) Tistamukh - Bahadurabad route.

The Tistamukh on the west bank and the Bahadurabad on the east bank are both terminals of meter gauge.

2) Sirajganj - Jagannathganj route.

The Sirajganj terminal on the west bank is of broad gauge, while the Jagannathganj terminal on the east bank is of meter gauge.

2. Bangladesh Inland Water Transport Corporation Ferry.

(1) Route of operation.

1) Jamuna River Route.

This route joins Aricha on the east bank of Jamuna River with Nagarbari on the east bank about 12 miles upstream.

The Aricha ghat is situated at the terminal of the Dacca - Aricha trunk road on the east river bank of the Jamuna River. In the past there has been no changes of physical conditions by erosion or siltation, and the location of the ghat has for a long period remained very stable. The ghat is at the same location for both the rainy and dry seasons.

The bank on which the Nagarbari ghat is situated is a strip of land which has long been under erosion so that it has now been pushed backwards to a point about 3 miles away from the junction of the Kashinathpur road.

The river bank is unstable, and the ghat has to be shifted to and fro along the river bank. At present, the location of the ghat is different between the rainy and dry seasons.

In the rainy season, the terminal of the Nagarbari Bogra trunk road directly faces the Jamuna River. However, in the dry season, the river dries up to a great extent and the ghat is closed.

The dry season ghat is established at the end of the dried up zone about 1 mile upstream.

2) Padma River Route.

Aricha - Goalundo (Daulatdia)

Aricha - Teprakandi

The above service routes are mutually complementary to each other according to the changes in condition of operation during the rainy and dry seasons.

The route and the position of the ghat have to be greatly

changed between the rainy and dry seasons at the Goalundo ghat.

In the dry season, the char land along the west bank of the Padma River dries up for a span of about 3 miles between Goalundo and the main stream of Padma River. Therefore, the Daulatdia ghat has been newly opened about 4 miles downstream from Aricha during the dry season, and the ferry service is operated up to this point. From this point to Goalundo, a dry season road of about 5 miles in length runs over the char land, and then a creek of about 350 ft. in width has to be ferried over by a marboat operated by the Road and highway Directorate. Also, the ferry service operated by the R & H Directorate at the Daulatdia crossing is seasonal, and the marboat allocated may serve only light vehicles up to small buses and small trucks. Therefore the Aricha - Daulatdia route is a ferry service only for light vehicles during the dry season and the transportation of heavy vehicles during this period depends on the Archia - Teprakandi route.

During the rainy season the char lands along the west bank of Padma River are flooded and the Daulatdia ghat is closed, while a Goalundo ghat is established at the terminal of the Goalundo - Faridpur road.

The Teprakandi route is situated along the secondary water channel which cuts deeply across the char land. A dry season road of about 1.5 miles in length connects this point with Faridpur.

The service from Aricha along this route is a long route of about 17 miles in length and is operated in both the rainy and dry seasons, but the one-day round-trip operation of the

ferry is very straining.

This route forms the main service route of the Padma River route during the dry season, but becomes only a secondary service route during the rainy season, because this route is inferior to the Aricha - Goalundo route in travel distance and travel time.

(2) Present status of ferry operation

Transition of ferry transportation on both Padma and Jamuna routes are shown in Table 8-1.

As seen in Table 8-1, the total traffic volume doubled each year until 1967, according to the increase in the number of ferries, but it does not show drastic increases after the number of ferries was stabilized at five.

However, the average annual utilization ratio of ferries after 1967, is estimated to have been a considerably high percentage (50 to 70%), taking the capacity of ferries into account.

From this observation, it may be concluded that potential demand for cross river traffic on Jamuna and Padma routes is considerably high, and that the volume of cross river traffic was always restricted by the capacity of ferry transportation.

Table 8-1

Passenger and Motor Vehicle Traffic Volumes

		Jamuna route	Padma route	Total
1965	Passengers	*67.0	100.0	167.0
	Motor vehicles	4,368	3,785	8,153
1966	Passengers	111.7	161.9	273.6
	Motor vehicles	9,854	8,121	17,975
1967	Passengers	244.6	306.0	550.6
	Motor vehicles	18,991	15,134	34,125
1968	Passengers	307.9	409.4	717.3
	Motor vehicles	25,193	17,461	43,072
1969	Passengers	345.6	417.0	762.6
	Motor vehicles	25,193	15,299	40,492
1970	Passengers	388.2	429.6	817.8
	Motor vehicles	26,011	14,760	40,771

* In thousands.

1965 : 2 ferries + 1 standby ferry
1966 : 3 " + "
After 1967 : 5 " + "

According to B.I.W.T.C., traffic levels in 1973 are expected to be 750,000 passengers/year and 45,000 motor vehicles/year.

To this effect, seven car ferries are presently employed for the Jamuna and Padma river routes, both of which hold Aricha as key transportation base.

All are car ferries which require normal ship operation

techniques, and are classified into 140, 120, and 95 ft class, according to the vessels length.

Nine round trips, by seven ferries, are provided for the Jamuna and Padma routes as normal day services during the dry season, as shown in Table 8-2.

Though these ferries are operated on a fixed time schedule, delay is remarkable and the schedule is always unstable.

Cycle operation times shown in Table 8-2 is under normal conditions, but it easily fluctuates and increases when the number of mixed loadings of heavy and light vehicles increases, and car accidents and other troubles during loading and unloading occur at the ghats.

For example, at times one cycle time for 140 ft class ferries on the Aricha - Nagarbari route is as much as seven hours and thirty minutes.

Normal day ferry services during the dry season on the Jamuna and Padma routes are as stated above, but temporary increase of ferry services, by over-time work, is often employed during traffic peaks.

Table 8-2

Normal day Services of Ferries During the Dry Season

Route	Operation frequency	Necessary time for navigation toward upstream and downstream
Aricha - Nagarbari		
Two ferries of 140 ft class	Two round trips	Up : 3.5 hours (2.5) Down : 3.0 hours (2.0)
Two ferries of 95 ft class	Two round trips	Up : 3.0 hours Down : 2.5 hours

Route	Operation frequency	Necessary time for navigation toward upstream and downstream
Aricha - Daulatdia		
One ferry of 95 ft class	Three round trips	Up : 65 minutes (45) Down : 50 minutes (30)
Aricha - Teprakandi		
Two ferries of 120 ft class	Two round trips	Up : 4.5 hours (4.0) Down : 4.0 hours (3.5)

Note 1. Times do not include waiting time.

2. Times shown in parenthesis are net cruising times.

At these times, priority is normally given to passenger transportation (passenger cars, buses, etc.) at each ghat, and trucks are often left without being loaded on the vessels.

This results in a river crossing pattern of trucks arriving at ghats in the evening and being loaded on the first vessels the next morning. Taking Aricha - Nagarbari route for example, the number of trucks waiting overnight and being loaded on the vessel early the next morning are 30 to 40 at each ghat.

In other words, shortage of ferry transportation capacity results in increased waiting time by vehicles at each ghat, and peak traffic is presently handled in the manner explained above.

(3) Vessel.

Ferries of 140 ft class have spacious deck areas, and the decks are rectangular shaped. Therefore, deck areas can be very effectively utilized.

It is possible to load 7 ton trucks, and it is also possible to arrange loading of only heavy vehicles. However, the side boarding

system is inconvenient for arranging loaded vehicles on deck, and it takes much time and elaboration for the unloading of vehicles. Since the number of vehicles to be handled is large, this situation has considerable impact on time and duration necessary for loading and unloading. Normally it takes 60 minutes to load or unload 28 vehicles when the capacity of each ferry is 14 vehicles. Usually the loading of heavy and light vehicles is intermingled. In this case, the normal number of vehicles loaded on each ferry of the above capacity, increases to 23 to 24 vehicles. This means the handling of 46 to 48 vehicles, and the time required is about 80 minutes.

The 95 ft ferry is not efficient, as it requires a crew of 15 or 16, and can load only two trucks and two cars.

Moreover, this class vessel is not of ample tonnage to handle heavy vehicles, and since loading and unloading of heavy vehicles by the side boarding system creates rolling, it is impossible to handle 7 ton trucks.

(4) Ghat .

The present situation of the ghat system greatly influences ferry operations.

Typical ghat facilities are;

Steel pontoon + Wooden gang planks + earthen slope.

The earthen slope engraved in the river bank becomes a poor surfaced steep slope during the dry season. This causes remarkably severe conditions for fully loaded trucks to climb after unloading from the vessel, and it is not rare that delays of 30 minutes occur due to truck accidents. Extra ferry services scheduled during cross river traffic peaks are often confused due to the delay of the regular service and overcrowding of berths as a result of delays. In addition, there are substantially no waiting lanes for vehicles at the ghats, loading disorders occur, and this causes another reason for delay in loading and unloading of vehicles.

3. Road and Highway Directorate Ferry

(1) Point of operation.

1) Mirpur crossing

This is the first ferry crossing from Dacca on the Dacca - Aricha trunk road which is authorized as the Asian Highway. At this crossing, there is an old and worn steel bridge of 10 ft in width, this being passable only for light traffic. Heavy traffic of over 5 tons in gross vehicle weight has to cross the river via the ferry.

During the dry season, the span of water surface narrows to 300 ft and the water depth is shallow.

2) Nayarhat crossing

This ferry crossing is operated stably throughout the year and is a crossing with few problems.

During the dry season the span of the water surface is about 400 ft, and there is sufficient water depth for ferry operation.

3) Taraghat crossing

This is the last ferry crossing on the Dacca - Aricha truck road and is the one of the most difficult to operate.

This is due to the characteristics of Kaliganga River at this location.

The Kaliganga River, together with the Dhaleswari River, form the outlet of flood discharge of the Jamuna River. During the rainy season, the span of water surface widens, the river flow becomes rough, the flow velocity increases, and both banks are eroded by the water.

When the flow velocity reaches 5 knots per hour, ferry operation becomes impossible under such strong current, and service is terminated. Consequently, during dry season, most of the river

bed is dried up, and the necessary water depth for ferry operation is virtually not sufficient, so that it is often necessary to alter the points of river crossing.

4) Bagabari crossing.

This ferry crossing is the only cross river point along the Nagarbari - Bogra trunk route and is situated some 7 miles south of Ulapara.

At this point, the Gohal River and the Baral River flow parallelly from west to east, with a river span of respectively 500 - 600 ft.

The water depth of the two rivers at this point is rather shallow during dry season and both the banks are very stable. However, this is a very difficult crossing for ferry operation due to the presence of the char land lying between the rivers.

Nowadays, a channel of 80 ft. in water surface span is dug across the char land to connect the two rivers during dry season.

Neverthless it is not possible to maintain a water depth of over 4 ft. for this connecting channel during dry season.

(2) Present situation of ferry operation

1) The river crossing motor vehicle traffic volumes at the ferry crossings, according to the statement of the Road and Highway Directorate, are as in Table 8-3.

Table 8-3 Daily Average Number of Gross River Vehicles (Aug. 1973)

Crossing	Total
Mirpur	237
Nayarhat	442
Taraghat	256

However, the Mirpur statistics does not include such light vehicles as passanger cars, auto-rickshaws, and motorcycles. The allocation of vessels for services to the traffic at the ferry crossings is composed of the Type C Unifloat ferry, the 36 ft class steel ferry and the powered marboat, being respectively operated at continuous circle.

The operating time of the Road and Highway Directorate ferries is generally from 6 a.m. to 10 p.m. and ferries are operated without a fixed schedule. The ferry crossings along the Dacca - Aricha trunk road are operated 24 hours daily by 3 shifts.

2) The traffic volumes of motor vehicles across the Bagabari crossing, according to the traffic census in 1973, are as in Table 8-4.

Table 8-4 Average Daily Traffic Volume (July 1973)

Direction	Heavy vehicle	Light vehicle	Total
Kashinathpur	62	62	124
Shahazadpur	64	61	125
Total	126	123	249

To cope with this traffic demand, 11 ferries are allocated to this ferry crossing and operated in 2 shifts from 6 a.m. to 10 p.m.

The situation of operation during the dry season is as follows. That is, light vehicles are transported by marboats through the connecting water channel so that the right bank of Baral River and the left bank of Gohala River are directly connected. For the transportation of heavy vehicles, a steel ferry is allocated at the Baral River and a unifloat is allocated at the Gohala River, and the central char land is traversed on land to form a two-ferry two-crossing system. In other words,

the connecting water channel does not have sufficient width for the travel of multiple ferries, the water depth is not sufficient for the sailing of steel ferries and the channel is used primarily for light vehicles. This culminates in overburden of the heavy vehicle route so that the deficiency in transport facility of the steel ferries of Baral River becomes a bottle neck at the crossing, and during peak hours congestion occurs and the crossing of the river takes more than 40 minutes. However, during rainy season the water level raises to over 10 feet above the char land, and it is possible for both light and heavy vehicles to be ferried directly across the river.

The service elements during dry season are as shown in Table 8-5.

Table 8-5 Service Elements (Dry season)

Route	Frequency	Time required for Crossing
Light vehicle	50 return trips/day	10 - 30 minutes
Heavy vehicle	80 return trips/day	40 - 70 minutes

(3) Vessel.

The Unifloat, as a vessel capable of handling heavy vehicles, was introduced into service immediately after the liberation. The vessel is robust, stable and agile, and its service drastically reduces travel time for river crossing. In river crossing, this vessel now forms the most up-to-date transportation system.

Steel ferries have been in service for 13 years, but are suitable for safe transportation of vehicles of only up to 3-tons.

The use of steel ferries for the transportation of heavy traffic is already exceeding safety limits from the point of increase in traffic volume. Today, the operation of the ferry service is in a very dangerous state, and does not match the demand for heavy vehicles.

a. Vigorous rolling occurs during the loading and unloading of heavy vehicles, and the situation is extremely dangerous.

b. The difference in height between the ferry deck and the pontoon deck is not uniform along the whole length of the vessel. For this reason, the method of using wooden gangplanks is time consuming and is also dangerous.

c. Since the loading and unloading of vehicles is through the side boarding system, the direction of the ferry has to be adjusted according to the direction of the vehicles when it pulls alongside. The vessel therefore has to cross the river in an S-shaped route, which is very time consuming.

When marboats are mechanically equipped, they are agile and easy to operate. These vessels are economical for the transportation of light vehicles, and are used along the trunk roads specifically for the transportation of light vehicles.

However, the engine power of the marboat is small, and, being a wooden vessel, it is not equipped with permament ramp boards. It is dangerous for operation in rough water or in poor weather.

(4) Ghat.

Regarding ghat facilities; due to the drastic seasonal change in water level, it is not posssible to provide permanent facilities, and all the existing facilities are in very poor condition.

As described below, ghat facilities are greatly varied, and differ according to the crossings or, even at the same crossing, according to whether it is a heavy vehicle route or a light vehicle route, Variations are also made to suit the topographical conditions.

a. Steel pontoon + steel gangway + earthen slope

b. Steel pontoon + wooden gangplanks + earthen slope

c. Wooden deck jetty + earthen slope

d. Earthen stage approach + earthen slope

All these approach-landing facilities are of the movable type, and must be adjusted to the changes in water level between the dry and rainy seasons.

4. Private Party Ferry.

(1) Point of operation.

1) East Bank Region.

a. Tangile - Nagarpur road route.

The ferry crossing on this route is at the Dhaleswari River. The right bank is steep and hanging, while on the left bank an extensive siltation is underway. During the dry season the span of water surface is about 500 ft., and a water depth of about 12 ft., while the water remains virtually stagnant.

b. Tangile - Charbari road route.

Between Charbari, the terminal of this route, and Porabari on the char land, private party ferries are now operated during the rainy season.

The distance between banks is about 3,300 ft., but the water surface span of about 170 ft. may be forded during dry season.

c. Jamalpur - Gabargaon road route.

There are three ferry crossings along this route. The first crossing is at char Chandra, 3 miles from Jamalpur. At a distance of 6 miles from this point there is a ford at Char Adiapara, where ferry service is operated during rainy season. During the dry season a temporary road across the ford is established by private party.

The last crossing is at Chatar River 1 mile further away from this point.

It is very shallow along both banks and the water surface span is about 300 ft. during dry season.

d. Jamalur - Bahadurabad road route.

On this road there is a ford at Char Bani, 4 miles from Jamalpur which is served by ferry during rainy season.

During dry season the ford is traversed by a temporary road established by private party.

2) West Bank Region.

a. Shahzadpur - Sonatani road route.

The ferry crossing on this route is at Karatoya River which is only one mile from Shahzadur. The left bank is of slope surface while the right bank is very shallow. The water surface span during dry season is about 250 ft. and the water depth is shallow.

At Hurasagar N River, 6 miles from Shahzadpur, the river bed dries up during dry season, but ferries are operated during rainy season.

b. Hatikumrul - Sirajganj road route.

The ferry crossing is at Nalkasenganti of Karatoya River, 3 miles from Hatikumrul. This point is immediately downstream of the confluence of Karatoya River and Ichamati River. During dry season, the water flows along the left bank while the right bank forms a very gradual slope. The water surface span is 500 - 700 ft., the water is almost stagnant, and the water depth at the crossing is rather shallow.

c. Bogra - Shariakandi road route.

The ferry crossing is at the Bangali River, 8 miles from Gabtali. During dry season the water surface span is about 250 ft., with extensive siltation on the left bank and steep and hanging cliff-like surface on the right bank. Water flow during rainy season is strong.

d. Gobindganj - Shaghatta road route.

The ferry crossing is at Katohari River, 1 mile from Mahimaganj. During dry season, the water surface span is about 250 ft., the water is almost stagnant, and the slopes on both banks are very gradual. The water flow is not

strong even during rainy season.

(2) Present situation of ferry operation.

The traditional manually rowed Catamaran type vessels called marboats form the main stream of the ferries are now operated by private party, and are used for the transportation of bullock carts and pedestrians. This vessel has a wooden double hull body of 33 - 44 ft. in length with a bamboo deck, and is not suitable for transportation of motor vehicles.

This may be said of the present situation of ferry allocation. In the east bank region of the Jamuna River, reflecting the low traffic demand, almost all the ferry crossings are using 1 marboat for service. Traffic demand is comparatively larger in the west bank region, so that besides 1 marboat, a single type wooden boat is supplementarily used specifically for transportation of pedestrians. These are about the standard ferry vessel allocation in this river region.

The operation by private party is generally from 5 a.m. to 11 p.m. on a two shift system to meet actual traffic demand and without a fixed schedule. The frequency of service of a marboat at a typical ferry crossing is about 50 return trips per day.

However, in the medium and minor rivers in the Jamuna River region, many suffer drastic reductions of water during the dry season, so that ferries cannot be operated, and the crossings are turned into fords.

At crossing where the water depth at the fords presents difficulties of crossing by bullock carts and pedestrians, it is customary for some embanking to be carried out by private party to establish temporary roads in the place of ferry service and tolls are charged for the crossings.

During the rainy season (May - November), ferry operation is said to be possible even when the water current is strong.

CHAPTER IX

ECONOMIC AND TRAFFIC STUDY

1. General.

This chapter covers the results of the traffic study which has been done so far and provides the first trial quantifications of the future traffic crossing the Jamuna since the Tokyo meeting.

There still remains much to be discussed on the estimated traffic, for which many assumptions had to be set up. Due to the lack of necessary data and information, the Traffic Study Team had requested more information through the agenda for the Tokyo meeting in September 1974. The required information is expected to be available before or after the Dacca meeting in October 1974. The factory survey by the Jamuna Bridge Survey Office has been completed.

Those new data and information will be fully incorporated into the traffic study in the next stage. Therefore, it must be kept in mind that the results from this study will not fully represent the level and characteristics of future traffic across the Jamuna. A more detailed study by repetition concerning traffic and the economy will be going on. The results will be presented in the succeeding reports.

Section 2 explains the traffic forecasting method used for this study. Rate of population growth and economic index, which would be closely interrelated in an emerging economy, are briefly stated in Sections 3 and 4, respectively. Section 5 deals with the forecasted passenger

traffic and Section 6 with the forecasted commodity traffic crossing the Jamuna. In Section 7 the assumptions for converting the forecasted traffic into modal capacity are discussed for the succeeding study.

2. Method of Traffic Forecast.

In order to predict future traffic, passenger movements and commodity flows crossing the Jamuna, analyses were made of the findings and information of the existing network of transportation facilities, the regional economy, the volume and the results of the site survey of traffic crossing Jamuna River to calculate the present traffic volume crossing the river. On the basis of the above study results, a forecast of passenger movements and commodity flows was made by taking into full consideration the future plans of Bangladesh, especially, the First Five Year Plan, etc. From the forecasted traffic, the future passenger movements and commodity flows for all alternative bridge sites were estimated with factors relevant to each bridge site taken into consideration. And finally, the probable future traffic crossing the Jamuna was distributed among the competing modes of transport for each alternative route.

Figures 9-1 and 9-2 illustrate the forecasting process of passenger movement and goods flow, respectively.

Figure 9-1

FORECASTING PROCESS FOR PASSENGERS ACROSS THE JAMUNA

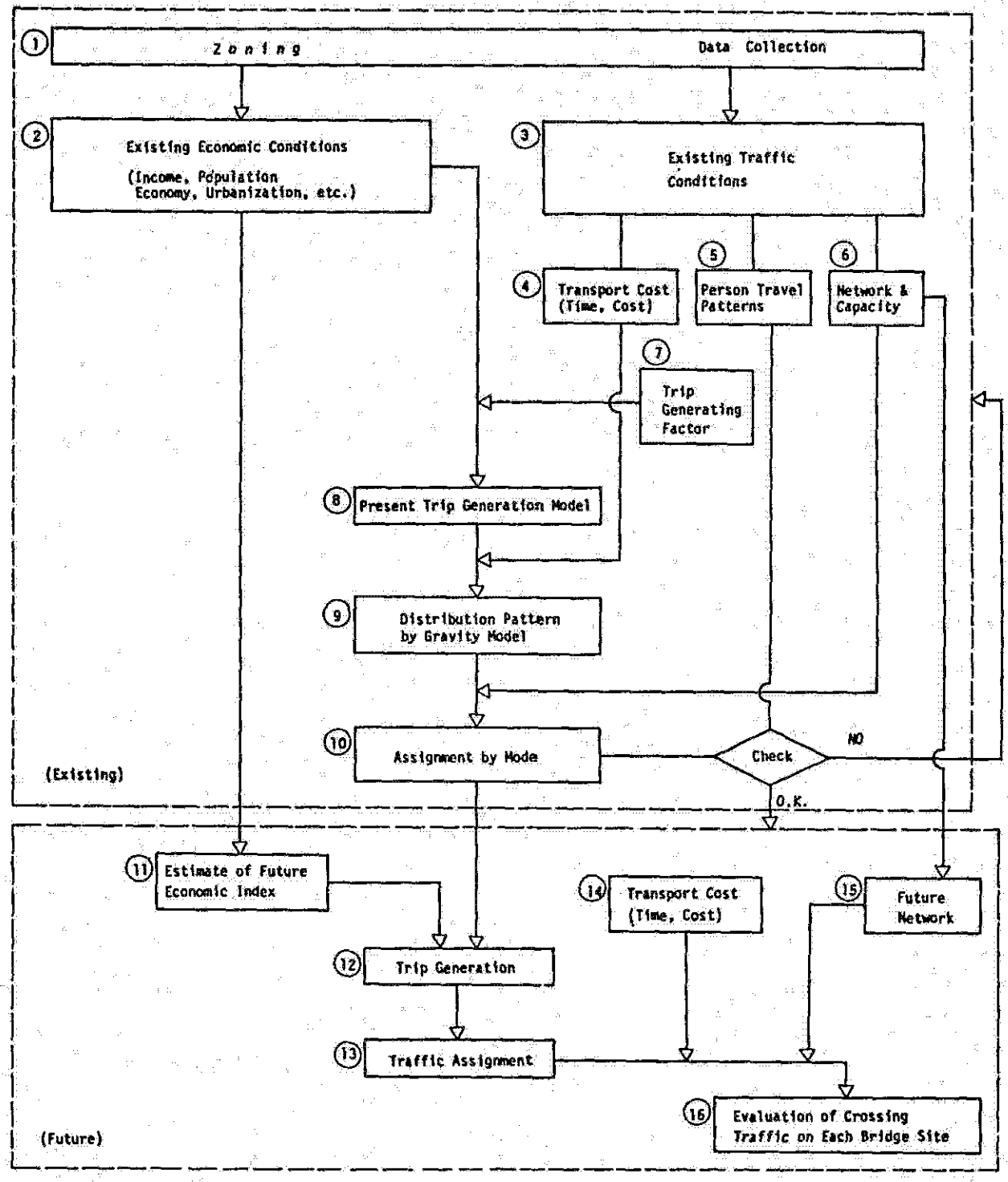
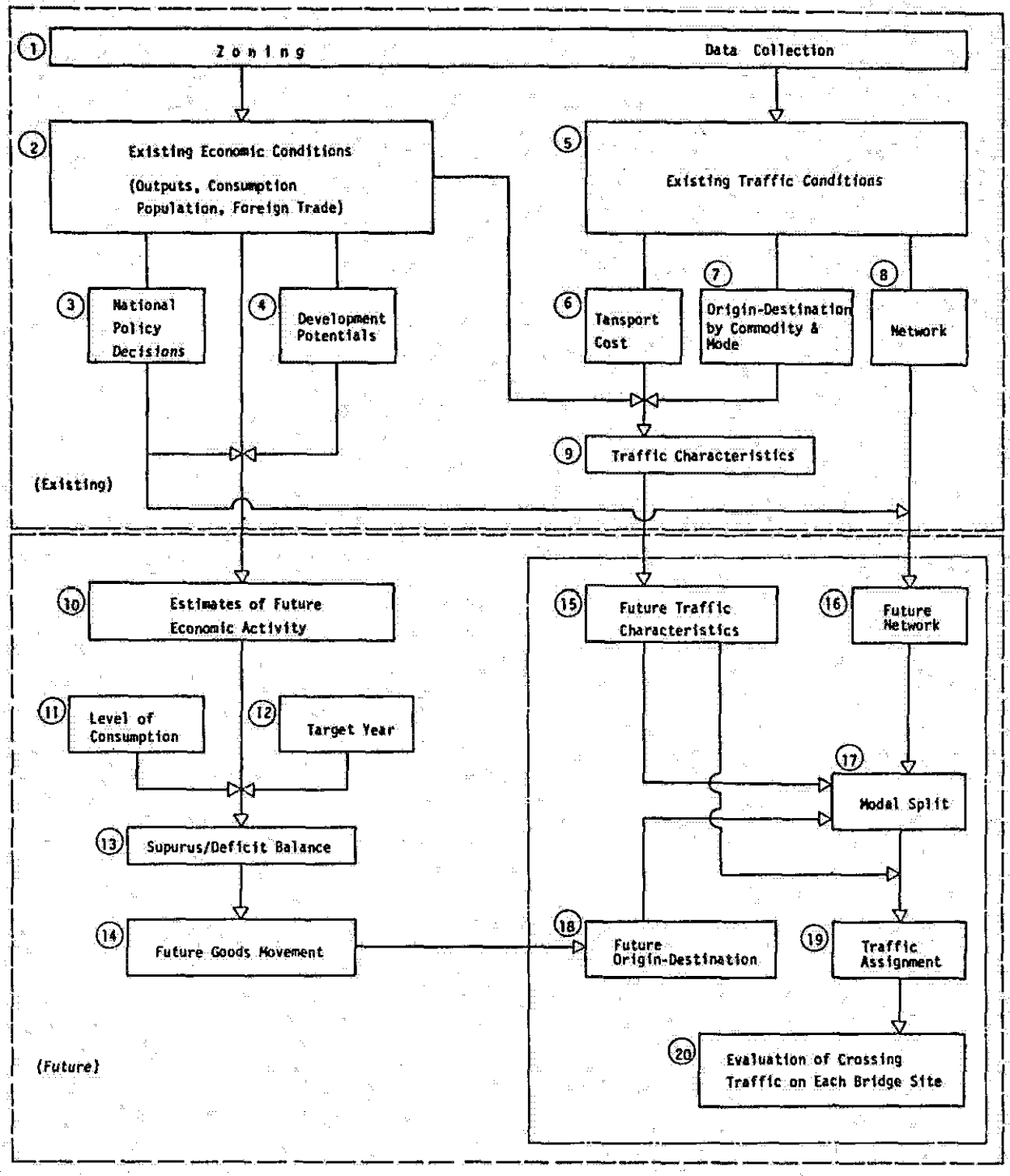


Figure 9-2

FORECASTING PROCESS FOR GOODS ACROSS THE JAMUNA



3. Population

The projections of the population for the years 1983, 1993 and 2003 were made based on the data from "Preliminary Results of Census of 1974" prepared by Government of Bangladesh and a report from IBRD. The projected population and density by division and district are shown in Tables 9-1 and 9-2, respectively.

It must be stated that there was great difficulty in estimating the future population with some problems in the above census in terms of accuracy and with the migration of a number of refugess overseas due to the Liberation War under the various domestic social conditions.

Table 9-1 Population by District, Past, Present and Future

Division/ District	(census) 1960/61		1973/74		Rate of increase	(projection) 1983		1993		2003	
	persons (1,000)	%	persons (1,000)	%	1974/1961(%)	persons (1,000)	%	persons (1,000)	%	persons (1,000)	%
Chittagong	10,140	19.97	13,873	19.44	36.81	19,096	18.89	24,165	18.40	30,590	17.93
Chittagong	2,983	5.87	4,325	6.05	44.41	6,197	6.14	8,109	6.17	10,820	6.34
CTG. H. T.	385	0.76	508	0.71	31.95	681	0.67	841	0.64	1,027	0.60
Noakhali	2,383	4.69	3,231	4.53	35.57	4,409	4.35	5,549	4.23	6,908	4.05
Comilla	4,389	8,65	5,809	8.15	32.37	7,809	7.73	9,666	7.36	11,835	6.94
Dacca	15,605	30.70	21,955	30.81	40.69	31,687	31.37	41,142	31.32	53,658	31.44
Sylhet	3,490	6.87	4,713	6.61	35.06	6,402	6.34	8,020	6.11	9,939	5.82
Dacca	5,095	10.03	7,608	10.68	49.29	12,008	11.89	16,228	12.34	22,453	13.16
Mymensingh	5,533	10.88	7,562	10.61	36.69	10,390	10.28	13,177	10.04	16,536	9.67
Tangail	1,487	2.92	2,072	2.91	29.32	2,887	2.86	3,717	2.83	4,730	2.77
Khulra	13,246	26.04	18,190	25.50	37,32	25,282	25.05	32,632	24.85	42,009	24,62
Khulna	2,449	4.81	3,552	4.98	45.00	5,107	5.06	6,848	5.21	9,136	5.36
Patuakhali	1,193	2.34	1,489	2.09	24.71	1,191	1.90	2,267	1.73	2,649	1.56
Barisal	3,068	6.03	3,906	5.48	27.32	5,119	5.07	6,161	4,69	7,338	4.30
Faridpur	3,179	6.25	4,047	5.67	27.31	5,315	5.27	6,360	4.84	7,566	4.44
Jessore	2,191	4.31	3,314	4.64	51.31	4,917	4.87	6,801	5.18	9,322	5.45
Kushtia	1,166	2.30	1,882	2.64	69.91	2,905	2.88	4,195	3.20	5,998	3.51
Rajshahi	11,849	23.29	17,299	24.25	46.00	24,935	24.69	33,383	25.43	44,343	26.01
Rajshahi	2,811	5.52	4,266	5.98	51.71	6,314	6.25	8,711	6.64	11,904	6.99
Pabna	1,958	3.85	2,809	3.94	43.38	3,995	3.96	5,263	4.01	6,856	4.02
Bogra	1,574	3.09	2,224	3.12	41.31	3,148	3.12	4,130	3.15	5,456	3.20
Rangpur	3,796	7.46	5.428	7.61	42.77	7,698	7.63	10.111	7.70	13,135	7.70
Dinajpur	1,710	3.37	2,572	3.60	51.00	3,780	3.73	5,168	3.93	6,992	4.10
Bangladesh Total	50,840	100.00	71,317	100.00	40.27	101,000	100.00	131,322	100.00	170,600	100.00

Table 9-2 Population and Density by District, Past, Present and Future

Unit: 1,000 persons
density: persons/km^2

Division/ District	Area (km^2)	(census)				(projection)					
		1961		1974		1983		1993		2003	
		persons (1,000)	density	persons (1,000)	density	persons (1,000)	density	persons (1,000)	density	persons (1,000)	density
Chittagong Division	31,706	10,140	320	13,873	438	19,096	602	24,165	762	30,590	965
Chittagong	7,003	2,983	426	4,325	618	6,197	885	8,109	1,158	10,820	1,545
CTG. H. T.	13,185	385	29	508	39	681	52	841	64	1,027	78
Noakhali	4,802	2,383	496	3,231	673	4,409	918	5,549	1,156	6,908	1,439
Comitla	6,716	4,389	654	5,809	865	7,809	1,163	9,666	1,439	11,835	1,762
Dacca Division	36.317	15,605	430	21,955	605	31,687	873	41,142	1,133	53,658	1,477
Sylhet	12,388	3,490	282	4,713	380	6,402	517	8,020	647	9,939	802
Dacca	7,461	5,095	678	7,608	1,020	12,008	1,609	16,228	2,175	22,453	3,009
Mymensingh	13,098	5,533	422	7,562	577	10,390	793	13,177	1,006	16,536	1,262
Tangail	3,370	1,487	441	2,072	614	2,887	857	3,717	1,103	4,730	1,404
Khulna Division	40,137	13,246	330	18,190	453	25,282	630	32,632	813	42,009	1,047
Khulna	12,043	2,449	203	3,552	295	5,107	424	6,848	569	9,136	759
Patuakhali	3,834	1,193	311	1,489	388	1,919	501	2,267	591	2,649	691
Barisal	7,143	3,068	430	3,906	547	5,119	717	6,161	863	7,338	1,027
Faridpur	6,974	3,179	456	4,047	580	5,315	762	6,360	912	7,566	1,085
Jessore	6,594	2,191	332	3,314	503	4,917	746	6,801	1,031	9,322	1,418
Kushtia	3,549	1,166	329	1,882	530	2,905	808	4,195	1,167	5,998	1,690
Rajshahi Division	34,548	11,849	343	17,299	501	24,935	722	33,383	966	44,343	1,284
Rajshahi	9,460	2,811	297	4,266	451	6,314	667	8,711	921	11,904	1,258
Pabna	4,858	1,958	403	2,809	578	3,995	822	5,263	1,083	6,856	1,411
Bogra	3,888	1,574	405	2,224	572	3,148	810	4,130	1,062	5,456	1,403
Rangpur	9,588	3,796	396	5,428	566	7,698	803	10,111	1,055	13,135	1,370
Dinajpur	6,754	1,710	253	2,572	381	3,780	560	5,168	765	6,992	1,035
Bangladesh Total	142,708	50,840	356	71,317	500	101,000	708	131,322	920	170,600	1,195

4. Economic index

Due to the absence of reliable statistics about the gross national product (GNP) or gross domestic product (GDP) which indicates the levels of national economic activities, the study was made of the figures of GNPs for three different years prepared by Government of Pakistan, Central Statistical Office and the ones mentioned in the First Five Year Plan, both of which are shown in Tables 9-3 and 9-4, respectively.

It can be said that there would arise no remarkable change of industrial structure in the future, judging not only from the planned GDP in the First Five Year Plan but from the past trend of the GDP compositions, where agriculture, which has a much lower level than in other countries, contributed more than a half of GDP, although its share was in a slightly decreasing tendency.

Table 9-3 Components of Gross National Product 1959/60 - 1969/70

(Unit: million rupee)

Sector \ Year		1959/60	1964/65	1969/70	Rate of Growth per annum (%) 59/60 - 64/65	64/65 - 69/70
Agriculture		9,919(62.1)	11,481(58.1)	13,514(55.1)	3.0 %	3.3 %
Manufacturing		965(6.0)	1,293(6.5)	2,128(8.7)	6.0	10.5
Scale	large	434(2.7)	679(3.4)	1,422(5.8)	9.3	16.1
	small	531(3.3)	606(3.1)	691(2.9)	2.7	2.7
Construction		240(1.5)	954(4.8)	1,447(5.9)	32.0	8.7
Public Services		23(0.1)	128(0.6)	218(0.9)	41.0	11.2
Transportation		990(6.2)	1,268(6.4)	1,494(6.1)	5.1	3.3
Other Services		3,801(23.8)	4,653(23.5)	5,735(23.4)	4.1	4.3
Total		15,938 (100.0)	19,777 (100.0)	24,536 (100.0)	4.4	4.4

Source: Economic Survey of East Pakistan (1969/70), Planning Department, Government of East Pakistan
Statistical Digest of Bangladesh (1970/71)

Table 9-4 Gross Domestic Product and its Components

(Unit: 100,000 taka at 1972/73 prices)

	Benchmark GDP	Estimated actual GDP 1972/73	Projected GDP 1977/78	Annual percentage rate of Growth over Benchmark GDP	Annual percentage rate of Growth over Benchmark 1972/73 GDP
Agriculture, Live-Stock, Forestry and Fishery	2,883 (57.6)	2,407 (56.1)	3,602 (55.0)	4.6	8.4
Manufacturing	520 (10.4)	358 (8.3)	731 (11.2)	7.1	15.4
Construction	184 (3.7)	171 (4.0)	326 (5.0)	12.1	13.7
Power and Gas	15 (0.3)	15 (0.3)	25 (0.4)	11.0	11.0
Housing	236 (4.7)	236 (5.5)	288 (4.4)	4.1	4.1
Trade, Transport and other services	1,165 (23.3)	1,107 (25.8)	1,570 (24.0)	6.2	7.2
Total	5,003 (100.0)	4,294 (100.0)	6,542 (100.0)	5.5	8.8
per capita GDP (taka)	676	580	766	2.5	5.7

Source: The First Five Year Plan 1973-78

Note: Figure in ( ) is percentage of total

5. Passenger Movement.

(1) Generating trips and zoning.

The total generating trips of the country in 1974 and 1993, on the hypothesis that there existed a bridge across the Jamuna, are to be estimated as 114,700 thousand and 306 million trips, respectively. The estimated total generating trips were distributed to each zone, district proportionate to the population in each district. Table 9-5 shows the distributed generating trips by district.

For the estimation of future passenger trips, zoning of the country was established and all zones were integrated into four large zones, regions by taking into account important factors resulting from the regional seperations by the four rivers, Jamuna, Ganges, Padma and Meghna, and the present and future transportation networks, etc. Zoning is tabulated in Table 9-6.

(2) Passenger trip distribution.

Based upon the above findings, the desired trip distribution of passengers among the large zones in 1974 and 1993 was examined by bridge location on an origin-destination basis by using the forecasted population with the gravity analysis.

The results were tabulated in Tables 9-7 and 9-8, respectively, where the result by district (zone) was summed into a respective large zone.

Table 9-5 Estimated Trips Generating from District

(Unit: 10,000 trips/year)

Zone No.	District	1974	1993
1	Sylhet	760	1,870
2	Dacca	1,220	3,780
3	Mymensingh	1,220	3,070
4	Tangail	330	870
5	Chittagong	700	1,890
6	Chittagong Hill Tracts	80	200
7	Noakhali	520	1,290
8	Comilla	940	2,250
9	Khulna	570	1,600
10	Patuakhali	240	530
11	Barisal	630	1,440
12	Faridpur	650	1,480
13	Jessore	530	1,580
14	Kushtia	300	980
15	Rajshahi	690	2,030
16	Pabna	450	1,230
17	Bogra	360	960
18	Rangpur	870	2,360
19	Dinajpur	410	1,200
T o t a l		11,470	30,600

Table 9-6 List of Zones for Traffic Study

Large Zone	Zone No.	District
Northeast (NE)	1	Sylhet
	2	Dacca
	3	Mymensingh
	4	Tangail
Southeast (SE)	5	Chittagong
	6	Chittagong Hill Tracts
	7	Noakhali
	8	Comilla
Southwest (SW)	9	Khulna
	10	Patuakhali
	11	Barisal
	12	Faridpur
	13	Jessore
	14	Kushtia
Northwest (NW)	15	Rajshahi
	16	Pabna
	17	Bogra
	18	Rangpur
	19	Dinajpur

Table 9-7 Passenger Trips Distribution (Origin - Destination), 1974

Bahadurabad, Gabargaon Unit: 10,000 trips/year

	NE	SE	SW	NW	Total
NE	917	946	256	494	3,530
SE		541	96	117	2,241
SW			966	633	2,917
NW				769	2,782
Total					11,470

Sirajganj

	NE	SE	SW	NW	Total
NE	899	923	290	517	3,528
SE		534	105	142	2,238
SW			954	619	2,922
NW				750	2,778
Total					11,466

Nagarbari

	NE	SE	SW	NW	Total
NE	867	885	396	518	3,533
SE		527	131	162	2,232
SW			907	579	2,920
NW				762	2,783
Total					11,468

Table 9-8 Passenger Trips Distribution (Origin - Destination), 1993

Bahadurabad, Gabargaon Unit: 10,000 trips/year

	NE	SE	SW	NW	Total
NE	2,355	2,510	878	1,495	9,593
SE		1,182	343	419	5,636
SW			2,250	1,886	7,607
NW				1,991	7,782
Total					30,618

Sirajganj

	NE	SE	SW	NW	Total
NE	2,296	2,438	963	1,596	9,589
SE		1,163	371	494	5,629
SW			2,218	1,841	7,611
NW				1,925	7,781
Total					30,610

Nagarbari

	NE	SE	SW	NW	Total
NE	2,190	2,323	1,266	1,618	9,587
SE		1,149	456	550	5,627
SW			2,088	1,715	7,613
NW				1,950	7,783
Total					30,610

(3) Probable passenger movement across the Jamuna.

From the origin-destination tables of the passenger trip distribution the probable passenger trips in 1974 and 1993 crossing the Jamuna were estimated by bridge location. The proposed bridge sites, Bahadurabad and Gabargaon are very close, and the result for Bahadurabad shall be the same as that for Gabargaon. Table 9-9 shows the estimated passenger movements between the east and the west areas of the country by bridge location and movement pattern.

(4) Passenger trips by mode.

In order to distribute the estimated passenger trips across Jamuna River to the competing transport modes of railway, highway and inlandwater, the rate of modalsplit was determined as in Table 9-10. The rate of inlandwater was assumed first and then the rates of the remaining two overland modes were estimated on the basis of the prevailing regional modal split in Japan as follows:

Year	Railway	Highway	Year applied to this study
1963	88.5 %	11.5 %	1974
1973	58.5	41.5	1993

Tables 9-11 and 9-12 indicate the annual passenger trips and the average daily passenger trips by transport mode, respectively. The trips in 1983 were interpolated and those in 2003 and 2013 roughly extrapolated. Thus the distributed passenger trips for the mode of railway and highway were assumed to be the passenger traffic crossing the proposed Jamuna bridge.

Table 9-9 Passenger Movements between East and West by Bridge Location, 1974 and 1993

Unit: 10,000 trips/year

Movement pattern \ Site / Year	Bahadurabad Gabargaon		Sirajganj		Nagarbari	
	1974	1993	1974	1993	1974	1993
NE - NW	494	1,495	517	1,596	518	1,618
NE - SW	256	878	290	963	396	1,266
SE - NW	117	419	142	494	162	550
SE - SW	96	343	105	371	131	456
Total	963	3,135	1,054	3,424	1,207	3,890

Table 9-10 Rate of Modal Split for Passenger Movements between East and West, 1974 and 1993

Unit: %

Movement pattern	Site \ Year / Mode	1974				1993			
		Rail	Road	IWT	Total	Rail	Road	IWT	Total
Northeast ↕ Northwest	Bahadurabad Gabargaon	80	10	10	100	80	10	10	100
	Sirajganj	80	10	10	100	80	10	10	100
	Nagarbari	80	10	10	100	75	10	15	100
Northeast ↕ Southwest	Bahadurabad Gabargaon	71	9	20	100	47	33	20	100
	Sirjganj	71	9	20	100	47	33	20	100
	Nagarbari	71	9	20	100	44	31	25	100
Southeast ↕ Northwest	Bahadurabad Gabargaon	44	6	50	100	29	21	50	100
	Sirajganj	44	6	50	100	29	21	50	100
	Nagarbari	44	6	50	100	29	21	50	100
Southeast ↕ Southwest	Bahadurabad Gabargaon	18	2	80	100	12	8	80	100
	Sirajganj	18	2	80	100	12	8	80	100
	Nagarbari	18	2	80	100	12	8	80	100

Table 9-11 Annual Passenger Trips Across the Jamuna by Transport Mode

Unit: 10,000 persons/year

Movement pattern	Year / Site / Mode	1983				1993			
		Rail	Road	IWT	Total	Rail	Road	IWT	Total
Northeast ↕ Northwest	Bahadurabad Gabargaon	774.5	96.8	96.8	968.1	1,196.0	149.5	149.5	1,495.0
	Sirajganj	822.5	102.8	102.8	1,028.1	1,276.8	159.6	159.6	1,596.0
	Nagarbari	792.9	103.9	142.2	1,039.0	1,213.5	161.8	242.7	1,618.0
Northeast ↕ Southwest	Bahadurabad Gabargaon	291.2	149.3	110.1	550.6	412.7	289.7	175.6	878.0
	Sirajganj	322.8	164.3	121.8	608.9	452.6	317.8	192.6	963.0
	Nagarbari	411.8	204.7	191.6	808.1	557.0	392.5	316.5	1,266.0
Southeast ↕ Northwest	Bahadurabad Gabargaon	84.7	45.4	130.0	260.1	121.5	88.0	209.5	419.0
	Sirajganj	100.8	53.6	154.4	308.8	143.3	103.7	247.0	494.0
	Nagarbari	113.1	59.8	172.9	345.8	159.5	115.5	275.0	550.0
Southeast ↕ Southwest	Bahadurabad Gabargaon	28.6	14.0	170.4	213.0	41.2	27.4	274.4	343.0
	Sirajganj	31.0	15.2	184.8	231.0	44.5	29.7	296.8	371.0
	Nagarbari	38.3	18.7	228.0	285.0	54.7	36.5	364.8	456.0
Total	Bahadurabad Gabargaon	1,179.0	305.5	507.3	1,991.8	1,771.4	554.6	809.0	3,135.0
	Sirajarj	1,277.1	335.9	563.8	2,176.8	1,917.2	610.8	896.0	3,424.0
	Nagarbari	1,356.1	387.1	734.7	2,477.9	1,984.7	706.3	1,199.0	3,890.0

Table 9-12 Average Daily Passenger Trips Across the Jamuna by Transport Mode

Unit: persons/day

Movement pattern	Year / Mode / Site	1983 Rail	1983 Road	1983 IWT	1983 Total	1993 Rail	1993 Road	1993 IWT	1993 Total
Northeast ↕ Northwest	Bahadurabad Gabargaon	21,219	2,652	2,652	26,523	32,767	4,096	4,096	40,959
	Sirajganj	22,534	2,817	2,817	28,168	34,981	4,373	4,373	43,727
	Nagarbari	21,724	2,847	3,896	28,467	33,247	4,433	6,649	44,329
Northeast ↕ Southwest	Bahadurabad Gabargaon	7,976	4,091	3,017	15,084	11,307	7,937	4,811	24,055
	Sirajganj	8,843	4,501	3,336	16,680	12,400	8,707	5,277	26,384
	Nagarbari	11,283	5,607	5,249	22,139	15,260	10,753	8,671	34,684
Southeast ↕ Northwest	Bahadurabad Gabargaon	2,320	1,243	3,563	7,126	3,329	2,411	5,740	11,480
	Sirajganj	2,761	1,468	4,229	8,458	3,926	2,841	6,767	13,534
	Nagarbari	3,098	1,639	4,737	9,474	4,370	3,164	7,534	15,068
Southeast ↕ Southwest	Bahadurabad Gabargaon	784	383	4,669	5,836	1,129	751	7,518	9,398
	Sirajganj	850	416	5,063	6,329	1,219	814	8,132	10,165
	Nagarbari	1,051	511	6,246	7,808	1,499	1,000	9,995	12,494
Total	Bahadurabad Gabargaon	32,299	8,369	13,901	54,569	48,532	15,195	22,165	85,892
	Sirajganj	34,988	9,202	15,445	59,635	52,526	16,735	24,549	93,810
	Nagarbari	37,156	10,604	20,128	67,888	54,376	19,350	32,849	106,575

6. Commodity Flows.

(1) Existing commodity flow crossing Jamuna River.

Goods traffic crossing Jamuna River is assumed to be composed of the following movements:

1) All movements between Rajshahi Division and the east area of the Jamuna.
2) Railway and highway movements between Khulna Division and the east area of the Jamuna, and
3) Traffic with India between Calcutta and the east area of the Jamuna.

Tables 9-13 and 9-14 show the total tonnage of commodities crossing the Jamuna in 1968/69 and 1972/73, respectively. Those reveal that in 1968, 620,000 tons of commodities which exclude cargo by country boat crossed the Jamuna and in 1972, 612,000 tons which include cargo by country boat crossed the river.

(2) Estimated commodity flow crossing the Jamuna after 1982/83.

Two estimates were made for the commodity flow in 1982/83 with and without consideration of the anticipated mining development in Rajshahi Division which would commence in the 1980's. This must be restudied in the later stage when detailed information thereof is available.

The probable traffic which would cross the Jamuna in 1982/83 would be generated by the construction of the proposed Jamuna Bridge was tabulated by main commodity in Table 9-15.

Table 9-13 Goods Flow Across Jamuna River, 1968/69

Unit: 1,000 tons

Division		Rail	Road	IWT	Country boat	Total
Origin	Destination					
Rajshahi	Chittagong	63	0	0	N.A.	63
Chittagong	Rajshahi	261	3	0	N.A.	264
Rajshahi	Dacca	157	3	0	N.A.	160
Dacca	Rajshahi	61	16	0	N.A.	77
Subtotal		542	22	0	N.A.	564
Khulna	Chittagong	3	0	26	N.A.	29
Chittagong	Khulna	20	1	146	N.A.	167
Khulna	Dacca	8	5	52	N.A.	65
Dacca	Khulna	15	4	349	N.A.	368
Total		588	32	573	N.A.	1,193

Note: Tonnage by Rail and IWT limited to main commodities.
N.A. means "not avalable".

Table 9-14 Goods Flow Across Jamuna River, 1972/73

Unit: 1,000 tons

Division		Rail	Road	IWT	Country boat	Total
Origin	Destination					
Rajshahi	Chittagong	25	0	30	10	65
Chittagong	Rajshahi	13	2	65	38	118
Rajshahi	Dacca	80	42	35	114	271
Dacca	Rajshahi	66	15	29	36	146
Subtotal		184	59	159	198	600
Khulna	Chittagong	1	0	128	72	201
Chittagong	Khulna	0	0	615	135	750
Khulna	Dacca	7	3	285	258	553
Dacca	Khulna	0	1	495	52	547
Total		192	63	1,681	715	2,651
India	Chittagong	0	0	10	0	10
India	Dacca	0	0	42	1,164	1,206

Note: Tonnage by Rail and IWT limited to main commodities.

Table 9-15 Estimated Goods Flows Across Jumuna River in 1982/83

Unit: 1,000 tons

DIVSION		COMMODITIES											
Origin	Destination	Raw jute	Jute products	Food grain	1) Cement	2) Coal	Oil	Steel	Fertilizer	Salt	Suguar	Stone	3) Total
Rajshahi	Chittagong	60	0	0	0(0)	278(0)	0	0	0	0	4	0	342 (64)
Chittagong	Rajshahi	0	0	0	0(49)	0(0)	0	25	264	119	0	0	408 (457)
Rajshahi	Dacca	169	0	0	253(0)	376(0)	0	0	0	0	64	120	982 (353)
Dacca	Rajshahi	0	0	0	0(0)	0(0)	0	0	134	0	0	0	134 (134)
Sub-total		229	0	0	253(49)	654(0)	0	25	398	119	68	120	1,866(1,008)
Khulna	Chittagong	60	0	92	0(0)	0(0)	0	0	0	0	4	0	156 (156)
Chittagong	Khulna	50	0	0	0(0)	0(0)	43	0	97	132	0	0	322 (322)
Khulna	Dacca	50	0	0	66(68)	0(178)	172	0	0	3	0	0	291 (471)
Dacca	Khulna	320	200	0	0(0)	0(0)	0	0	94	0	0	0	614 (614)
Total		709	200	92	319(117)	654(178)	215	25	589	254	72	120	3,249(2,571)

Note: 1) Figure in ( ) indicates goods flow in the absence of Joypurhat project.

2) Figure in ( ) indicates goods flow in the absence of Jamalganj project.

3) Figure in ( ) indicates goods flow in the absence of the two projects in Notes 1) and 2).

Tables 9-16, 9-17 and 9-18 show the goods traffic crossing the Jamuna in 1982/83 by bridge location on an origin-destination basis and by transport mode. As the bridge sites, Bahadurabad and Gabargaon are very close, the traffic estimated for the former shall be the same amount as that for the latter.

(3). Future commodity flow crossing the Jamuna.

In the same way as in 1982/83, the commodity flow crossing the Jamuna in 1992/93 was estimated by taking into consideration the rate of modal split. The result is tabulated in Table 9-19 with the one in 1982/83 used for comparison. The commodity traffic in 2003 and 2013 were roughly extrapolated and is tabulated in Table 9-20.

Table 9-16 Estimated Goods Movement by Mode for 1982/83 Across Jamuna River

-- Case I: Bahadurabad, Case II: Gavargaon --

(Unit: 1,000 tons)

Division Origin	Destination	Railway	Highway	I W T	Country boat	Total
Rajshahi	Chittagong	331 (53)	1	10	0	342 (64)
Chittagong	Rajshahi	317 (366)	0	52	39	408 (457)
Rajshahi	Dacca	740 (209)	195 (97)	0	47	982 (353)
Dacca	Rajshahi	117	0	11	6	134 (134)
Sub-total		1,505 (745)	196 (98)	73	92	1,866 (1,008)
Khulna	Chittagong	2	0	94	60	156 (156)
Chittagong	Khulna	0	0	220	102	322 (322)
Khulna	Dacca	0	0	240 (420)	51	291 (471)
Dacca	Khulna	15	0	577	22	614 (614)
T o t a l		1,522 (762)	196 (98)	1,204 (1,384)	327 (327)	3,249 (2,571)
India (Calcutta)	Dacca	0	0	0 (178)	-	0 (178)
	Chittagong	-	-	-	-	-

Note: Figure in ( ) shows the estimated goods movement in the absence of coal mining project and cement project in Bogra District.

Table 9-17 Estimated Goods Movement by Mode for 1982/83 Across Jamuna River

-- Case III: Sirajganj --

(Unit: 1,000 tons)

Division						
Origin	Destination	Railway	Highway	I W T	Country boat	Total
Rajshahi	Chittagong	331 (53)	1	10	0	342 (64)
Chittagong	Rajshahi	321 (370)	0	48	39	408 (457)
Rajshahi	Dacca	713 (194)	193 (83)	13	63	982 (353)
Dacca	Rajshahi	128	0	8	3	134 (134)
Sub-total		1,488 (740)	194 (84)	79	105	1,866 (1,008)
Khulna	Chittagong	2	0	94	60	156 (156)
Chittagong	Khulna	0	0	220	102	322 (322)
Khulna	Dacca	71 (125)	0	169 (295)	51	291 (471)
Dacca	Khulna	176	0	420	18	614 (614)
T o t a l		1,737 (1,043)	194 (84)	982 (1,108)	336 (336)	3,249 (2,571)
India	Dacca	0 (71)	-	(107)	-	0 (178)
(Calcutta)	Chittagong	-	-	-	-	-

Note: Figure in ( ) shows the estimated goods movement in the absence of coal mining project and cement project in Bogra District.

Table 9-18 Estimated Goods Movement by Mode for 1982/83 Across Jamuna River
-- Case IV: Nagarbari --

(Unit: 1,000 tons)

Division Origin	Division Destination	Railway	Highway	I W T	Country boat	Total
Rajshahi	Chittagong	331 (53)	1	10	0	342 (64)
Chittagong	Rajshahi	328 (377)	0	41	39	408 (457)
Rajshahi	Dacca	719 (195)	188 (83)	13	62	982 (353)
Dacca	Rajshahi	125	0	6	8	134 (134)
Sub-total		1,503 (750)	189 (84)	70	104	1,866 (1,008)
Khulna	Chittagong	2	0	94	60	156 (156)
Chittagong	Khulna	0	0	220	102	322 (322)
Khulna	Dacca	95 (167)	0	145 (253)	51	291 (471)
Dacca	Khulna	228	0	368	18	614 (614)
T o t a l		1,828 (1,147)	189 (84)	897 (1,005)	335 (335)	3,249 (2,571)
India (Calcutta)	Dacca	0 (89)	0	0 (89)	-	0 (178)
	Chittagong	-	-	-	-	-

Note: Figure in ( ) shows the estimated goods movement in the absence of coal mining project and cement project in Bogra District.

Table 9-19 Estimated Commodity Flow Crossing the Jamuna by Mode, 1982/83 and 1992/93

Unit: 1,000 tons/year

Site / Year / Mode	Bahadurabad Gabargaon		Sirajganj		Nagarbari	
	1982/83	1992/93	1982/83	1992/93	1982/83	1992/93
Railway	1,522 (762)	2,441 (1,189)	1,734 (1,043), [71]	2,758 (1,737)	1,828 (1,147), [89]	2,871 (1,915)
Highway	196 (98)	352 (176)	194 (84)	381 (165)	189 (84)	408 (181)
Inland-water	73	122	79	133	70	114
Country boat	92	153	105	177	104	171
Total	1,883 (860)	3,068 (1,365)	2,112 (1,127), [71]	3,449 (1,902)	2,191 (1,231), [89]	3,564 (2,096)

Note: 1) Figure in ( ) shows the goods movement in the absence of coal mining project and cement project in Bogra District.

2) Goods movement by inland-water between Khulna Division and Dacca and Chittagong Divisions is excluded.

3) Figure in [ ] shows the goods movement with India.

Table 9-20 Rough Estimates of Overland Commodity Flow Crossing the Jamuna by Mode, 2002/3 and 2012/3

Unit: 1,000 tons/year

Site / Year / Mode	Bahadurabad Gabargaon		Sirajganj		Nagarbari	
	2002/3	2012/13	2002/03	2012/13	2002/03	2012/13
Railway	3,908 (1,850)	6,244 (2,870)	4,354 (2,694)	6,823 (4,154)	4,451 (2.936)	6,769 (4,437)
Highway	633 (317)	1,139 (570)	750 (325)	1,475 (639)	880 (391)	1,899 (844)
Total	4,541 (2,167)	7,383 (3,440)	5,104 (3,019)	8,298 (4,793)	5,331 (3,327)	8,668 (5,281)

Note: Figure in ( ) shows the goods movement in the absence of development projects in Rajshahi Division.

7. Estimate of Model Capacity.

The estimated traffic by overland transport mode crossing the Jamuna will be converted into respective modal capacity on the following assumptions:

1) Passengers.

i. Railway.

- one coach carries 70 passengers, and
- one train consists of 20 coaches.

ii. Highway.

- one bus carries 40 passengers, and
- one passenger car carries 3.5 persons.

In this study passenger cars include all passenger carriers except buses.

The allotment of passenger rides to bus and passenger car was examined with the survey results of years 1973 and 1974 (each survey period was 2 days).

Rate of allotment

	Bus	Passenger car
1973	70%	30%
1974	76	24

For the near future the above rate will be considered. However for the projections for the distant future a rate of allotment to bus and passenger car will be 50 and 50 percent, respectively with full consideration of the increase of vehicular demand affected by the construction of the proposed Jamuna bridge.

2) Commodities.

i) Railway.

- one freight wagon carries 20.0 tons.
- one freight train consists of 60 wagons.
- actual rate of loading is 95 percent.

ii) Highway.

- one truck carries 5 tons, and
- actual rate of loading is 80 percent.

3) Capacity of the bridge.

The capacity of a single track railway-cum two-lane Highway bridge is tabulated in Tables 9-21 and 9-22.

These tables show the total capacity of the bridge in case of operated train numbers.

Total amount of goods depends on the commencement year of mining development in Rajshahi Division.

Table 9-21 Capacity of the Jamuna Bridge

Number of Trains Vs. Traffic

Start of Mining Development
in Rajshahi Division in 1980's

RAILWAY						HIGHWAY		CAPACITY	
Total No. of Trains daily (1)	Distance between Stations (km) (2)	No. of passenger trains daily (3)	No. of passengers (1,000) annual (4)	No. of freight trains daily (5)	Amount of goods (1,000 tons) annual (6)	No. of passengers (1,000) annual (7)	Amount of goods (1,000 tons) annual (8)	Total No. of passengers (1,000) (4) + (7)	Total amount of goods (1,000 tons) (6) + (8)
40		23	11,750	17	7,200	14,000	4,800	25,750	12,000
50	10	33	16,860	"	"	"	"	30,860	"
60	8	43	21,970	"	"	"	"	35,970	"
65	7.5	48	24,530	"	"	"	"	38,530	"
70	6.5	53	27,080	"	"	"	"	41,080	"
75	6	58	29,640	"	"	"	"	43,640	"
80	5.5	63	32,190	"	"	"	"	46,190	"
85	5	68	34,750	"	"	"	"	48,750	"
90	4.5	73	37,300	"	"	"	"	51,300	"

Table 9-22 Capacity of the Jamuna Bridge

Number of Trains Vs. Traffic

Commencement year of
Mining Development in
Rajshahi Division is 1990's.

RAILWAY						HIGHWAY		CAPACITY	
Total No. of trains daily (1)	Distance between stations (km) (2)	No. of passenger trains daily (3)	No. of passengers (1000) annual (4)	No. of freight trains daily (5)	Amount of goods (1,000 tons) annual (6)	No. of passengers (1,000) annual (7)	Amount of goods (1,000 tons) Annual (8)	Total No. of passengers (1,000) annual (9)=(4)+(7)	Totol amount of goods (1,000 tons) annual (10)=(6)+(8)
40		27	13,800	13	5,200	14,000	4,800	27,800	10,000
45	12	32	16,350	"	"	"	"	30,350	"
50	10	37	18,910	"	"	"	"	32,910	"
55	9	42	21,460	"	"	"	"	35,460	"
60	8	47	24,020	"	"	"	"	38,020	"
65	7.5	52	26,590	"	"	"	"	40,590	"
70	6.5	57	29,130	"	"	"	"	43,130	"
75	6	62	31,680	"	"	"	"	45,680	"
80	5.5	67	34,240	"	"	"	"	48,240	"

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APPENDIX I

NOTE VERBAL

APPENDIX. NOTE VERBAL

EMBASSY OF JAPAN
DACCA

No.32 - DL (12)/B/73

April 9, 1973

The Embassy of Japan in Bangladesh presents its compliments to the Ministry of Foreign Affairs, Government of the People's Republic of Bangladesh and has the honour to inform the Ministry that in response to the request from the Government of the People's Republic of Bangladesh and in accordance with the laws and regulations in force in Japan, the Government of Japan has decided to conduct a feasibility survey for the construction of a bridge over the Jamuna River, as part of its technical co-operation with the People's Republic of Bangladesh and has antrusted the survey to the Overseas Technical Co-operation Agency (hereinafter referred to as the "OTCA"), an official execution agency responsible for Japan's overseas technical co-operation activities.

The OTCA will conduct the survey according to "The Scope of Works", appended with this note verbal.

In order to facilitate the survey work smoothly, the Government of Japan requests the Government of the People's Republic of Bangladesh to grant the survey mission and the member of the mission oriviledges, exemptions and facilities and also assure security and safety for the members of the mission during the period of their stay in Bangladesh, as in the attached "The Scope of Works".

The Embassy of Japan has the honour to request the Ministry to inform the Embassy of its opinion on the above at an early date.

The Embassy of Japan has further the honour to inform the Ministry that the members of the Consultating Mission on this survey have already arrived in Bangladesh and would leave the country on April 13, 1973 on completion of their task.

The Embassy of Japan in Bangladesh avails itself of this opportunity to renew to the Ministry of Foreign Affairs, Government of the People's Republic of Bangladesh, the assurance of its highest consideration.

The Ministry of Foreign Affairs,
Government of the People's
Republic of Bangladesh,
Dacca.

SCOPE OF WORKS

I. PURPOSE

The Government of the People's Republic of Bangladesh, pursuing after improvement of traffic condition and economic development, drafted the Jamuna River Bridge Construction Project and requested Japan's assistance in conducting a necessary feasibility study. Noting the importance of the project for the future development of Bangladesh, the Government of Japan acceded to the request and decided to conduct the feasibility study in accordance with laws and regulations in force in Japan as part of its technical cooperation with the People's Republic of Bangladesh. The Government of Japan has entrusted the execution of this study to the Overseas Technical Cooperation Agency (hereinafter referred to as the OTCA), an official execution agency responsible for Japan's overseas technical cooperation activities.

Under this government assignment, the OTCA is charged with the task of conducting necessary surveys in accordance with the present scope of works in order to select a site and type of the bridge, to prepare preliminary design and to evaluate the project.

II. CUTLINE OF SURVEY

The survey is intended to be carried out over a period of three years starting 1973.

At the first stage of the survey period, a number of promising bridge construction sites will be selected on the basis of the findings of the preliminary survey, and studies will be made on the traffic systems, river hydrology and hydraulics, topography, geology and other factors for each of the proposed sites to determine their priority order and select the most suitable site.

At the second stage, detailed surveys will be carried out on the basis of the outcome of the first stage survey.

Survey Items:

The following surveys will be conducted:

a) Topographic Survey

1) Aerial Photography and Mapping
Aerial photography for understanding of flow conditions, selection of suitable sites, and mapping to cover the area embracing the most suitable site for bridge construction. Ground control survey required for mapping will also be conducted.

2) Ground Surveying
Cross-leveling at the proposed sites, survey of the access route and topographic survey at the most suitable site.

b) Traffic Survey

1) Studies of the present land use, distribution of population and industries within the area likely to be influenced by the project implementation, and estimation for the future trend of these factors.

2) Studies of the existing movement of persons and goods, with estimation for their future trend.

3) Estimation and planning of traffic pattern and volume crossing the Jamuna River in future.

c) River Survey

1) Studies of water level, discharge, flow velocity and suspended load during the flood seasons required for the feasibility study.

2) Studies of the movement of river course to determine the suitable bridge site, bridge span and its access.

3) Survey of scouring along the river banks and prevailing revetment works in the flood season.

d) Soil Test and Geological Survey

1) Boring at the proposed sites and soil tests.

e) Materials and Contractor

1) Survey of availability of necessary construction materials.

2) Survey of capability of local contractors.

f) Preliminary Design

1) Layout of the bridge and access route at the suitable sites, and preliminary design at the most suitable site for estimation of the construction cost.

g) Evaluation of the Project

III. SURVEY SCHEDULE

The survey will be conducted according to the tentative schedule attached hereto as Appendix - I.

IV. REPORT

1. Inception Report

The Japanese survey mission is to submit to the Government of the People's Republic of Bangladesh 10 copies of an inception report prepared in English to provide an overall information on the entire survey activities. The schedule and method of survey as well as survey items will be contained in the inception report.

2. Interim Report

At the stage when the priority order of the proposed sites has been determined, as interim report stating the progress of the survey activities so far completed and containing the survey mission's comments and recommendations is to be submitted to the Government of the People's Republic of Bangladesh.

It is understood that the Government of the People's Republic of Bangladesh will convey its comments, if any, to the survey mission within one month after receipt of the interim report.

3. Final Report

The final report of the project, to be preparad by the OTCA upon completion of the feasibility study, is to be presented in 50 copies to the Government of the People's Republic of Bangladesh through the Government of Japan within 35 months after the present Scope of Works has been finalized between the two governments.

V. CONTRIBUTION TO THE PROJECT

1. Japanese Contribution

Besides conducting feasibility study of the project as mentioned above, the OTCA will contribute to the project by:

a) Manding ever, upon completion of the survey, such survey equipment and instrument to be decided by the governments.

b) Providing training in Japan for Bangladesh government engineers related to the project as separately agreed upon by the two governments.

2. Bangladesh Contribution

The Government of the People's Republic of Bangladesh is to contribute to the project by providing the survey mission with the following conveniences, facilities and services:

a) Exemption from custom duties, taxes and charges of any kind in respect of the equipment including vehicles and vessels, machinary, materials and medical rupplies as necessary for the performance of the duties of the members of the mission

b) Exemption from customs duties, taxes and charges of any kind, other than those for storage, cartage and similar services, in respect of the personal an household effects of the members of the mission, as admissible under the model rules for custom concessions to the privileged personnel

c) Available data and information necessary for smooth execution of the survey

d) Services of linison staff, interpreters, labourers, chauffeurs, etc., the cost of which is to be borne by the Government of Japan

e) Suitable office spaces equipped with appurtenant facilities, and suitable storage facilities and garages

f) Free transfer of the data and materials of the Government of the People's Republic of Bangladesh to Japan for the purpose of executing the project

g) Freedom of taking air-photographs related to the project, in all such aerial survey missions an officer of the Government of Bangladesh will accompany the flight

h) Complete freedom for all activities required for the execution of the survey

i) Assurance of security and safety for the member of the survey mission as well as for the survey equipment, instrument and other properties of the mission

j) Available communication facilities as far as possible

k) Medical facilities equivalent to those extended to government officers of the People's Republic of Bangladesh.

APPENDIX II

A G E N D A

FOR

TOKYO MEETING

In the course of the study, we have encountered several problems which, we think, have relations with the Bangladesh Government's policy. Some of them have to be solved at the first stage of the study or before finishing the Interim Report and others will have to be solved before proceding to the second stage of the study or the stage of the Feasibility Study.

Those problems, we expect, shall be solved by the discussion in the Tokyo Meeting to be held in coming September. The subjects on them are shown below together with brief explanations.

1. Effective Width of the Bridge.

We propose an effective width required for one single track with broad gage and two lanes for highway because, according to the rough estimation at this stage, it is presumed that the traffic capacity of this width will meet the volume of traffic to be expected for the time being. If there is no objection from the viewpoint of communication policy, we want to obtain a consent from your side.

2. Minimum Width of the Jamuna River.

In the progress report on the river training, we have proposed a minimum river width principally judging from the natural aspect of the river. If there is no objection from the river management side, we want to use this width as the lower limit when we plan the length of the bridge.

3. Design Discharge for Bridge Construction.

Guide bank system is being considered as river control works for bridge crossing. Design water level is required to determine the elevation of the lower face of the bridge and the design discharge is required to determine the water level. The design discharge for bridge construction may have relations with that in flood control policy. If so and necessary, we must obtain a consent from the river management side with respect to the design discharge which has been proposed for the bridge project in the progress report.

4. Procurement of Stones.

The present project requires several million cubic meters of stones for pitching and concrete. However, it has become clear as the result of

the first investigation that the required quantity of stones does not exist in the land of Bangladesh. On the other hand, a prospective quarry site had been considered in Assam State, but no investigation was possible as the entry permission was not issued. We are therefore planning the second investigation on other prospective quarry than the above in coming dry season.

Even if we should be permitted to enter India to conduct our investigation, it is still doubtful to secure such amount of stones in a considerably short period. Anyway Bangladesh has to import them from the foreign countries since the required quantity of stones does not exist within the territory. What do you think about the possibility of import? If the import is possible, what do you think about the transportation and the unit price of them?

5. Route Location of Railway Links.

In the progress report, we have proposed the route of the railway links which were located in connection with each site for the bridge crossing. If there is no objection from the viewpoint of the railway policy, we want to obtain a consent from your side with respect to the proposed route.

6. Gage Length of the Railway Links.

As is seen in the progress report, we have planned single-track railway with broad gage on the whole link lines in connection with each site for bridge crossing. This was made in connection with the gage which has been adopted for the bridge planning on the basis of the Minutes of the Meeting held in Dacca on August 8, 1973. If there is no objection from the viewpoint of the railway policy, we want to obtain a consent from your side.

7. Route Location of Highway Links.

In the progress report, we have proposed the routes of the highway links which were located in connection with each site for bridge crossing. If there is no objection from the viewpoint of the highway policy, we want to obtain a consent from your side with regard to the proposed route.

8. Navigation Clearance for Other Rivers than the Jamuna.

The Jamuna Bridge is being planned in consideration of the navigation clearance presented by the Bangladesh Government. Since the standard of clearance is not presented for other rivers than the Jamuna, we propose the clearances for them as mentioned in the progress report on the bridge planning. If there is no objection from the viewpoint of inland navigation policy, we want to obtain a consent from your side.

9. Information to be Required for Further Development of the Study on Economy and Traffic Volume.

The following information is required to develop further the study on economy and traffic volume. If possible and in time, it is requested to bring them to the Tokyo Meeting.

(1) Information in connection with the Five-Year Plan.

a. Surplus of agricultural products.

Demand for food grain and role of the North-West Region -- local surplus and deficit, although the Five-Year Plan states national surplus.

(2) Information in connection with the long-term or fundamental plans other than the Five-Year Plan.

1) Network.

a. Network plan (conception) of roads and rails after the Five-Year Plan period (chronological): the level of improvement after 10 and 20 years and future plans of new routes.

b. Operation of road ferry.

- especially for the Aricha ferry: measures to counter the vehicle traffic which has been growing rapidly.

2) Foreign trade ports.

a. Fundamental plan of the ports of Chittagong and Chalna
- especially their roles:

i. regional (longitudinal) allotment under the two ports' charge, e.g., eastern region for Chittagong Port and western for Chalna Port.

ii. functional allotment, e.g., imports for one port and exports for the other.

b. Third port plan:

scale and realizability of a deep-sea terminal off Chittagong Port.

3) Development policy of the North-West Region.

- realizability of mining of lime-stone and coal after 10 and 20 years.

4) Inlandmanufacturing in the North-West Region.

development plans of manufacturing industries centering around Bogra.

5) Traffic with India.

Coal is imported from India at present. Possibility of enlargement of trading with India for other commodities and developments of a connection with the Calcutta industrial areas.

APPENDIX III

AGREED MINUTES

AT

DACCA MEETING

AGREED MINUTES
AT
DACCA MEETING
FOR
JAMUNA BRIDGE PROJECT, BANGLADESH

5th NOVEMBER, 1974

JAPAN INTERNATIONAL COOPERATION AGENCY

AND

ADVISORY COMMITTEE

JAMUNA BRIDGE PROJECT, BANGLADESH

Discussions were made between the Bangladesh Delegation and the Japanese delegation on the matters mentioned in the Agenda attached herewith at the meetings which were held in Dacca under the auspices of the Bangladesh side from October 30th to November 4th 1974 and the following conclusions were obtained.

A. Construction costs and traffic capacity of bridge.

1. Construction costs.

The Japanese side explained the details of construction costs of the Project at each of the four proposed sites. There was no objection from Bangladesh side regarding the contents of the costs but so far as the costing in respect of the railway tracks etc were concerned it was felt that the costing was a little on the high side although it was agreed that the costing in respect of the Highway portion was realistic.

2. Traffic capacity of bridge.

The Japanese side proposed a railway-cum highway bridge with a single broad-gauge track (5'6") and two-lane carriageway (24') and clarified that the traffic capacity of the above-mentioned system of width will cope with even the forecasted traffic volume after fifty years.

B. Successive work schedule.

The Japanese side showed the successive work schedule for the study attached herewith and the Bangladesh side agreed to the contents of the schedule.

C. Requests for facilities.

The Japanese side requested facilities mentioned in the attachment and the Bangladesh side promised to make every effort for them.

D. Requisities for carrying out the second-stage studies.

1. Effective width of the bridge.

The Bangladesh side agreed to the Japanese-side's proposal to design the bridge with the width system of a single broad-gauge track (5'6") for railway and two-lane carriageway (24') for highway.

The Japanese side agreed to recommend that emergency space for traffic shall be taken into consideration in the phase of detail design of this Project.

2. Treatment of the Dhaleswari River.

a. The upper inlet channel of the Dhaleswari River shall be closed by the access road and the lower inlet channel shall be so improved as to have the same function as both the upper one and lower one combined.

b. The improved lower channel will require maintenance. Cost for the maintenance shall be included in the cost in the B/C (benefit-cost) analysis of the project.

c. No hydraulic model test is contained in the present feasibility study. The Japanese side agreed to recommend that the model test shall be conducted in accordance with necessity at Sirajganj site in the phase of detail design.

d. The Bangladesh side expressed its concern on the possibility of the river changing its course at some points upstream and requested that some studies be undertaken in this direction. If this problem is recognized, such a study can be recommended even outside the present feasibility study.

The Japanese side recognized the desirebility of such a study but stated that it should be separated from the present feasibility study.

3. Design specifications for railway and highway design.

It was confirmed that the following specifications shall be used also in the design of railway and highway in the second-stage study.

Schedule of dimensions (5'6" gauge), Bangladesh Railway.
Code of Practice for Engineering Department of Bangladesh Railway.
Loading Charts, Bridge Rules, Steel Structure Codes of Bangladesh Railway.
Geometric Design Standards for Highway from Modern Road Construction Procedures, Road and Highway Directorate, Bangladesh.

E. Additional matters.

1. Additional facilities of the bridge.

The Bangladesh side requested that additional facilities such as Gas/Oil pipelines and transmission lines should be included in the design of the bridge.

The Japanese side agreed that it would be taken into consideration if the plans are presented by the Bangladesh side before the end of December of 1974.

H. Arao

A Sawada

2. Improvement of the existing railway between Dacca and Tungi.

The Bangladesh side requested that improvement plan of the existing railway between Dacca and Tungi should be included in the present feasibility study. The Japanese side accepted it.

3. Information about stone to be exploited at Madhyapara.

The Japanese side stated that stones to be exploited at Madhyapara region in the Dinajpur District would be taken into consideration in the study if information of quality and unit price of stones at the extraction source be presented to the Japanese side before the end of March, 1975.

F. Determination of the most suitable site for bridge crossing.

The Japanese side stated that based on the study under Phase I, they consider the Sirajganj site as the most suitable one for the Jamuna River Crossing from the technical, engineering, traffic and economic points of view, and proposed to conduct the detailed study under Phase II for Sirajganj site only.

The Bangladesh side agreed to this proposal and requested further that soil boring tests only may also be conducted at Gabargaon site during the study under Phase II. The Japanese Delegation could not agree to include the boring tests at Gabargaon site for lack of provision for the purpose in the present project.

Japanese delegation

1. Mr. Hidekazu Arai,
Leader of the Delegation &
Member of Supervisory Committee
for the Feasibility Study on the
Jamuna Bridge Project, JICA.
(Ministry of Construction)

2. Mr. Akihiko Tsuchiya,
Member of Supervisory Committee
for the Feasibility Study on
the Jamuna Bridge Project, JICA.
(Ministry of Construction).

3. Mr. Sadao Kishimoto,
Member of Supervisory Committee for
the Feasibility Study on the Jamuna
Bridge Project, JICA.
(Ministry of Construction)

H. Arai

Bangladesh delegation

1. Mr. Abdus Samad,
Leader of the Team &
Secretary, Ministry of
Communications.

2. Mr. S.S.M. Lutful Huq,
Joint Secretary,
Ministry of Communications.

3. Mr. Mosihur Rahman,
Chief Engineer, R&H Directorate.

A Samad

Japanese delegation	Bangladesh delegation
4. Dr. Shizuo Inose, Leader in General of the Feasibility Study Team for the Jamuna Bridge Project, JICA.	4. Mr. Mustafizur Rahman, Engineer-in-Chief, Bangladesh Railway.
5. Dr. Seiichi Sato, Chief of the River Planning division of the Feasibility study Team, JICA.	5. Mr. Emdad Ali, Chief Engineer, Planning and Design, Water Development Board.
6. Mr. Kaoru Tezuka, Chief of the Bridge Planning Division of the Feasibility Study Team, JICA.	6. Mr. G.G. Chowdhury, Chief Engineer, Hydrology, Water Development Board.
7. Mr. Kunio Teshima, On behalf of Chief of the Traffic Survey Division of the Feasibility study Team, JICA.	7. Mr. Mesbahuddin Ahmed, Director-General, Geological Survey.
8. Mr. Fumio Higai, Coordinator, JICA.	8. Mr. A.H.M. Ghulam Kibria, Chief Engineer, I.W.T.A.,
	9. Mr. Mohd. Shafiullah, Deputy Chief Engineer, R & H.

AGENDA
FOR
DACCA MEETING
ON
JAMUNA BRIDGE PROJECT

OCTOBER 1974

JAPAN INTERNATIONAL COOPERATION AGENCY

MATTERS TO BE DISCUSSED

IN

DACCA MEETING

A. Determination of the most suitable site for bridge crossing.

List of construction costs.
List of traffic volume.

B. Successive work schedule.

Bar chart of successive work schedule for the second-stage study.

Bar chart of successive work schedule for geological and quarry survey in Bangladesh and India.

Bar chart of successive work schedule for topographic survey.

C. Request for facilities.

List of items of request for facilities for topographic survey and boring and stone survey in Bangladesh.

D. Requisites for carrying out the second-stage studies.

1. Effective width of the bridge.

2. Treatment of the Dhaleswari River.

3. Design specifications for railway.

Schedule of dimensions (5 ft.6in. gage), Bangladesh Railway.
Code of Practice for Engineering Department of Bangladesh.

4. Design specifications for highway

Geometric Design Standards for Highway from Modern Road Construction Procedures, Road and Highway Directorate, Bangladesh.

ROUGH ESTIMATION OF CONSTRUCTION COSTS OF JAMUNA RIVER BRIDGE

River training : Guide bank system.

Bridge : 3-span continuous steel truss (3 @ 150 m), well foundations and approaches (highway : 2 lanes, railway : single broad gage).

Access railway : Broad gage (5'6"), single track.

Access highway : 2 lanes (24').

Unit: 10 crore TK

Proposed Site for Bridge Construction	Distance between Guide Banks Km (mile)	Bridge			Access			Grand Total
		River Training	Bridge	Total	Railway	Highway	Total	
Bahadurabad	4.2 (2.6)	8.3	22.3	30:5	12.9	2.3	15.2	46
	5.6 (3.5)	6.9	27.9	34.7	12.9	2.3	15.2	50
Gabargaon	4.2 (2.6)	9.6	22.3	31.9	13.0	2.6	15.6	48
	5.2 (3.3)	7.9	26.3	34.2	13.0	2.6	15.6	50
Sirajganj	4.2 (2.6)	9.3	22.3	31.6	8.9	2.8	11.7	43
	5.6 (3.5)	8.0	28.0	36.0	8.9	2.8	11.7	48
Nagarbari	4.2 (2.6)	11.3	23.9	35.2	10.3	1.6	11.9	47
	5.2 (3.3)	9.3	27.6	36.9	10.3	1.6	11.9	49

Note :

1. All costs given in the above table were counted at unit prices as of March 1974.
2. The following costs are excluded from the grand total of the above table and will roughly amount to TK 2,200,000,000.
   a. Costs for administration and engineering.
   b. Costs of general facilities for construction.
   c. Contingencies.
3. The project cost will roughly amount to TK 6,700,000,000 to TK 7,000,000,000 adding the above cost.
4. Costs of Sirajganj are based on closing the upper one of the offtakes of the Dhaleswari River.

Estimated Passenger Trips Crossing the Jamuna

Unit : 10,000 persons/year

Site / Mode \ Year	1982/83	1992/93	2002/03	2012/13	2022/23
Bahadurabad, Gabargaon					
Overland	1,484.5	2,326.0	3,424.1	3,715.1	4,006.1
Waterborne	507.3	809.0	900.0	900.0	900.0
Total	1,991.8	3,135.0	4,324.1	4,615.1	4,906.1
Sirajganj					
Overland	1,613.0	2,528.0	3,452.4	3,732.4	4,012.4
Waterborne	563.8	896.0	1,000.0	1,000.0	1,000.0
Total	2,176.8	3,424.0	4,452.4	4,732.4	5,012.4
Nagarbari					
Overland	1,743.2	2,691.0	3,856.8	4,165.3	4,473.8
Waterborne	734.7	1,199.0	1,200.0	1,200.0	1,200.0
Total	2,477.9	3,890.0	5,056.8	5,365.0	5,637.8

Estimated Commodity Flow Crossing the Jamuna

Unit : 1,000 tons/year

Site / Mode \ Year	1982/83	1992/93	2002/03	2012/13	2022/23
Bahadurabad, Gabargaon					
Overland	860	1,365	2,167	3,440	4,359
	(1,718)	(2,793)	(4,541)	(7,383)	(9,338)
Waterborne	165	275	275	275	275
Total	1,025	1,640	2,892	3,715	4,634
	(1,883)	(3,068)	(4,816)	(7,658)	(9,613)
Sirajganj					
Overland	1,198	1,902	3,019	4,793	6,465
	(1,931)	(3,139)	(5,104)	(8,298)	(11,251)
Waterborne	184	310	310	310	310
Total	1,382	2,212	3,329	5,103	6,775
	(2,115)	(3,449)	(5,414)	(8,608)	(11,561)
Nagarbari					
Overland	1,320	2,096	3,327	5,281	6,640
	(2,017)	(3,279)	(5,331)	(8,668)	(11,067)
Waterborne	174	285	285	285	285
Total	1,494	2,381	3,612	5,566	6,925
	(2,191)	(3,564)	(5,616)	(8,953)	(11,352)

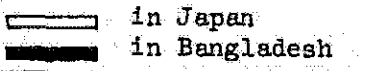
Note: Figure in ( ) shows the goods movement in the presence of development projects in Rajshahi Division.

WORK SCHEDULE

in Bangladesh
in Japan

Item \ Fiscal Year (Japan) / Month	1974 A	M	J	J	A	S	O	N	D	J	F	M	1975 A	M	J	J	A	S	O	N	D	J	F	M	1976 A	M	J	J	A	S	O	Remarks
Surveying																																
Cross-sectional surveying							■	■	■	■	■	■	■																			
Topographic surveying							■	■	■	■	■	■	■																			
Aerophotographing and mapping								■	■	■	■	■	■																			
Geological and quarry survey																																
Boring								■	■	■	■	■																				
Test of sampled soil												■	■																			
Quarry								■	■	■	■	■	■																			
River planning																																
Collection of data							■	■	■	■	■	■	■																			
Geomorphologic study							■	■	■	■	■	■	■																			
Planning of river training works														■	■	■	■	■	■	■	■	■	■	■								
Planning of construction works																																
Traffic survey																																
Collection of data										■	■	■	■																			
Study on economic activity										■	■	■	■																			
Study on transportation										■	■	■	■																			
Bridge planning																																
Collection of data														■	■	■	■	■	■	■	■	■	■	■								
Planning of bridges																																
Planning of construction works																																
Benefit-cost analysis																																
Estimation of benefits																■	■	■	■	■	■	■	■	■								
Estimation of total cost																																
Benefit-cost analysis																																
Report																																
Draft final																									■							
Final																															■	

WORK SCHEDULE FOR GEOLOGICAL AND QUARRY STUDY IN BANGLADESH



	1974		1975		
	November	December	January	February	March
Boring work	14				14
Stone survey*	18	25			

WORK SCHEDULE FOR SURVEYING

Item \ Month	1974 AUG	SEP	OCT	NOV	DEC	1975 JAN	FEB	MAR
Advance prepararation	11 ———	———	——— 31					
Preparartion in field			23 ———	———	4			
Establishment of gauging stations					28	2		
A block								
Control point survey					6 ———	——— 23		
Hydrographic survey						3 ——— 22		
B block								
Control point survey					24 ———	——— 7		
Hydrographic survey						23 ———	——— 13	
C block								
Control point survey						8 ——— 20		
Hydrographic survey							14 ———	——— 11
Sounding at river mouth								2 3
Sounding at other river								4 6
Leveling and pricking					5 ———	———	——— 20	
Photographing				14 ———	14			

LIST OF ITEMS OF REQUEST FOR FACILITIES FOR TOPOGRAPHIC SURVEY AND BORING AND STONE SURVEY IN BANGLADESH

1. Topographic survey.

(1) Aero-photography.

i. Securing aviation fuel required for aero-photographing in Bangladesh. The fuel expenses shall be borne by the Japanese survey team.

ii. Permission to taking out the photographed negative firms from Bangladesh for the work in Japan.

iii. Permission to utilization without compensation of facilities necessary for processing photographs as one rectifier and two printers, and photograph-materials such as developing solution and sensitive papers shall be borne by the Japanese survey team.

iv. Providing two well-experienced counterparts in processing the above photographs for about one month from November to December 1974. Remuneration to counterparts shall be borne by the Japanese survey team.

(2) Survey on the spot.

i. Furnishing a list of coordinates of bench marks and triangulation stations near the survey spot and guiding the survey team to those points.

ii. Furnishing a list of coordinates of the reference points for cross-leveling of the Jamuna river and guiding the team to those points.

iii. Providing six counterparts in total to the Japanese survey team as follows;

one person for the headquarter of the team,
three persons for three groups of control point survey,
one person for one leveling group, and
one person for one sounding group.

Accommodation costs and travel expenses for the counterparts shall be borne by the Japanese survey team.

iv. Permission to taking out the results of surveying and the photographs for the work in Japan.

v. Permission to using radio wave (27 or 50 MC and 0.5 W of electricity) for tranceivers for mutual communication among the surveying groups.

(3) Base camp.

i. Guard for securing safety during the survey works.

ii. Permission to using wireless telephones for communications between the base camp and the Sirajganj office.

iii. Intercession the land for the base camp and taking-off-and landing of the helicopter.

iv. Transportation and medical treatment for any patient in case of emergency.

2. Boring and stone survey.

i. Intercession for lodgings during the quarry survey in Bangladesh.

ii. Securing car fuel necessary for survey on the spot. The fuel expense shall be borne by the geological survey team.

iii. Providing one counterpart from the Geological Survey of Bangladesh for the quarry survey. Accommodation cost and travel expenses for the counterpart shall be borne by the Geological survey team.

GEOMETRIC DESIGN STANDARDS FOR HIGHWAY

		2-LANE TWO-WAY HIGHWAY
ROADBED		12.200m (40'-0") 20.740m (68'-0")
LANE		3.355m (11'-0")
SHOULDER		2.440m (8'-0")
EARTHBERM		0.305m (1'-0")
DESIGN SPEEDS	RURAL	96.5km (60mph)
	URBAN	80.5km (50mph)
RUNNING SPEEDS	RURAL	72.5km (45mph)
	URBAN	64.5km (40mph)
RADIUS OF CORVATURE	60mph	350m (1,146')
	50mph	230m (754')
GRADES		3.0% MAX
PASSING SIGHT DISTANCE	60mph	610m (2,000')
	50mph	520m (1,700')
STOPPING SIGHT DISTANCE	60mph	145m (475')
	50mph	107m (350')
SUPERELEVATION		8.0% MAX

APPENDIX IV

LIST OF MEMBERS

OF

SUPERVISORY COMMITTEE

AND

STUDY TEAM

(1) Supervisory Committee

Assignment		Name	Occupation
Chairman		Mr. Toshiro Nagai	Ministry of Construction
Member	River	Mr. Toshio Iizuka	"
"	"	Mr. Akihiko Tsuchiya	"
"	"	Mr. Shigeyuki Watanabe	Science & Technology Agency
"	"	Mr. Masahiro Taniguchi	Ministry of Construction
"	"	Mr. Sadao Kishimoto	"
"	Bridge	Mr. Ishio Kawasaki	Honshu-Shikoku Bridge Authority
"	"	Mr. Nirekichi Hirokawa	"
"	"	Mr. Tetsuo Kunihiro	Ministry of Construction
"	Geology & Quarry	Mr. Hiroshi Yoshimura	"
"	"	Mr. Keiichi Komada	"
"	Highway	Mr. Shinichiro Asai	"
"	"	Mr. Tooru Nishiyama	"
"	"	Mr. Tamotsu Matsumura	"
"	Regional Economy	Mr. Hidekazu Arai	"
"	"	Mr. Hideo Tokuhiro	"
"	Railway	Mr. Enskichi Abe	Japan Railway Construction Public Corporation
"	"	Mr. Shooji Miyashita	Ministry of Transportation
"	"	Mr. Takeo Kobayashi	"
"	Surveying	Mr. Keiji Nishimura	Ministry of Construction
"	"	Mr. Toshitomo Kanakubo	"

(2) Study Team

Leader in General	Dr. Shizuo Inose
Leader of Geological & Quarry Survey	Mr. Masanobu Sakaita
Member	Dr. Zensuke Yoshida
"	Dr. Mitsuo Oyama
"	Mr. Masao Chida
"	Mr. Yoshiharu Ito
Leader of River Planning	Dr. Seiichi Sato
Member	Prof. Masahiko Oya
"	Mr. Shoji Kawabata
"	Mr. Keiji Adachi
"	Mr. Kazuo Kurosawa
"	Mr. Noboru Jitsuhiro
"	Mr. Takayuki Nobe
Leader of Traffic & Economic Survey	Mr. Yasuo Yanai
Member	Mr. Kinio Teshima
"	Mr. Nobuwaka Yamakawa
"	Mr. Shizuo Iwata
Leader of Highway Planning	Mr. Kunimura Nagashima
Member	Mr. Harumi Nishikawa
"	Mr. Kunio Ohashi
Leader of Railway Planning	Mr. Kazuo Yoshie
Member	Mr. Susumu Shinozaki
Member of Ferry Survey	Mr. Junichi Shimada
Leader of Bridge Planning	Mr. Kaoru Tezuka
Member	Mr. Takeo Sakurai
"	Mr. Yoshihiko Wakabayashi
"	Mr. Toshio Tanaka
"	Mr. Tadao Kamide
Leader of Surveying	Mr. Masao Kikuchi