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

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR RECONSTRUCTION OF FIVE BRIDGES ON DHAKA-CHITTAGONG HIGHWAY

IN

THE PEOPLE'S REPUBLIC OF BANGLADESH

OCTOBER 1997

JAPAN INTERNATIONAL COOPERATION AGENCY
JAPAN BRIDGE AND STRUCTURE INSTITUTE, INC.

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PREFACE

In response to a request from the Government of the People's Republic of Bangladesh the Government of Japan decided to conduct a basic design study on the Project for Reconstruction of Five Bridges on Dhaka-Chittagong Highway and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bangladesh a study team from March 26 to April 15, 1997.

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

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

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

October 1997

Kimio Fujita
President
Japan International Cooperation Agency

Letter of Transmittal

October 1997

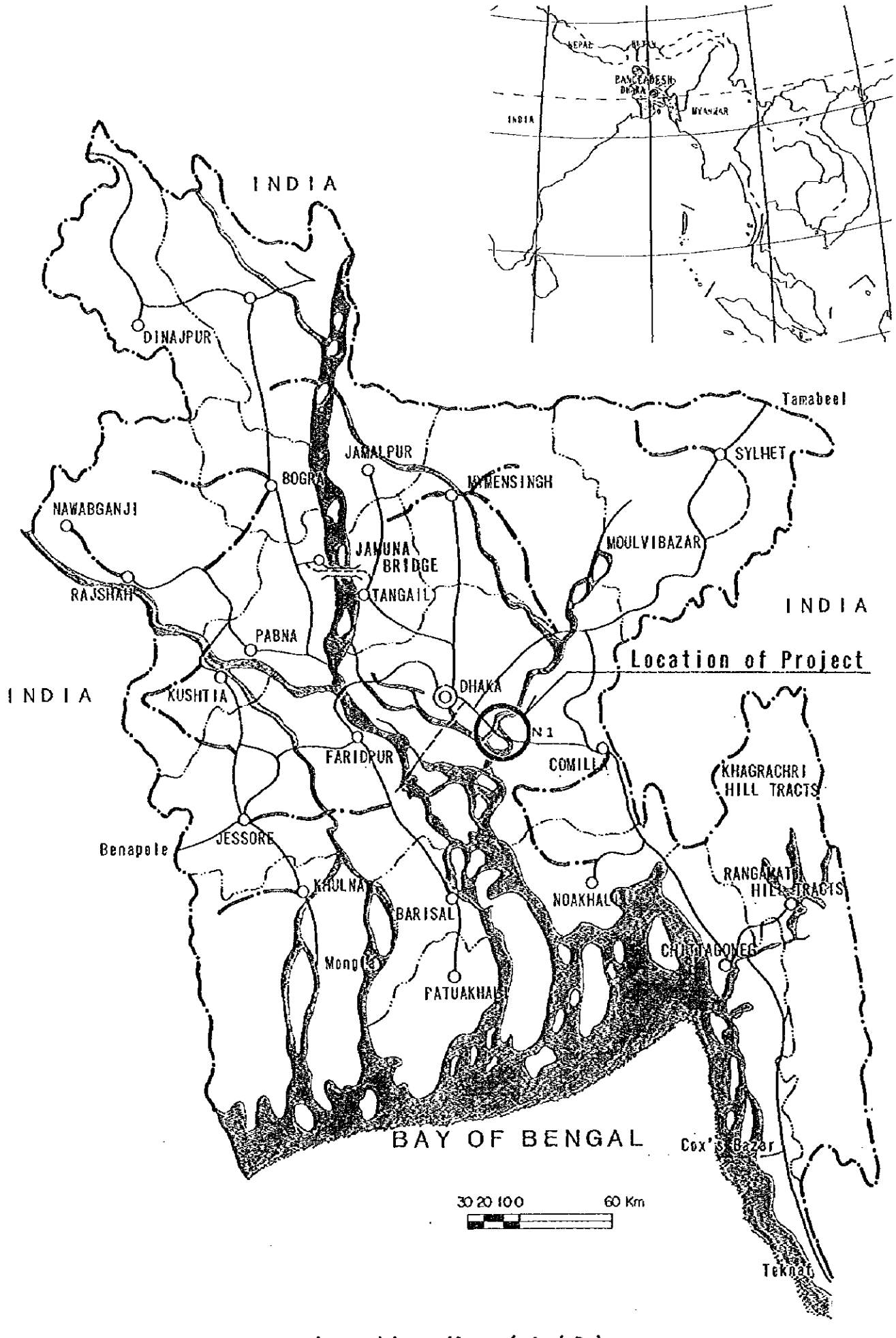
We are pleased to submit to you the basic study report on the Project for Reconstruction of Five Bridges on Dhaka-Chittagong Highway in the People's Republic of Bangladesh.

This study was conducted by Japan Bridge and Structure Institute, Inc., under a contract to JICA, during the period from March to October, 1997. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Bangladesh and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

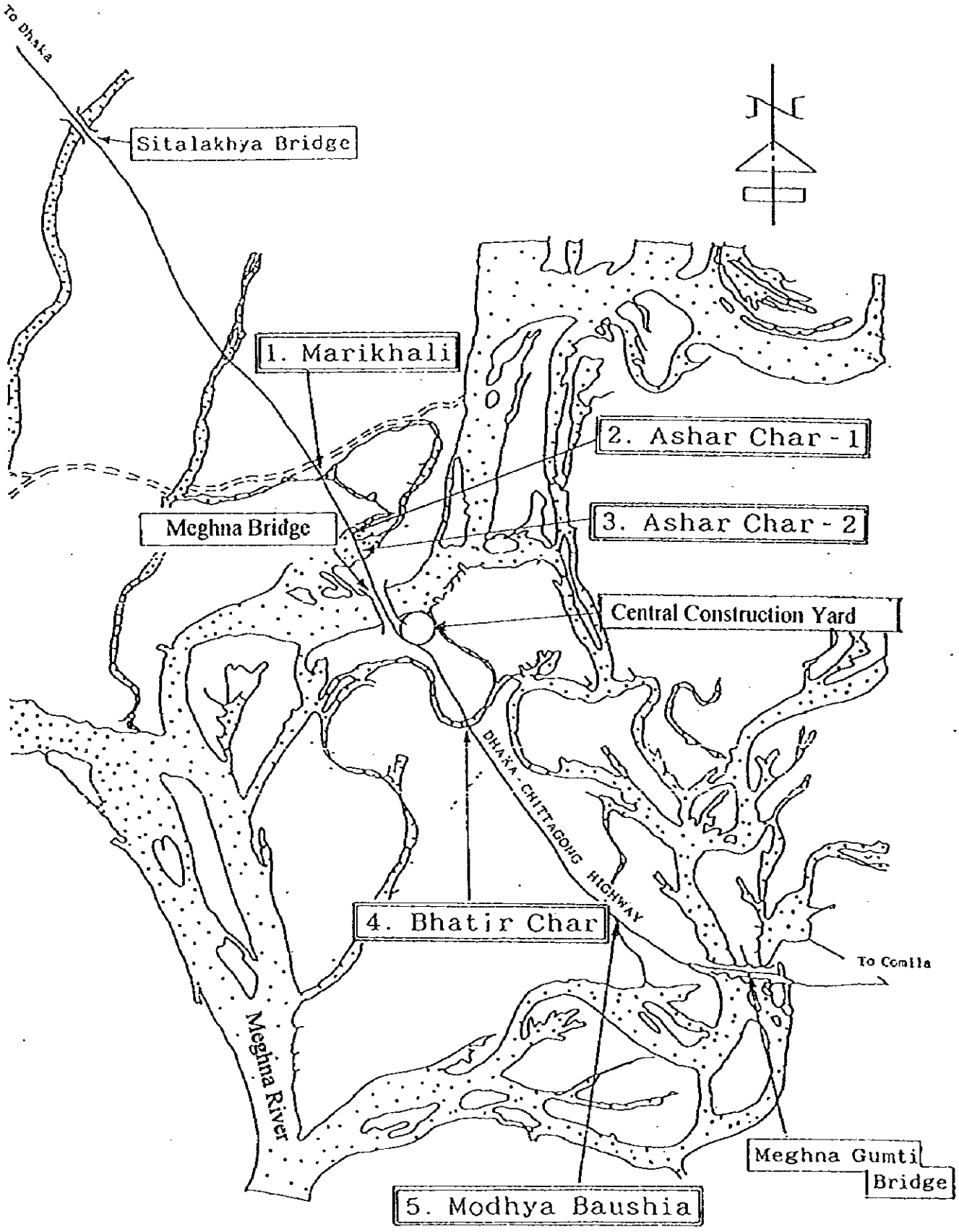
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Dr. Masahisa Komiya
Project manager,
Basic design study team on
the Project for Reconstruction of
Five Bridges on Dhaka - Chittagong Highway
Japan Bridge and Structure Institute, Inc.



Location Map (1 / 2)



Location Map (2/2)

ABBREVIATION

Authorities and Agencies

AASHTO	:	American Association of State Highway and Transportation Officials
ADB	:	Asian Development Bank
GOB	:	Government of Bangladesh
GOJ	:	Government of Japan
JICA	:	Japan International Cooperation Agency
MOC	:	Ministry of Communications
OECF	:	Overseas Economic Cooperatio Fund, Japan
PMOs	:	Project Management Office
PMU	:	Project Management Unit
RHD	:	Roads and Highways Department

Project

BRMP	:	Bangladesh Road Master Plan
JBARP	:	Jamuna Bridge Access Roads Project

Others

Ch.	:	Chainage
D/D	:	Detailed Design
E/N	:	Exchange of Notes
EL	:	Elevation Level
F/S	:	Feasibility Study
HFL	:	Highest Flood Level
ODA	:	Official Development Assistance
PC	:	Prestressed Concrete
ROW	:	Right of Way
psi	:	Pounds per Square Inch

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CHAPTER 1 BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

The roads have the most significant role in infrastructure which in turn support any economic activities of industries in Bangladesh, and approximately 60% of freight transportation depend on the road mode. Among the various routes, Dhaka-Chittagong Highway (Highway No. 1) that links Dhaka to Chittagong, is the most important road since the Dhaka is a center of both politics and economy, and Chittagong; the second capital with a biggest port of the country, is the biggest industrial center in Bangladesh. In fact, around 30% of whole road freight volume is catered by Dhaka-Chittagong Highway. On the other hand, more than 90% of the country area is located in delta regions which have formed by alluvial activities of the Ganges, so the country often suffers from floods in the rainy season which disturb the road transportation. And further deterioration of the Dhaka-Chittagong Highway can be found at many sections. At present, the rehabilitation and improvement of the infrastructure is an urgent matter to promote industrial and economical development of the country. Therefore, the government of Bangladesh has prepared the Road Master Plan (hereinafter referred to as the "BRMP") in which the rehabilitation and improvement plan of the road network is included, and an improvement plan for Dhaka-Chittagong Highway with the support of United Nations, World Bank, Asia Development Bank (ADB), and the government of Japan, is promoted. The BRMP is a long-term programme, divided into different terms each of 10 years duration, regarding the development of the national road network and its maintenance. The Project for the Reconstruction of Five Bridge on Dhaka–Chittagong Highway (hereinafter referred to as the "Project") has been included in the BRMP.

The width of the 5 bridges on the Dhaka–Chittagong Highway is quite narrow (6.7 m), and these bridges will not be able to cope with traffic volume which has increased due to newly constructed bridges; Meghna Bridge, and Meghna Gumti Bridge. Further, all the benefits from these two new bridges cannot be realized because of the vehicle weight restrictions imposed on these five bridges to cover their present deteriorated state regarding durability and strength since these have been in use for the last 33~37 years.

On the other hand, an improvement plan for the road connecting Dhaka to Chittagong, and the road extending to Jamuna Bridge from Dhaka, 283 km in total, is recently being promoted by ADB. The feasibility study (F/S) for the Second Road Improvement Project was implemented in 1991, and the detailed design of Jamuna Bridge Access Roads Project (hereinafter referred the "JBARP") was carried out during 1994~1996. ADB has framed a plan judging from the present traffic conditions that the road connecting Dhaka to Chittagong shall be widened to 4-lane in the future.

Considering the situation, the government of Bangladesh (hereinafter referred to as the "GOB ") has made an application to the government of Japan (hereinafter referred to as the "GOJ") for Grant Aid for the reconstruction of the five bridges which need to be urgently reconstructed, promoting improvement projects of the road assisted by ADB and OECF.

CHAPTER 2 CONTENTS OF THE PROJECT

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2-1 OBJECTIVES OF THE PROJECT

All of the road rehabilitation/development projects undertaken by Road Highway Department (RHD) comply with the BRMP. The JBARP has also been implemented based on the BRMP. The JBARP has a total length of about 143 km; a part (from Jamuna bridge to 20 km south of Feni with a total length of about 77 km) to be executed by ADB loan, and a part (from Dhaka to Tangaile with a total length of about 66 km) to be executed by OECF loan. The Project is a part of the JBARP to be executed by ADB, and is also one of the 40 projects which have to be completed by the year 2000 as per draft document of RHD Fifth Five Year Plan (1997/98 ~ 2001/02).

The 5 bridges are located on the Dhaka–Chittagong Highway, and each bridge is quite narrow to cope with the present traffic volume which has increased due to the completion of the Meghna bridge and Meghna Gumti bridge (Traffic volume at present: 25,600 pcu/day (7th April, 1997), Roadway capacity: 27,600 pcu/day). Further, all the benefits from the new two bridges cannot be realized because of the vehicle weight restrictions imposed on the 5 bridges to cover their durability and strength which have been reduced bue to their deterioration.

The objective of the Project is to reconstruct the 5 bridges to cope with the increased traffic volume after the completion of Jamuna bridge and to realize the maximum benefits from the Meghna and the Meghna Gumti bridges.

2-2 BASIC CONCEPT OF THE PROJECT

2-2-1 EXAMINATION OF APPLICATION

An application from the government of Bangladesh to the government of Japan was made for the reconstruction of the following 5 bridges.

1. Marikhali bridge	L = 92.2 m (Existing)
2. Ashar Char - 1 bridge	L = 217.2 m (Existing)
3. Ashar Char - 2 bridge	L = 108.0 m (Existing)
4. Bhatir Char bridge	L = 153.9 m (Existing)
5. Madhya Baushia bridge	L = 59.0 m (Existing)

The Study Team stayed in Bangladesh from March 26, 1997 to April 15, 1997 to confirm the necessity of the reconstruction of the above mentioned five bridges based on the site survey, have a discussion with the concerned Bangladeshi agencies, and collect the data and information. As a result of this investigation, the Study Team concluded that the application from the government of Bangladesh was appropriate for the Japan's Grant Aid scheme due to their urgent necessity for the reconstruction of these bridges owing to safety problems arising from decrepit state, structural defects and narrow widths.

2-2-2 ALTERNATIVE DESIGN

The detailed design of these 5 bridges has already been carried out by ADB, therefore, the Study Team has reviewed these designs based on the basic concept; to reconstruct bridges which comply with the international standards with low cost and within the schedule. The detailed design for the 5 bridges by ADB was carried out provided that local contractor shall construct these bridges, therefore, the basic concept cannot be realized. So the Study team has made an alternative design (JICA alternative) based on the review which was done for 1) bridge length, location of substructure and span length, 2) type of superstructure, 3) foundation pile, 4) type of abutment, and 5) type of pier.

The differences between the ADB detailed design and the JICA alternative are shown in Table 2-1-1.

2-2-3 ADJUSTMENT WITH ADB PORTION

After the reconstruction of these 5 bridges by Japan's Grant Aid, the other five bridges (ADB portion); parallel and adjacent to these 5 existing bridges, shall be constructed by ADB loan following the same design. Therefore, JICA alternatives and the ADB portions, should have correspondence to each other from hydrological and aesthetical design aspects. The procedure for the adjustment with ADB such as, modification of ADB detailed design and its approval, will be carried out by the government of Bangladesh as its obligation.

Table 2-1-1 Difference between JICA Alternatives and ADB Detailed Design (1/2)

Item	Concept of ADB D/D	Concept of JICA B/D
Center to center spacing between new and existing bridges	9.0 m	The damages around existing abutments are remarkable, and there are road sections which have more than 3 m high gap between existing and new approach roads leading to the bridges. Therefore, c/c spacing of 12 0 m is adopted considering the safety of traffic flow during the construction of new bridges.
Location of New bridges	No. 5 Madhya Baushia bridge is planned at up stream side due to erosion of river bed at down stream side. Other 4 bridges are planned at down stream side where land is secured by GOB.	All 5 bridges are planned at down stream side. For No. 5 bridge, relocation of electric power line and additional land acquisition is necessary at up stream side, however, construction work can be commenced smoothly since land on down stream side is owned by GOB. In addition, the horizontal alignment of the road can be improved resulting in traffic safety flow.
Location of abutments and span components	The location of abutments and piers is determined considering that existing foundations shall not be obstacles when new foundation are constructed after the demolition of existing bridges.	The location of abutments and span components is determined considering that the hydrological conditions shall be improved or at least equivalent to those of present existing bridges, and the existing foundations shall not be obstacles when new foundations are constructed after the demolition of the existing bridges.
Type of superstructure	PC composite beam cast-in-situ on scaffolding at each site is selected considering very common practice in Bangladesh. Three different lengths of beams are considered as; 30m, 40m and 45m.	PC composite beam composed of precast segments (production in central construction yard), for which the construction can be carried throughout the year, is selected to complete the work within certain construction schedule. The span length is basically unified to 30 m considering present local practice, saving in material used, reduction in labor for girders erection and transportation.
Bridge accessories	Expansion joint : Steel plates Handrail : All concrete made Bearing : Rubber Newel post : None	Expansion joint on piers : Slab connection on abutments : Steel fingers Handrail : Precast concrete made Bearing : Rubber Newel post: Concrete made
Foundation pile	Cast-in-place RC piles with 750 mm ϕ are selected, which can be handled by the local contractor.	The kind of pile is as the same as ADB D/D. However, the diameter of 1m is selected considering minimum number of piles, 4 piles (cost saving), and to shorten the construction period.
Type of abutment	Height is determined considering depth of foundation buried enough against existing river bed. Counterfort type is selected, which is very common in Bangladesh. Spill-through type is not selected because of possible danger of erosion and lack of maintenance.	Inverted T wall type is selected, which has superior construction period in addition to saving in cost.
Type of pier	Since rivers in Bangladesh are in natural state and direction of current changes, therefore, rigid frame with 2 round columns type is selected.	Same as ADB D/D.

Table 2-1-1 Difference between JICA Alternatives and ADB Detailed Design (Cont'd)

Vertical profile of road	The design road level has been calculated considering the subgrade level at 30 cm above the design HFL.	Same as ADB D/D
Minimum vertical clearance	One (1) meter above highest flood level (HFL) with a return period of 50 years.	Same as ADB D/D
Concrete works	Concrete mixing by portable mixer with manual casting is assumed, which is common practice in Bangladesh.	In order to obtain high quality concrete, batching plant, agitator truck transportation, and machine casting method is planned.

The second Buriganga bridge is now under construction by one of the biggest contractors in Bangladesh, in which the precast girders for the main span of 44 m are going to be placed by launching girder. Furthermore, the contractor is capable of constructing "Cast-in-place RC piles" up to a diameter of 100 cm by earth auger. Considering this engineering progress, the tender documents shall be reviewed at the time of lending the contract for the ADB portion because these differences might be solved at that time.

2-2-4 BASIC CONCEPT OF THE PROJECT AND ITS OUTLINE

The five bridges, for which the government of Bangladesh has requested, are located on the Dhaka-Chittagong Highway connecting two big cities of the country. Currently, the weight restriction has been imposed on these bridges due to their deteriorated conditions. On the other hand, both Meghna bridge and Meghna Gumti bridge constructed by Japan's Grant Aid are also located on this highway, and various other road rehabilitation projects have been implemented by ADB, OECF, etc.

The field study was carried out by the Study Team from March 26, 1997 to April 15, 1997, to confirm the appropriate contents of the Project; the reconstruction of five bridges to be executed by the Japan's Grant Aid. The coordination with the JBARP and the adjustment between Japan portion and ADB portion are the main tasks for the Study since this Project is cooperative project between Japan and ADB. The government of Bangladesh and ADB have agreed for the effective implementation of the cooperative projects.

Prior to the discussion on the Basic Design Draft Report by the Study Team, the executing agency, RHD, requested for the relocation of No. 5 bridge from upstream side to downstream side of the existing road alignment. The previous location of the bridge was based on the former construction plan with 4-lane bridges. However, the construction plan has been changed to 2-lane bridges to be constructed each by Japan and ADB, and now there is no limitation for the determination of the bridge location. Through the discussion and site reconnaissance, the Study Team has judged that the request by RHD is appropriate by the

reasons; 1) risk for land acquisition required for the construction can be reduced, 2) more desirable road alignment can be obtained, and 3) no engineering problem has been found.

Furthermore, the RHD requested the following matters regarding the Japan portion and the ADB portion at the time of the discussion for the Basic Design Draft Report.

1) The 12 m of embankment from the back of abutments which is to be carried out by Japan's Grant Aid shall be changed to 25 m. Originally, all of the embankment had to be executed by ADB, but now a section of 25 m shall be carried out by the Japan's Grant Aid.

2) The pavement for bridge surface and approach roads of the bridges shall be of asphaltic concrete. These works originally had to be carried out by the Japan's Grant Aid, but now shall be carried out by ADB.

The Study Team judged that the requests were reasonable by the reasons below:

1) Embankment for Approach Road by Japan

- Embankment would be required anyway for the construction yard at the back of the abutments and transportation of equipment and materials for pier construction.
- Protection would be needed at the back of the abutments for floods during rainy seasons.
- The results from site study during rainy season show that 25 m of embankment is reasonable.
- The total cost on part of ADB will be reduced if Japan portion is increased for the embankment.

2) Pavement for Bridge Surface and Approach Road by ADB

- The cost on part of Japan can be saved since it would not be necessary to procure the asphalt plant for small area of the five bridges.
- The cost on part of ADB will not be changed so much even if the pavement is included in the ADB portion. Because pavement works have to be taken likewise for the Sixth construction area (Contract No. 6) for the JBARP.

From the acceptance of their request, the total cost on the part of each Japan and ADB will be reduced respectively.

The basic concept of the Project, established on the above-mentioned judgment and findings, is to promote its effectiveness and maximize the effect from various assisting funds by applying the Japan's Grant Aid to reconstruct the five bridges located on the Dhaka-Chittagong Highway in conformity with the relevant projects such as the JBARP.

2-3 BASIC DESIGN

2-3-1 DESIGN CONCEPT

(1) Design Concept

The basic design has been carried out by considering the followings items in particular.

1) Natural Conditions

i) Climate, Hydrology, and Hydraulics

The rainy season in Bangladesh falls between June and October, and 80% of the annual rainfall (2,000 ~ 2,500 mm) is concentrated during this season.

While the hydrological data at the site of five bridges is not available, the record of water level is available for Meghna river, and the nearby area. According to the maximum water level of Meghna river and other rivers in the neighborhood, and annual hydrographs at the Meghna bridge and Meghna-Gumti bridge, the flood plains spreading besides both banks of each river are flooded for a period of 5 to 6 months. This period starts from May/ June at the latest and ends around October. These flood plains are entirely submerged except main roads and villages owing to the flooding of the Meghna river. The flood with a water height of five meters, corresponding to the elevation of the hills on which villages are located, occurs every year. The maximum water level and its duration depends on the floods in the Meghna river. In the area where the construction of five bridges is anticipated, additional flood damages will not occur along the road, and its upstream and downstream area by securing at least the present discharge of each bridge after the execution of the said road construction project.

The upstream and downstream areas of the five bridges belong to the alluvial low lands and are mostly the plains with an elevation of 5 m or less. The plains are referred to as meander flood plains. Three bridges on the Dhaka side of the Meghna river are built in areas which are topographically categorized as Old Brahmaputra flood plains, while the two bridges on the Comilla side of the Meghna river are built in areas categorized as Middle Meghna flood plains. The villages in the upstream basin are located on plateaus with an elevation of 5 m or more and the areas outside the embankments of both banks of the channels which are mainly used as farmland are low plains with an elevation of approximately 3 m.

The rivers on which these five bridges shall be built and their associated river basins can be considered as the areas similar to lakes and retarding basins rather than ordinary rivers because of their topographic, hydrological and hydraulic properties. In addition, the channels have low average velocity at the time of flood (1 m/s), and a little floating matter such as driftwood. According to the field survey, the boats moving downstream and upstream in channels at the bridge location, have lengths ranging from 5 to 10 m, and widths ranging from 1 to 2 m.

In view of the above mentioned explanation, it is decided to secure hydraulic conditions which are equivalent, or, better than the lengths and spans of the existing bridges. The location of abutments and piers has been planned so that the old foundations may not be obstacles when new foundations are constructed after demolition of the existing old bridges. The most adequate span arrangement has been adopted considering the aspects like cost saving, construction method, and construction period.

ii) Soil

The ground layer at the site is an alluvial stratum composed of silt and clay. The bearing stratum, with the N-value of more than 30, is 25 to 35 m deep, therefore, pile foundation has been considered.

iii) Earthquake

There is almost no data and any information regarding earthquake in Bangladesh since the movement in its crust is not that substantial. Therefore, a horizontal design seismic coefficient k_h has been adopted as 0.06 which is determined based on Bangladesh seismic design code with some modifications according to the Japanese Highway Bridge Specifications.

2) Social Conditions

The cultivation patterns following an increase and a decrease of water level are observed in the areas which are flooded by raised water level during the rainy season. The fisheries those catch the fish carried by flood, as well as inland water fisheries including fish farms those use flood water and ponds to which young fish are carried during the rainy season, are important source of income in the rural community while offering important source of animal protein to the farmers. Therefore, a consideration must be given not to change the various realities of water use during flood and low water seasons both for upstream and downstream areas after the completion of the existing facilities.

3) Construction Field

It is necessary to understand the present condition of the construction field for rational and effective implementation of the basic design. A sufficient consideration has been given to structural, constructional, economical, and safety aspects for the planning of the bridge construction.

- Equipment and materials (quality and difficulty in procurement)
- Level of engineering ability (contractor, consultant)
- Working condition (relevant regulations and laws, customs in commercial activity)

4) Maximum Utilization of Local Contractor, Equipment and Materials

Since experienced local contractors are available for bridge construction in Bangladesh, therefore, it is advisable to subcontract them. On-job-training could be appropriate for technology transfer of precast segmental method by making use of a central construction yard.

A maximum utilization of local contractors, equipment and materials shall be considered for reduction in construction cost.

5) Ability of Agencies Concerned for Maintenance and Management

Many eroded sections in the approach road embankments and at the back of abutments are seen on the existing road. The residents use the embankments for crossing the road, that is also a main factor to promote the erosion of these embankments.

In the basic design, the bridge type and other structural details have been considered for easy maintenance with low cost. In addition, the drainage of road surface and bridge surface has also been considered.

6) Scope and Quality

The construction of the 5 bridges, which have been requested by the government of Bangladesh, shall be the subject of the project. Since these 5 bridges are to be constructed on the most important trunk road in the country, the quality of these structures shall comply with certain international standards.

7) Construction Duration

It is desired that the JBARP, together with this Project, should be completed as soon as possible with the condition that the Jamuna bridge should be completed in June 1998 which will result in a remarkable increase in traffic. A project for the road between Dhaka-Tangail funded by OECF will be opened for public partly in June 1999 by the request of the government of Bangladesh although it is planned to be opened in September 2000. The JBARP will be commenced in September 1997 and completed in December 2000 with a construction period of 39 months. The completion of this project is expected by the end of fiscal year 1999 considering the completion of these relevant projects, and construction period of approach roads which are carried out by ADB loan.

(2) Selection of Bridge Construction Site

The location of bridge sites is selected at the downstream side of existing bridges with center to center spacing of 12.0 m, based on the site survey and review of ADB design.

The location is selected due to the following reasons:

i) Since the land at the downstream side is owned by the government, the project can be commenced without any land problems. There are some houses dotted in private land at upstream side and high voltage electric power lines along the road.

ii) The damages around existing abutments are remarkably progressing, and there are road sections which have height gap of more than 3 m between the existing and new approach roads leading to the bridges. Therefore, c/c spacing of 12.0 m is adopted considering the safety of traffic flow during the new bridge construction.

For the construction to be continued effectively, the superstructure has to be completed in rainy season, while the substructure shall be constructed only in the dry season. To satisfy these conditions, precast segmental method using central construction yard is selected. A vacant land, owned by the government, which is located upstream of Chittagong side of Meghna approach bridge, is selected for the central construction yard. The land is located in the middle of the five bridges, and its location is good for central construction yard with easy transportation of materials by road and waterway, and enough space.

The existing old bridges shall be removed for the construction of new 2-lane bridges to be executed by ADB. These new bridges would be located parallel and adjacent to the five bridges to be constructed by this Project, and their construction shall be carried out after the completion of this Project.

2-3-2 BASIC DESIGN

(1) Bridge Planning

1) Location of Abutments and Span Components

The location of abutments and span components is determined considering that the hydrological conditions shall be improved or at least equivalent to those of present existing bridges, and the existing foundations shall not be obstacles when new foundations, to be constructed by ADB, are constructed after demolishing existing bridges.

The center to center spacing between new piers and the existing ones shall be at least 5 m to prevent any hindrance (see Fig. 2-3-1).

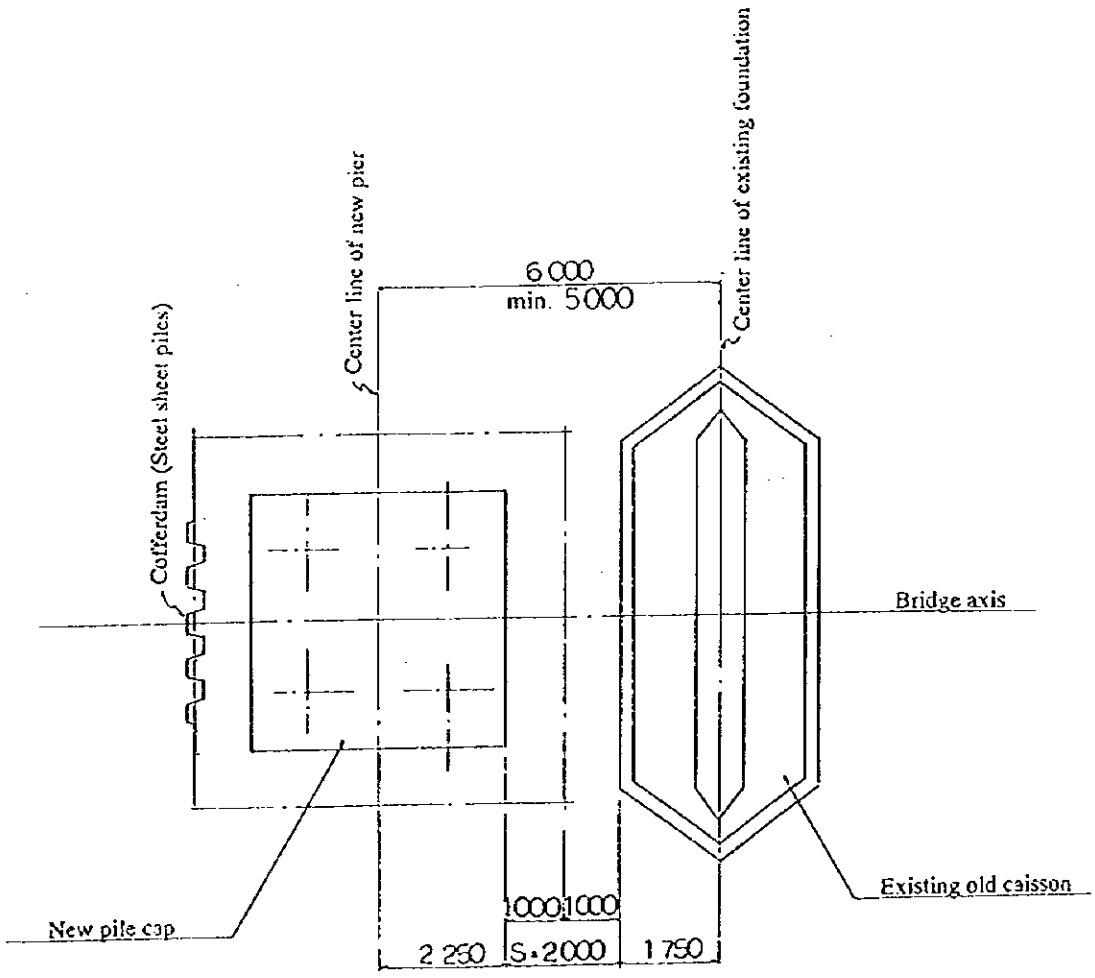


Fig. 2-3-1 Center to center spacing between new and existing foundations

Basically, a span length of 30 m has been selected due to the following reasons:

i) The span length of the existing bridges vary from 18 m to 30.8 m (average 24.1 m), therefore, the hydrological conditions will be improved if span length of 30 m is adopted.

ii) Generally, the impediment ratio of pier width to waterway should be less than 3~5%. The impediment ratio for proposed bridges varies from 2.0% to 3.7%, while that of existing bridges varies from 2.0% to 3.2%.

iii) The construction shall be continued throughout the year to reduce the construction period. In such a case, the superstructure has to be completed in rainy season, while the substructure shall be constructed only in the dry season. To satisfy these conditions, it is the most appropriate to produce precast segmental blocks in the central construction yard during the dry season, and to transport and erect them during the rainy season. A launching girder erection method is more suitable than cast-in-situ on scaffolding. The other advantages for the erection method are as follows:

- The materials required for the construction of superstructure can be saved (see Table 2-3-2).
- It is more economical since only one type of production equipment for girders (30 m), and a launching girder are to be used.
- It is limited to transport a segmental block up to a length of 10 m with a maximum weight of 15 tons due to the present condition of the road between Dhaka and Chittagong. In the case of 30 m span length, one girder (30 m) can be divided into 3 parts with a maximum block weight of 13 tons, therefore, it is more reasonable from the structural, constructional, and economical aspects.
- In case of technology transfer to locals, a span length of 30 m can be commonly used and it is more practical.

The location of abutments and span components, determined in the above mentioned study and discussions, are shown in the Table 2-3-1.

Table 2-3-1 Bridge Length and Span Component

	Name of bridge	Location (Ch km+m)	Proposed Span Component (EL. m)	Proposed Length (m)	ADB Length (m)	Existing Length (m)
1	Marikhali	13+040	3@30.0	90.0	90.0	92.6
2	Ashar Char 1	14+540	4@30.0+35.0+2@30.0	215.0	165.0*	215.5
3	Ashar Char 2	14+945	4@30.0	120.0	120.0	107.5
4	Bhatir Char	20+150	20.0+4@31.0+20.0	164.0	160.0	153.0
5	Madhya Baushia	25+570	2@30.0	60.0	60.0	59.0

*: the proposed bridge length of 165.0 m is derived from the drawings of ADB D/D. The proposed bridge length of 200 m is written in the "Final Report Chapter 4 Hydrology Study Table 4.3 (page 4-15)" prepared by ADB.

2) Type of Superstructure

i) Type of Bridge

A consideration has to be given to the following items to determine the type of a bridge.

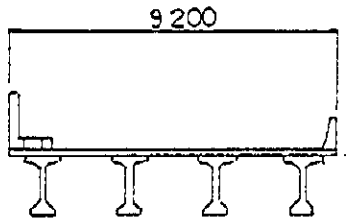
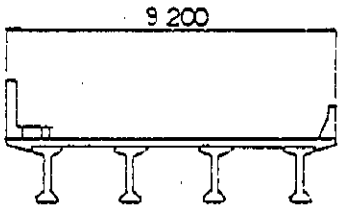
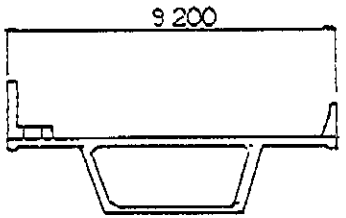
- Maintenance after completion
- Economical aspects
- Constructibility and accuracy to be secured for production of girders
- Conditions for procurement of materials
- Equipment and machinery
- Present condition of construction field and labor
- Type of existing structures

It is judged that the adoption of prestressed concrete bridge is appropriate by considering the above mentioned items, existing bridges, and the bridges currently being constructed in Bangladesh.

ii) Type of Superstructure

The selection of the most appropriate superstructure has been carried out by making a comparison among 3 designs; ADB detailed design, JICA alternative (modified ADB D/D), and another alternative which is totally a new type of PC box girder bridge. As the result of the comparison and discussion, JICA alternative has been selected. The comparison is shown in Table 2-3-2.

Table 2-3-2 Comparison between Types of Superstructure

	Type of superstructure	Span Component		Quantities			Construction
Existing Bridges	simply supported girder with dropping span	Total 23spans	No 1: 30.7+30.8+30.7 = 92.2 m No 2: 19.8+3@24.7+27.7+3@24.7+19.8 = 215.5 m No 3: 19.2+22.2+25.2+22.2+19.2 = 108.0 m No 4: 25.8+20.25+19.55+30.7+30.7+26.0 = 153.0 m No 5: 18.0+23.0+18.0 = 59.0 m				
ADB D/D		3 type L=30m L=40m L=45m Total 16spans	No 1: 3@30.0 = 90.0m No 2: 40.0+45.0+40.0+40.0 = 165.0 m No 3: 3@40.0 = 120.0 m No 4: 4@40.0 = 160.0 m No 5: 2@30.0 = 60.0 m	Concrete Form Reinforcement PC wires Bearing Expansion	m3 m2 t t nos. nos.	3,204 (1.00) 18,227 (1.00) 361 (1.00) 96 (1.00) 128 (1.00) 21 (1.00)	· cast in situ on scafolding · temporaly casting yard at construction site = 6,000 m2
JICA Alternative		one type L=30m Total 21spans	No 1: 3@30.0 = 90.0 m No 2: 7@30.0 = 210.0 m No 3: 4@30.0 = 120.0 m No 4: 5@30.0 = 150.0 m No 5: 2@30.0 = 60.0 m	Concrete Form Reinforcement PC wires Bearing Expansion	m3 m2 t t nos. nos.	2,636 (0.82) 16,267 (0.89) 316 (0.88) 63 (0.66) 168 (1.31) 10 (0.48)	· precast segment by launching girder · temporaly yard = 3,100 m2
Alternative		one type L=30m Total 21spans	No 1: 3@30.0 = 90.0 m No 2: 7@30.0 = 210.0 m No 3: 4@30.0 = 120.0 m No 4: 5@30.0 = 150.0 m No 5: 2@30.0 = 60.0 m	Concrete Form Reinforcement PC wires Bearing Expansion	m3 m2 t t nos. nos.	2,373 (0.74) 13,365 (0.73) 260 (0.72) 74 (0.77) 52 (0.41) 10 (0.48)	· precast segment by incremental launching · temporaly yard = 1,100 m2 · no nessecity cast in situ concrete at construction site

The main features of JICA alternative are as follows:

- Production of precast segmental blocks in the central construction yard during dry season
- Construction by launching girder during rainy season
- Modifications in dimensions of the main girders to reduce their self weight

3) Substructure

i) Foundation Piles

The foundation piles shall be cast-in-place concrete piles which have the same design as that of ADB detailed design.

The diameter of pile is set as 75 cm in the ADB detailed design subject to the ability of local contractor to deal with a pile dia. of 75 cm only at present in Bangladesh. However, for the JICA alternative, it is possible to procure the driving machine for the most appropriate dia. of pile from Japan. Further, a minimum number of piles required is 4 per pier. But the number of piles would be less than 4 if piles of over 100 cm dia are used, which is not desirable structurally. The construction period required for pile works of 100 cm dia. and 75 cm dia. is 110 days and 205 days respectively. The piles of 100 cm dia. are selected due to the above mentioned reasons, and the realization of sharp reduction in construction period.

ii) Type of Abutment

The height of abutment ranges from 9 m to 11.5 m. It is possible to adopt an "inverted T type abutment" which is commonly used in Japan within this range. This type is more economical with a reduced construction period as compared to the Counterfort type abutment of ADB detailed design. The constructibility for the inverted T abutment is superior to the other types. Therefore, the "inverted T type abutment" is selected.

iii) Type of Pier

A rigid frame with two round columns is selected for pier structure. Since the rivers are in natural state, the water currents change their direction but the

velocity of flood water currents is not so high, and debris and drift woods seldom come across. Therefore, there are not so many problems from the river/ hydraulic engineering aspects. In addition, this type of pier is very common practice in Bangladesh.

Where the span length is 35 m, trestle deck type pier is selected to shorten the span length to 30 m as shown in Fig. 2-3-2.

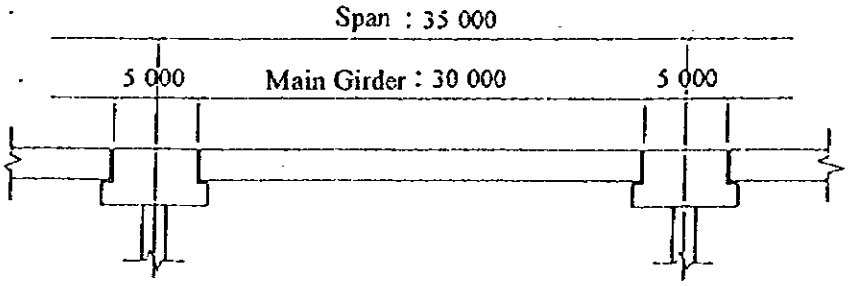


Fig. 2-3-2 Trestle deck type pier

iv) Embedded Depth of Pier/ Planned Earth Cover

In this study, the embedded depth of pier for each bridge has been set as shown in Table 2-3-3, based on the estimation from Andru's formula, which gave the largest depth of scour among the six formulas shown below.

- Andru formula
- Laursen formula
- Neill-Cunha formula
- Tarapore formula
- Breusers formula
- Lacey formula

Table 2-3-3 Planned Earth Cover

	Name of bridges	Width of pier (m)	Design flood level (EL. m)	Average elevation of river bed (EL. m)	Present deepest elevation of river bed (EL. m)	Depth of scour (m)	Assumed max. depth of scour (m)	Planned earth cover (m)
1	Marikhali	1.20	6.27	1.85	-0.146	3.54	-1.69	1.60
2	Ashar Char 1	1.20	6.25	1.24	0.436	4.01	-2.77	3.30
3	Ashar Char 2	1.20	6.24	-0.58	-2.722	5.45	-6.03	3.40
4	Bhatir Char	1.20	6.17	-1.35	-8.621	6.02	-7.37	1.00
5	Madhya Baushia	1.20	6.09	0.27	-1.430	4.65	-4.38	3.00

Notes:

1. Average elevation of river bed :
   (planned high water level) - (area of river under planned high water level / width of water surface)
2. Depth of scour :
   determined by Andru formula
3. Planned earth cover :
   (assumed max. depth of scour) - (present deepest elevation of river bed)

The results are rounded up by 10 cm (minimum 1.00 m).

4) Protection Works for Abutments / Piers

i) Bank Protection Works for Abutments

Although a maximum velocity of 1 m/s in rivers at the bridge construction sites is not high, the floods from the surrounding areas are concentrated just upstream of the bridge locations, and these flows scour the river bed near the foundations of substructures. Since the backfill around the abutments, where flood flows down, is expected to be affected by erosion and scouring partly due to the influence of overflow from road surface, therefore, measures to protect the abutments from such influences of flow must be taken.

An anti-erosion structure stretching 10 m shall be built upstream and downstream along both sides of abutment to protect the filling at the back of the abutment and to prevent scouring of both sides of abutment footing.

The methods such as, gabion piling method, sheet pile method, and reinforced concrete bank protection method, shall be adopted for the construction of anti-erosion structures. The most optimum method will have to be determined by comparing and examining these methods keeping in mind safety, executability and economic efficiency. At the same time, these forms of anti-erosion structure shall be examined to select the form that requires a little maintenance cost in the future and leads to a reduction in the project cost.

ii) Protection Works for Piers

Since the pier foundation in the river is subjected to localized erosion, which is judged from the geological condition of the river bed, therefore, sufficient embedment depth of the substructure foundation, and local scour depth of piled foundation, have been secured in the design.

(2) Establishment of Design Conditions

The design conditions and standards are established based on AASHTO, which is commonly used in Bangladesh, and a discussion with RHD. An outline of these is as follows:

1) Standards to be Applied

- AASHTO (Standard Specifications for Highway Bridges, 1992)
- Japan Highway Bridge Specifications, 1995

2) Width Components and Sectional Dimensions of Parapet Wall and Hand Rail

See Fig. 2-3-3.

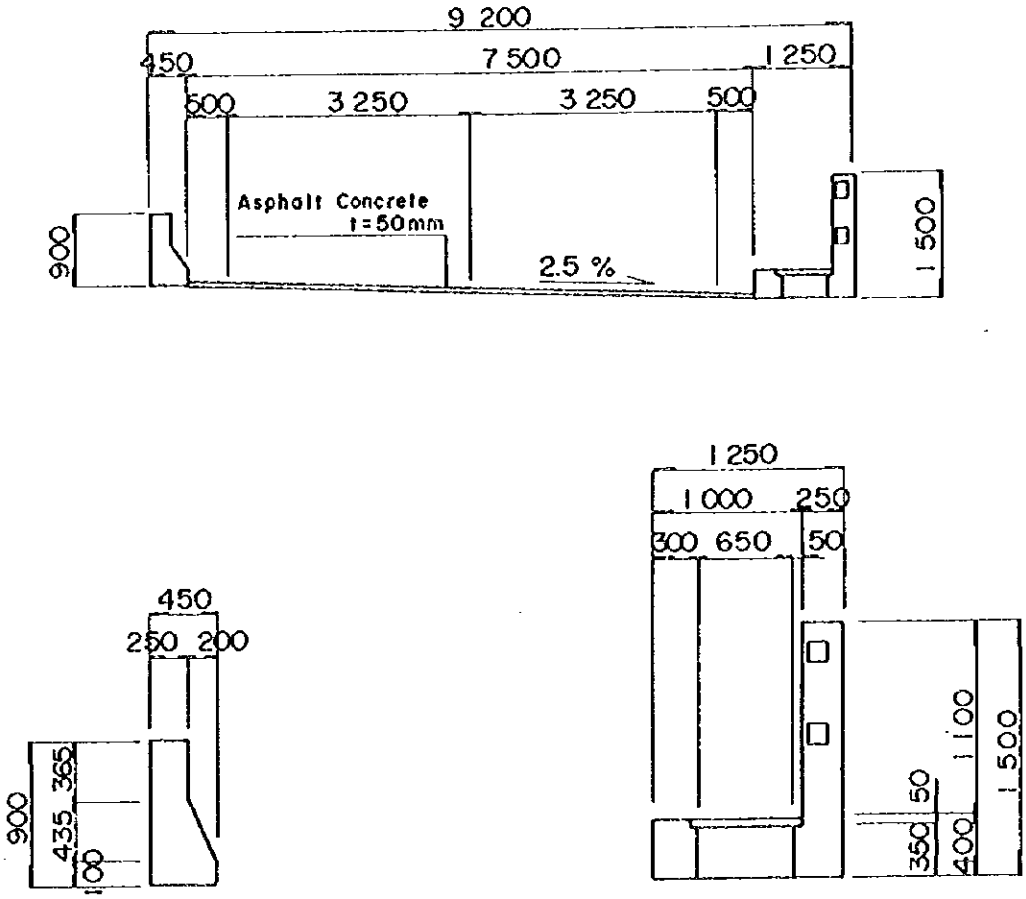


Fig. 2-3-3 Width components and sectional dimensions of parapet wall and hand rail

3) Design Flood Level

The design flood level for each bridge shall be established based on the flood record of 1987. The flood of 1987 is estimated as a flood with a probability of 1/20 as mentioned in the Detailed Design Report of ADB, and is used as the highest water level (Design Flood Level) for these bridges in the relevant section of the Project.

According to the above mentioned report, the design flood level at respective locations was established based on the flood water level of 1987 through linear interpolation between Demra of Shitalakhya river and Daudkandi of Meghna river using assumed alignment. The design flood level for each location is shown in Table 2-3-4 in the following.

Table 2-3-4 Design Flood Level

	Name of Bridges	Location (Ch. km+m)	Design flood level (1987) (EL. m)	Flood level of 1/20-possibility (data up to 1983) (EL. m)	Max. flood level (flood in 1988) (EL. m)
1	Marikhali	13+040	6.27	6.33	6.68
2	Ashar Char 1	14+540	6.25	6.32	6.63
3	Ashar Char 2	14+945	6.24	6.31	6.62
4	Bhatir Char	20+150	6.17	6.19	6.49
5	Madhya Baushia	25+570	6.09	6.02	6.39

4) Structural Analysis

Design of Superstructure

- Analyzed by elasticity theory
- Designed by allowable stress design method and load factor design method:
  Serviceability limit state : Allowable stress design method
  Ultimate limit state : Load factor design method
- Calculations for load distribution are carried out by grid analysis
- Designed after considering the effect of age difference of concrete between main girder and the deck slab

Design for Substructure

- Foundation has been designed to transmit the load from the superstructure as specified in AASHTO, and the load acted on substructure itself, safely to the ground.
- Each member of the substructure shall be designed both at serviceability limit state and ultimate limit state.

5) Loads and Load Combinations

The design live load shall be as follows:

HS load (AASHTO 3. 7. 6)

Loads to be considered and their symbol are as follows:

- Self weight : DL
- Bridge surfacing works : SDL, and, D = (DL+SDL)
- Vehicle (Live) : L

- Impact : I
- Longitudinal Force : LF
- Wind : W
- Temperature : T
- Water stream pressure : SF
- Buoyancy : B
- Earthquake : EQ
- Prestressing force : P
- Shrinkage : S
- Creep : R
- Earth pressure : E
- Erection load : ER

Note : For loads such as wind, temperature, and earthquake, the environmental conditions shall be considered at the location of 5 bridges for their design.

Load combinations are shown in Table 2-3-5.

Table 2-3-5 Load Combinations

Load Com.		D	L+I	E	B	SF	W	WL	LF	R|S|T	EQ	%
1	S	1.00	1.00	β_E	1.00	1.00	—	—	—	—	—	100
	U	$1.3\beta_D$	2.17	$1.3\beta_E$	1.30	1.30	—	—	—	—	—	N/A
2	S	1.00	—	1.00	1.00	1.00	1.00	—	—	—	—	125
	U	$1.3\beta_D$	—	$1.3\beta_E$	1.30	1.30	1.30	—	—	—	—	N/A
3	S	1.00	1.00	β_E	1.00	1.00	0.30	1.00	1.00	—	—	125
	U	$1.3\beta_D$	1.30	$1.3\beta_E$	1.30	1.30	0.39	1.30	1.30	—	—	N/A
4	S	1.00	1.00	β_E	1.00	1.00	—	—	—	1.00	—	125
	U	$1.3\beta_D$	1.30	$1.3\beta_E$	1.30	1.30	—	—	—	1.30	—	N/A
5	S	1.00	—	1.00	1.00	1.00	1.00	—	—	1.00	—	140
	U	$1.25\beta_D$	—	$1.25\beta_E$	1.25	1.25	1.25	—	—	1.25	—	N/A
6	S	1.00	1.00	β_E	1.00	1.00	0.30	1.00	1.00	1.00	—	140
	U	$1.25\beta_D$	1.25	$1.25\beta_E$	1.25	1.25	0.375	1.25	1.25	1.25	—	N/A
7	S	1.00	—	1.00	1.00	1.00	—	—	—	—	1.00	133
	U	$1.3\beta_D$	—	$1.3\beta_E$	1.30	1.30	—	—	—	—	1.30	N/A

Notes:
1. β_D is 0.75 for the design of column (at minimum axial force and maximum moment either from bending or eccentricity), and 1.0 for other members.
2. β_E is 1.0 for vertical earth pressure, 0.5 for lateral earth pressure when checking the moments in rigid frames, and 1.3 for design of retaining wall.
3. Checking for erection shall be made by a load combination of 1.30 × (DL+ER)

6) Materials to be Used and their Strength

- Concrete

Main girder	: Compressive strength	: 350 kg/cm² (5,100 psi)
Cross beam & Deck slab	: Compressive strength	: 240 kg/cm² (3,500 psi)
Structural part above pile cap for abutment and pier & pile cap	: Compressive strength	: 240 kgf/cm² (3,500 psi)
Pile	: Compressive strength	: 300 kgf/cm² (4,250 psi)

- Reinforcement (Deformed Bars, Grade 60)

: Yield strength : 4,200 kgf/cm² (60,000 psi)

- PC tendons : Tensile strength : 19,000 kgf/cm² (T12.7)
18,500 kgf/cm² (T21.8)
16,500 kgf/cm² (12 ϕ 7)

7) Stability Calculations for Pile Foundation

The following 3 forces shall be checked according to Article 4.6; Drilled Shafts, of AASHTO, 1992.

- Push-in force in pile axial direction determined from the ground condition
- Pull-out force in pile axial direction determined from the ground condition
- Load resistance force of pile

i) Push-in force in pile axial direction

$$Q_u = Q_s + Q_t - W$$

and

$$Q_a = Q_u / FS$$

where,

Q_u = Push-in force in pile axial direction determined from the ground condition (Kips)

Q_s = Maximum pile skin frictional capacity (Kips)

The soil in this project is sandy, therefore, formula for only sandy soil is shown in the following .

$$Q_s = \pi B \sum_{i=1}^{N} \gamma'_i z_i \beta_i \Delta z_i \quad \text{(Sandy soil)}$$

where,

$$\beta_i = 1.5 - 0.135\sqrt{z_i} \quad (1.2 > \beta_i > 0.25)$$

Q_t = Pile end bearing capacity (Kips)

$$Q_t = q_t . A_t \quad \text{(Sandy soil)}$$

where,

$q_t = 1.20\,N$ (Ksf) $(0 \le N \le 75)$

$q_t = 90$ (Ksf) $(N > 75)$

A_t = Cross-sectional area at the bottom of pile (sft)

W = Pile self-weight (Kips)

FS = Factor of safety = 2.5

ii) Pull-out force in pile axial direction

$$Q_u = 0.7\,Q_s + W$$

and

$$Q_a = Q_u / FS$$

where,

Q_u = Pull-out force in pile axial direction determined from the ground condition (Kips)

Q_s = Same as mentioned in (i) above

FS = Factor of safety = 2.5

iii) Load resistance force of pile

The pile has been examined for the following 2 cases similar to other structural members.

- Serviceability limit state : Allowable stress design method

Allowable stress:

Concrete, $\sigma_{ca} = 0.4 f'_c$ (psi)

Reinforcement, $\sigma_{sa} = 24{,}000$ (psi)

- Ultimate limit state : Load factor design method

$\phi M_n \geq M_d$

ϕ : Strength reduction factor = 0.9

M_n : Moment of resistance of pile

M_d : Applied moment

The quantity of reinforcement determined from the serviceability and ultimate limit state has been satisfied.

8) Soil Constants

The soil constants are determined from the geotechnical survey carried out for the ADB detailed design at each location of the bridge. The followings are the tests conducted during the survey which provide an information on the soil classification and relative soil hardness.

- Boring test (soil stratum classification)
- Standard penetration test (relative soil hardness)
- Grain distribution (soil classification)

The design soil constants are established from the existing data in Japan, the above mentioned test results, and the site survey.

Design Constants for Soil

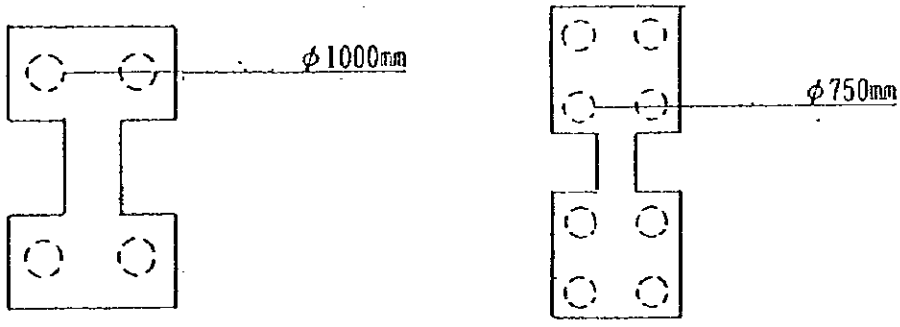
Name of Soil	SPT	Unit weight	Modulus of deformation
Sandy silt	N-value	1.8 tf/m^3	28·N
Silty fine sand	N-value	1.8 tf/m^3	28·N

The soil mainly consists of silty fine sand of well-distributed grains, therefore, the design constants for normal and dynamic conditions, which are commonly used in Japan, are adopted.

(3) Phase 2 (ADB portion)

The structural design and specifications for the Phase 2 shall be implemented in accordance with AASHTO, the same as for the Phase 1. The design results established in Phase 1 shall be applied to Phase 2.

However, the structural checks shall be carried out for pile caps and for structures below pile caps because 750 mm dia. piles which can be constructed locally are used in foundations.



Phase 1
(to be constructed by this Project)

Phase 2
(to be constructed by ADB)

Fig. 2-3-4 Structures below pile caps

(4) Results of Basic Design

The results of basic design are shown in Table 2-3-6 below, and drawings are attached in the Appendix.

Table 2-3-6 Results of Basic Design (Summary)

Bridge No.	1	2	3	4	5
Name	Marikhali	Ashar Char 1	Ashar Char 2	Bhatir Char	Madhya Baushia
Location	STA.12+986.5 to STA.13+76.5	STA 14+442.5 to STA.14+657.5	STA 14+891.0 to STA.15+11.0	STA.20+68.5 to STA 20+232.5	STA 25+547 to STA 25+607.0
Length	90 m	215 m	120 m	164 m	60 m
Span	3@30.0 m	3@30.0+27.5 +30.0+27.5 +30.0 m	4@30.0 m	20.5+4@30.0 +20.5 m	2@30.0 m
Nos. of lanes	2-lane				
Width	Total: 9.2 m, Carriageway: 7.5m				
Superstructure	PC 3-span simple composite girder	PC 7-span simple composite girder	PC 4-span simple composite girder	PC 6-span simple composite girder	PC 2-span simple composite girder
Abutment	Inverted T type				
Pier	Rigid frame with 2 round columns type				
Foundation	Cast-in-place concrete piles of 1000 mm dia.				
Bank protection	Gabions				
Approach road	25.0 m on each side from back of abutment, 50 m in total.				
Location of bridges	Downstream side of existing bridges. Center-to-center spacing of 12.0 m between new and existing bridges.				
Removal of existing bridges	Obligation of GOB.				
Temporary jetty	Embankment + Steel temporary jetty				

CHAPTER 3 IMPLEMENTATION PLAN

CHAPTER 3 IMPLEMENTATION PLAN

3-1 IMPLEMENTATION PLAN

3-1-1 Implementation Concept

The implementation concept for the Project carried out by the Japan's Grant Aid is written below.

(1) It has been considered to reduce the construction period. The commencement of the construction should be at least in the middle of dry season of 1998, and completion should be in the fiscal year 1999 (March 2000). The construction period for the project is 24 months in which three dry seasons are included.

(2) To realize the completion of the 5 bridges by the time as mentioned above, No. 5 Madhya Baushia bridge; which should be reconstructed urgently among the five bridges due to remarkable structural degradation, shall be completed within 1 fiscal year, and other bridges shall be constructed as Japanese government's multi-fiscal year project.

(3) To shorten the construction period, the construction works shall be carried out throughout the year. Since the construction of substructure has to be carried out during dry season in which water level is low, the construction of substructure shall be mainly carried out during the second dry season. The construction of superstructure shall be carried out throughout the year by producing precast girder segments in the central construction yard during dry season and erecting them using the launching girder during rainy season.

(4) To reduce the construction cost, a few number of Japanese engineers and specialists are procured. Re-use of equipment and machinery should be considered. The equipment and materials shall be procured locally unless it disturbs the construction schedule and works.

(5) The construction schedule has been prepared with due consideration given to the ADB portion of 5 parallel bridges, which makes the bridges 4-lane after the completion of the Project.

3-1-2 Implementation Conditions

The following important points should be considered for the construction.

(1) Although there is a plenty of labor in Bangladesh, most of the laborers are now working for Jamuna bridge construction project. Therefore, it can not be expected to utilize this labor force. However, it is quite obvious to expect a certain level of capability from the experiences of an appropriate technology transfer by providing on-job-training by the engineers and the specialists from Japan and other countries.

(2) The local construction including concrete placing is mainly carried out by man-power. The concrete is mixed in a portable concrete mixer and carried on head in a steel pan for placing in the mold. Since high quality is required for the construction, these local construction practices can not be adopted.

(3) Some materials shall be manufactured/ finished locally with the procurement of raw material from Japan or other countries, for example, steel form for deck slab works shall be manufactured locally using steel plate procured from outside the country.

(4) According to the Japanese contractor residing in Bangladesh, there are two major points to be considered according to his construction experience as mentioned in the followings. These points are quite important and might be arisen in this construction, therefore, it is necessary to hold minute discussions with the agencies concerned for the rational and effective construction before the commencement of the construction.

- It takes a long time for import procedure of equipment and materials.
- It takes a long time for procedure and implementation of utility relocation such as, electric line, telecommunication line, etc.

(5) The local engineers shall be employed as site engineers to work under the Japanese engineers who will deal with the technology transfer.

(6) The production and erection of PC girders which requires high engineering skills shall be carried out under the supervision of engineers to be dispatched from Japan as well as the machines and equipment shall be operated under the supervision of Japanese instructors.

(7) The offices for contractors and consultants shall be built in the central construction yard.

(8) Sufficient attention shall be drawn on the existing facilities including bridge structure to be used for transportation of equipment and materials. Any damaged parts shall be repaired before using them to prevent further damage or accidents.

(9) The implementing agency is RHD which is also responsible for maintenance after the completion of the Project.

3-1-3 Scope of Works

The portion of works allocated to Japan and Bangladesh separately are shown in the following.

(1) Japanese Side

- Construction of the 5 bridges
- Approach roads (25 m long from back of each abutment wall)
- Embankment works on the back of abutments for the construction yard
- Construction of road for the bridge construction
- Bank protection works around the bridges
- Construction and removal of temporary facilities for the bridge construction
- Procurement of equipment, materials, and labor for the construction works
- Supervision of the construction works
- Consultancy services for the Project

(2) Bangladesh Side

- Procurement of right-of-way (ROW) and provision of the central construction yard and other land required for the construction
- Resettlement of residents living within ROW and compensation for agricultural produce and fishery
- Tax exemption and procedure of custom clearance for equipment and materials to be imported
- Tax exemption for any staff from Japan and other countries who are concerned with the Project

- Asphaltic concrete pavement works on the 5 bridges and its approach roads

3-1-4 Construction Supervision

(1) Basic Concept for Detailed Design and Construction Supervision

The basic concept for the detailed design and the construction supervision is given as follows.

1) A final decision shall be made for various matters related to the detailed design based on the discussion with the government of Bangladesh and ADB.

2) The government of Japan recommends to the government of Bangladesh that the detailed design and the construction supervision shall be carried out by the consultant who has prepared the basic design.

3) Since the design and quantity calculations are already completed required for the detailed design level at the basic design stage, therefore, the tasks for the detailed design are; preparation of the construction drawings, determination of the final quantities of equipment and materials, preparation of the tender documents, and relevant tender works.

4) The tender documents shall be prepared to meet the requirements for Japan's Grant Aid projects based on the ADB tender documents.

(2) Construction Supervision

1) Assistance in Implementation of Tendering

The tendering shall be carried out by the consultant on behalf of the Government of Bangladesh after the approval of JICA, according to "Guidelines for Consultancy Services - Tendering for Grant Aid Project" prepared by JICA.

2) Construction Supervision

The engineers dispatched for the construction supervision shall carry out the

following tasks.

- Approval of construction plan and construction drawings
- Management for construction schedule and inspection for quality and quantity of the construction works
- Issue of various certificates (payments, completion, and defects liabilities)
- Preparation and submission of reports (progress report, final report, others)

A bridge maintenance guideline will be prepared by the Consultant, which will be a reference for RHD while preparing their bridge maintenance manual for systematic maintenance of bridges constructed under the Project.

(3) Construction Supervision by Consultant

The members of the team for the construction supervision by Consultant shall be as follows:

- Project Manager
- Tendering Specialist (1)
- Tendering Specialist (2)
- Bridge Engineer (Superstructure)
- Bridge Engineer (Substructure)
- Resident Engineer (Bridge Engineer I)
- Resident Engineer (Bridge Engineer II)

3-1-5 Procurement Plan

(1) Materials

1) Basic Concept

The materials required for the construction shall be basically procured locally. The materials which are imported but can be bought at the local market are regarded as local procured materials. However, the materials which involve quality, stable procurement problems, or, extremely high price, shall be imported from Japan and other countries.

2) Local Procurement Condition for Materials

The following is a result of a survey regarding present condition for the material procurement in Bangladesh.

Cement:

The cement which was produced in Indonesia and used to sell in the local market is not available at present. Although there is a Korean cement plant which produces high quality of cement, stable supply cannot be expected due to its capacity. This single plant is currently providing cement for the Jamuna Bridge Project. Another option is to import a cement package of 1 ton from Singapore and store it at the site or to import from Japan.

Reinforcing Bars:

There are some factories which manufacture reinforcing bars up to dia. of 32 mm using imported ingot in the cities of Dhaka and Chittagong. These can be procured locally, however, reinforcing bars with a dia. greater than 35 mm have to be imported.

PC Tendons:

All PC tendons including sheaths have to be imported due to non-availability of these materials locally.

Aggregate:

The aggregate for the concrete and the road can be procured from Sylhet which is located in the north of Bangladesh. The transportation has to be done using waterway during the wet season extending from May to November. During the dry season, sufficient quantity and quality cannot be transported while the prices are high.

Form Materials:

The materials for steel form have to be imported. Timber forms can be procured locally but their quality is quite poor. They also have to be imported if large quantity is required.

Soil for Embankment/ Backfillig behind Abutment:

Purchased soil with good quality dredged from river (sandy soil) can be procured locally. For temporary embankment works, silty sand around site can be used or purchased.

Electric power:

There are electric power lines along the road. However, stable procurement of the power for construction cannot be expected due to low capacity, frequent power cut and unstable voltage. The generator shall be used for this Project as being used for the construction of Meghna and Meghna Gumti bridge projects.

Water:

Since there is not any water supply, deep wells shall be drilled to obtain water for the construction of this Project similar to the above mentioned other 2 bridge projects.

3) Procurement Plan

The procurement plan for the major materials is shown in the Table 3-1-1.

Table 3-1-1 Procurement Plan for Major Materials

Materials			Procurement			Remarks
			Local	Japan	Others	
Steel	Deformed Bar	ASTM GRADE 40,60	*			
	H-beam			*		
	Angle			*		
	Plate			*		
	Sheet pile			*		
	Block slab			*		
	Welding rod			*		
Soil/Stone	Embankment	Dragged soil	*			
	Backfill		*			
	Brick		*			
	Sand		*			
	Gravel		*			
	Crashed stone		*			
	Boulder		*			
	Bentonite		*			
Concrete	Cement		*	*		2/3 : Bangladesh 1/3 : Japan
	Admixture			*		
	Mortar	Non-shrinkage		*		
	Fine aggregate		*			
	Course aggregate		*			
Wood	Plywood			*		
	Timber		*			
Form work, Support	Metal form			*		
	Square pipe			*		
	Pipe			*		
	Form tie etc.			*		
	Support			*		
PC bridge	PC tendon	ASTM A416-85		*		
	Sheath			*		
	Rubber Bearing			*		
	Expansion joint			*		
Pavement	Bitumen		*			
Petrol	Gasoline		*			
	Diesel oil		*			

(2) Equipment and Machinery

1) Basic Concept

The equipment and machinery for the construction shall be basically procured locally, the same as for material procurement. The large-scale machinery shall be imported from Japan and other countries. However, effective re-use of the machinery shall be considered from the economical aspect. The procurement shall be considered for the minimum number of equipment and machinery required.

2) Local Procurement Condition for Equipment and Machinery

There is no private lease company for the equipment and machinery in Bangladesh. Although there are mainly two public lease companies under the RHD and the Dhaka Development Authority, all the machinery is in poor condition and it usually takes about 10 days to start working after the lease. It is judged that the construction plan based on the lease of the equipment and machinery is quite risky.

Any lease company does not exist in Singapore and Thailand. Pay-back system shall be applied for the long-term use.

Therefore, major equipment and machinery shall be procured basically from Japan.

3) Procurement Plan for Equipment and Machinery

The procurement plan for equipment and machinery is shown in the Table 3-1-2.

Table 3-1-2 Procurement Plan for Equipment and Machinery

Name	Specifications	Procurement		Remark
		Local	Japan	
Bulldozer	15 t, 21 t	*		
Backhoe	0.6 m3		*	
Clamshell	0.6 m3		*	
Tractor shovel	1.2 m3		*	
Dump track	10 t		*	
Trailer	25 t		*	
Crawler crane	35-37 t, 40 t,50 t		*	
Track crane	5 t, 15 t, 35 t		*	
Vibration hammer	60 kw, 90kw		*	
Road roller	Macadam 10-12 t		*	
Vibration roller	0.8-1.1 t		*	
Tamper	60-100 kg		*	
Concrete pump track	30 m^3/Hr		*	
Water Sprinkler	5500-6500 L		*	
Generator	20-450 KVA		*	
Concrete plant	30 m^3/Hr		*	
Agitator track	4.4-4.5 m^3		*	
Water pump	150 mm - 20 m		*	
Track	4 t		*	
Welder	250 A		*	
Compressor	3.5-3.7 m^3/Hr		*	
Crawler type piling	2.5t/102 PS/59.5t		*	
Launching girder			*	

3-1-6 Implementation Schedule

The Project will be implemented into 2 stages; the first stage includes the detailed design for all 5 bridges and the construction of No. 5 Madhya Baushia bridge, while the second stage includes the construction of other 4 bridges.

1) The period of the detailed design of the Project will be 2 months. The scope for detailed design is as follows:

   i) Field Study

      After binding in the Consultancy agreement between GOB and the Consultant, the Consultant shall have discussions with GOB and ADB, and final determination shall be made regarding confirmation of the construction site, design conditions, results of the basic design, scope of both Bangladesh and Japanese governments, etc.

   ii) Study in Japan

      Based on the field study, the results of basic design on 5 bridges will be reviewed, and tender documents will be prepared. Drawings for the 5 bridges to be constructed by ADB will also be prepared. Accordingly, modification of tender documents for ADB shall be carried out.

   The undertakings of the GOB about the approval of two detailed design for both Japanese and ADB sides shall be as follows:

   i) The detailed design of the Project shall be approved by GOB after the Exchange of Notes (E/N) in accordance with the general procedures of Japan's Grant Aid scheme.

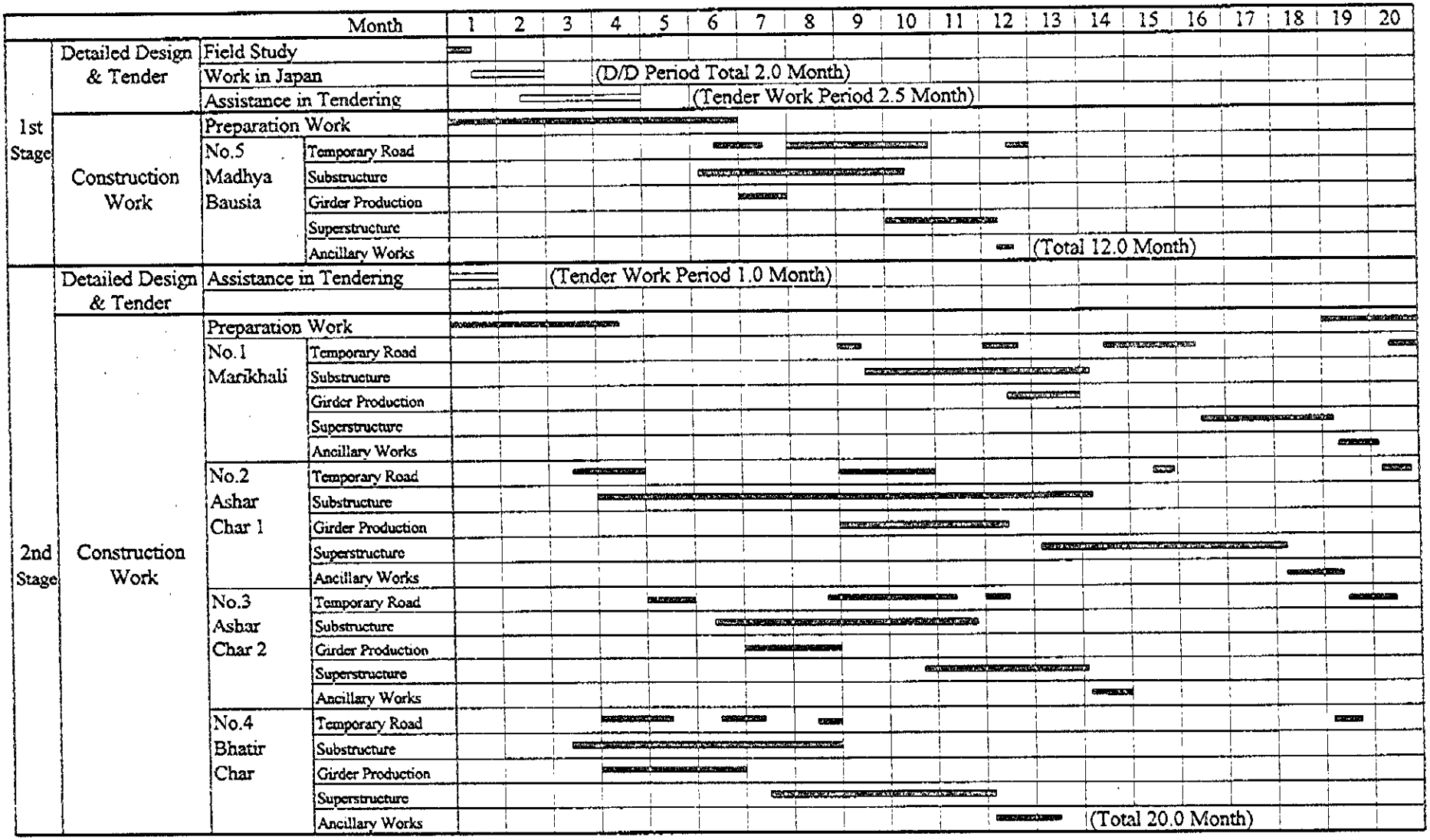
   ii) The GOB shall request to ADB, and ADB consultants, to check the results of detailed design submitted by the Japanese side on the modification of 5 bridges to be constructed by ADB, and take the responsibility for the approval of the design.

2) Construction Works

The construction works can be roughly classified into two groups; whole preparation works, and bridge construction works. The whole preparation works consist of procurement and import of equipment and materials to be used immediately after agreeing the contract, preparation of central construction yard, and the construction of temporary buildings. The bridge construction works include site clearance, foundation works (piles), substructure and superstructure construction works, and construction works for approach road, and bank protection.

Implementation schedule is shown in Table 3-1-3.

Table 3-1-3 Implementation Schedule



3-1-7 Obligation of Recipient Country

The obligation of Recipient Country is described in the Minutes of Discussions attached in this report.

It is desirable when the GOB commences the widening of bridges to 4-lane, the new 5 bridges shall be constructed following the design of this Project. The modification of the detailed design of ADB and its approval shall be carried out under the responsibility of Bangladesh side, therefore, GOJ will not have any concern related to the above matter basically.

3-2 Operation and Maintenance Plan

(1) Organization for Maintenance

The maintenance of the 5 bridges to be constructed, together with other bridges on Dhaka-Chittagong Highway to be constructed by ADB loan, has to be carried out by PMU under the RHD.

The prestressed concrete bridge has been adopted due to its easy and simple maintenance with a minimum cost. Furthermore, a continuous deck slab has been adopted to reduce the number of bearings resulting in minimum maintenance. A sufficient consideration has been given to the drainage of road surface and bridge surface of the designed bridges.

(2) Maintenance Procedure

To keep bridges in an appropriate condition, it is necessary to detect any damage at its initial stage, and to take an appropriate action for its repair. It is important to prepare a manual for bridge maintenance/ management, and use it for understanding the present bridge condition correctly, evaluating, and taking an action for appropriate rehabilitation. The definitions of the bridge maintenance/ management, and their functions, which are the outlines of the manual, are shown in Fig. 3-3-1.

The bridge maintenance guidelines will be prepared by the Consultant, and submitted to the RHD to prepare a manual for bridge maintenance.

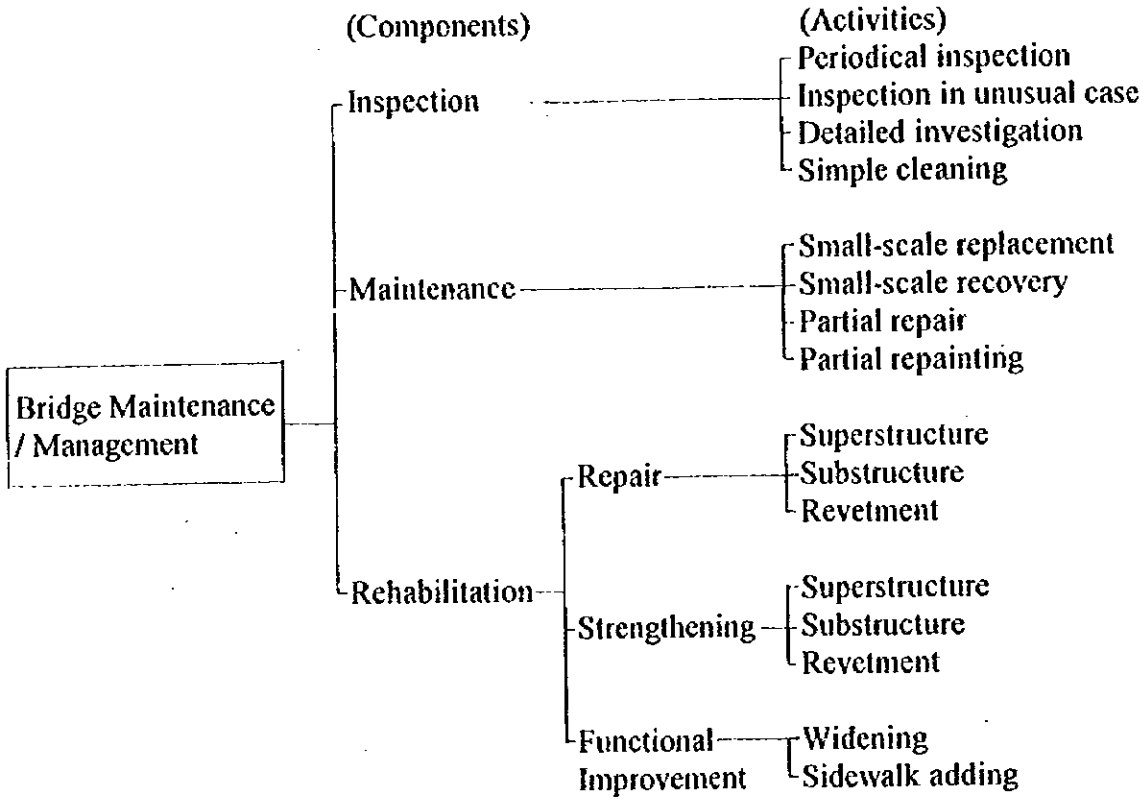


Fig. 3-3-1 Definitions of bridge maintenance/ management and their function

In 1994, the RHD has prepared the bridge inventory collecting data and information from various site offices to respond to many requests of other organizations and agencies related to road and transport sector. It would take some time to establish the maintenance system in accordance with the manual, therefore, temporary daily maintenance action including simple repair shall be taken based on Table 3-3-1. Furthermore, the results of inspection shall be recorded in the bridge inventory each time to keep up with the bridge present condition.

Table 3-3-1 Temporary Maintenance Plan

Item	Inspection Frequency	Repair / Rehabilitation	Repair/Rehab Frequency
Drainage of bridge surface	2 / year	- Remove the earth and sand from bridge surface - Clean drainage pipes	1 / year
Handrail	2 / year	- Repair the damage area of traffic accident	1 / year
Expansion joint	2 / year	- Clean the joints	1 / year
Bearing	2 / year	- Remove the earth and sand from the bearing sheets	1 / year
Substructure	2 / year	- Remove the drift stuff	1 / year
Drainage ditch on approach road	2 / year	- Clean the drainage ditches	1 / year
Embankment works	2 / year	- Repair the damaged parts	1 / years
Pavement	2 / year	- Surfacing, patching, partly paving	1 / 5 years
		- Overlaying, whole paving	1 / 10 years

(3) Cost for Maintenance/ Management

The cost for maintenance/ management of the 5 bridges is estimated as follows:

Inspection	4,000 Taka/ year
Maintenance/ Rehabilitation	262,500 Taka/ year
Total	266,500 Taka/ year

The cost of maintenance/ management is only 0.01% of the annual budget for road maintenance by RHD, amounting 259 Crone Taka for the year 1996-97. In addition, PMOs shall be established, and budget shall be allocated to PMOs for the daily maintenance. Therefore, there may not be a problem for maintenance after the completion of the project.

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATIONS

4-1 PROJECT EFFECT

(1) Study and Examination of Validity

Since the transportation of container trucks has been prohibited on small-medium bridges including the five bridges on the Dhaka-Chittagong Highway, therefore, all the heavy transportation is relied upon railways. However, the railway transportation cannot cope with the increasing traffic volume, which impedes the economic development of Bangladesh. Implementation of the Project leads to the economic development of Bangladesh through an increase in freight by road mode and relieving the restriction of using the bridges by heavy vehicles.

Although the five bridges are located on the Dhaka-Chittagong Highway, which is a target of the JBARP by ADB, the validity of measures to be taken by the Grant Aid of Japan ODA has been confirmed for the five bridges due to their severe deterioration. It is possible for the government of Bangladesh to carry out maintenance and management of the five bridges after their completion quite easily.

(2) Profitable Effect

1) Direct Effect

The following direct effects are expected from implementation of the Project.

- Relaxation of restrictions due to an increase in load carrying capacity (design load HS20-44: vehicle weight 20 t), and improvement of traffic safety.
- Increase in number of passing vehicles, and an improvement in traffic safety, due to the widening of road and bridge structures from 6.7 m to 9.4 m.

2) Indirect Effect

The following indirect effects are expected from the implementation of the Project.

- Economic stimulation effect around the area of Dhaka-Chittagong Highway due to an increase in traffic volume.

- Economic growth due to an increase in physical distribution between the industrial city of Chittagong with a port mainly used for import, and consuming city of Dhaka.
- Effective use of Meghna Bridge and Meghna Gumti Bridge because of passing of large scale vehicles throughout the route.

Along with this Project, the other road improvement projects are carried out by ADB and OECF funds as a part of Jamuna Bridge Access Road Project. Furthermore, in the near future ADB will carry out demolition of existing bridges and reconstruction of new ones as well as widening of road to 4-lane. Since the Dhaka-Chittagong Highway is a part of Asian Highway which passes through Bangladesh, implementation of this Project will result in an increase in International transportation with long-term effects.

4-2 RECOMMENDATIONS

After the completion of five-bridge construction of the Project by Japan's Grant Aid, the same design of bridges will be considered for other five bridges to be undertaken by ADB to increase the total number of lanes to four. Therefore, the design of ADB bridge portion shall be adjusted according to the design of Japan portion to have an easy management, and from their aesthetic point of view. The government of Bangladesh shall deal with all the discussions with ADB regarding any changes in the design of ADB and their approval.

The five bridges funded by Japan's Grant Aid will be opened after the completion of access road constructed by ADB. Since the bridge construction by ADB will start after the demolition of existing old bridges, the access road construction should be completed before the commencement of the bridge construction by ADB in order to secure safe traffic diversions.

APPENDICES

1. Member List of the Survey Team
2. Survey Schedule
3. List of Concerned Party
4. Minutes of Discussion
5. Design Criteria
6. Basic Design Drawings
7. Summary of Jamuna Bridge Access Roads Project's Main Report
8. References

1. Member List of the Survey Team

Basic Design Study (March 25 - April 15, 1997)

Team Leader	
Mr. OKAZAKI Yuji	Director of Planning Division, Grant Aid Project Management Department, JICA
Coordinator	
Ms. YOKOTA Kyoko	Second Expert Assignment Division, Expert Assignment Department, JICA
Consultant	
Mr. KOMIYA Masahisa	Chief Consultant / Road & Bridge Planner Japan Bridge & Structure Institute, Inc.
Mr. HONDA Hiroshi	Bridge Planner I Japan Bridge & Structure Institute, Inc.
Mr. FURUKAWA Tsuyoshi	Bridge Planner II Japan Bridge & Structure Institute, Inc.
Mr. OKABE Nobuyuki	Hydrologist Japan Engineering Consultants Co., Ltd.
Mr. KATAOKA Kazuo	Construction Schedule Planner / Cost Estimator Japan Bridge & Structure Institute, Inc.

Basic Design Study Draft Report Explanation (July 25 - August 4, 1997)

Team Leader	
Mr. OMOTE Shinichiro	Managing Director, Kyushu International Center, JICA
Coordinator	
Mr. IMAI Tatsuya	Second Project Study Division, Grant Aid Project Study Department, JICA
Consultant	
Mr. KOMIYA Masahisa	Chief Consultant / Road & Bridge Planner Japan Bridge & Structure Institute, Inc.
Mr. FURUKAWA Tsuyoshi	Bridge Planner II Japan Bridge & Structure Institute, Inc.
Mr. OKABE Nobuyuki	Hydrologist Japan Engineering Consultants Co., Ltd.
Mr. KATAOKA Kazuo	Construction Schedule Planner / Cost Estimator Japan Bridge & Structure Institute, Inc.

2. Survey Schedule

Basic Design Study (March 25 - April 15, 1997)

26/3 (Wed)	- Survey Team departure from Tokyo and arrival in Dhaka
27/3 (Thu)	- Courtesy Call to officies; JICA, EOJ, ERD, MOC, RHD ADB and OECF Submission of Inception Report and Questionnaires to GOB
28/3 (Fri)	- Site Survey
29/3 (Sat)	- Explanation of Inception Report and Japanese Grant Aid Scheme to MOC, and RHD at MOC - Explanation and discussion on Results of ADB D/D Review to MOC, RHD and ADB Consultant (DDC)
30/3 (Sun)	- Explanation and discussion on Results of ADB D/D Review to ERD, MOC and RHD - Signing of the Minutes of Meeting, Report to EOJ on M/M - Preparation of sub-consultant works
31/3 (Mon)	- Examination of bridge design criteria - Preparation of sub-consultant works - Mr.Okazaki, departure from Dhaka
01/4 (Tue)	- Inspection of 5 bridges - Guidance for scope of sub-consultant works and signing of contract
02/4 (Wed)	- Hydrological inspection at site - Data collection for construction planning and cost estimate - Mr. Furukawa, departure from Tokyo and arrival in Dhaka
03/4 (Thu)	- Data processing - Report to JICA on modification of ADB D/D - Data collection for construction planning and cost estimate - Ms. Yokota, departure from Dhaka
04/4 (Fri)	- Study of structures dimensions
05/4 (Sat)	- Meeting with RHD - Preparation of 5 bridges inspection report
06/4 (Sun)	- Internal meeting of study team
07/4 (Mon)	- Meeting with RHD and ADB consultant on bridge design criteria, proposed elevation, and structural dimensions - Traffic volume counting, axle load survey and topographic survey - Mr. Okabe, departure from Dhaka
08/4 (Tue)	- Meeting with MOC on land for construction yard and aerial observation of 5 bridges - Meeting with RHD relevant to questionnaire and observation of Jamuna bridge - Preparation for Field study report
09/4 (Wed)	- Preparation for Field study report - Preparation for observation of Jamuna bridge - Meeting with MOC on aerial observation of 5 bridges

10/4 (Thu) - Preparation of Field study report
- Observation of Buriganga bridge

11/4 (Fri) - Preparation of Field study report

12/4 (Sat) - Observation of Jamuna bridge
- Meeting with MOC on aerial observation of 5 bridges and appraisal procedure in GOB
- Preparation of Field survey report

13/4 (Sun) - Report to JICA and EOJ on the results of field study

14/4 (Mon) - Meeting with PCI
Consultant departure from Dhaka

15/4 (Tue) - Consultant arrival in Japan

Basic Design Study Draft Report Explanation (July 25 - August 4, 1997)

24/7 (Thu) - Survey Team departure from Tokyo and arrival in Manila

25/7 (Fri) - Courtesy Call to JICA Office and ADB headquarters
Submission of Draft Final Report to ADB and explanation on JICA concept of BD based on above-mentioned report

26/7 (Sat) - Survey Team Departure from Manila and arrival in Bangkok

27/7 (Sun) - Survey Team Departure from Bangkok and arrival in Dhaka
- Courtesy Call to JICA Office

28/7 (Mon) - Courtesy Call to ERD, MOC, RHD and ADB
Submission of Draft Final Report

29/7 (Tue) - Site Survey of 5 bridges
- Explanation and discussion on contents of Draft Final Report to RHD

30/7 (Wed) - Preparation of draft of Minutes of Meeting

31/7 (Thu) - Signing of the Minutes of Meeting
Report to EOJ and JICA on M/M

01/8 (Fri) - Mr.Omote, departure from Dhaka
- Aerial observation of 5 bridges
- Mr. Imai, shifts to other JICA study

02/8 (Sat) - Data processing

03/8 (Sun) - Consultant departure from Dhaka

04/8 (Mon) - Consultant arrival in Japan

3. List of Concerned Parties

Bangladesh Side

Economic Relations Division (ERD)

Mr. Suhel Ahmed	Additional Secretary
Mr. Azizul Islam	Deputy Secretary
Mr. Muhamad Saifullah	Senior Assistant Secretary

Ministry of Communications (MOC)

Mr. Muhamad Abul Quasem	Joint Secretary, Roads and Railways Division
Mr. A.N.M. Serajul Islam	Joint Chief, RRD, MOC
Mr. MD. Nurul Haque	Deputy Chief, RRD, MOC
Mr. A.K.M. Mosarraf Hussain	Deputy Chief, RRD, MOC
Mr. MD. Azizur Rahman	Deputy Secretary, RRD, MOC
Mr. Kamal Uddin Ahmed	Assistant Secretary, RRD, MOC
Mr. Mohammed Abdul Quadir	Research Officer, RRD, MOC

Roads and Highways Department (RHD)

Mr. Moyeen Uddin Ahmed	Chief Engineer
Mr. Mahtab Uddin Ahmed	Chief Engineer (at Field Study)
Mr. J. B. Barua	Additional Chief Engineer
Mr. Serajul Islam	Additional Chief Engineer
Mr. M.A. Jaigirdar	Superintending Engineer
Mr. Mohammed Ali	Sub-Divisional Engineer
Mr. Md. Delowar Hussain	Project Manager 3
Mr. Azizim Rahmeeu	Deputy Project Manager

ADB Resident Mission

Mr. Tord A. Rosengren	Officer-in-Charge
Mr. John F. Brooks	Senior Project Implementation Officer

ADB Consultant (DDC)

Mr. AKM Rafiquddin	Managing Director
Dr. Gholam Mostofa	Engineering Director
Mr. A.S.M. Abdul Hamid	Director, Structural Engineering Section

ADB Manila Headquarters

Mr. M. Faizur Razzaque	Alternate Executive Director
Dr. Gunter Hecker	Manager, Transport & Communication Division (West)
Mr. John R. Cooney	Senior Project Engineer, Transport & Communication Division (West)
Mr. Koji Kaminaga	Project Engineer, Transport & Communication Division (West)

Japanese Side

Embassy of Japan in Bangladesh

Mr. yoshikazu Kaneko	Ambassador
Mr. Hitoshi Sanada	First Secretary
Mr. Yoichi Yamauchi	Second Secretary

JICA Office in Bangladesh

Mr. Morimasa Kanamaru	Resident Representative
Mr. Masaaki Matsusima	Deputy Resident Representative
Mr. Yoshio Fukuda	Deputy Resident Representative
Mr. Zulfiker Ali	Assistant Director

OECF Dhaka Office

Mr. Takeo Matsuzawa	Chief Representative

4. Minutes of Discussion

4-1 Minutes of Discussions , March 30, 1997

4-2 Minutes of Discussions, April 7, 1997

4-3 Minutes of Discussions, July 31, 1997

MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY
ON
THE PROJECT FOR RE-CONSTRUCTION OF 5 BRIDGES ON DHAKA-CHITTAGONG HIGHWAY IN THE REPUBLIC OF BANGLADESH

In response to the request from the Government of the Republic of Bangladesh (hereinafter referred to as "the GOB"), the Government of Japan decided to conduct a Basic Design Study on the Project for Re-Construction of 5 Bridges on Dhaka-Chittagong Highway (hereinafter referred to as "the Project") in the Republic of Bangladesh (hereinafter referred to as "Bangladesh") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA")

JICA sent to Bangladesh the Basic Design Study Team (hereinafter referred to as "the Study Team)", which is headed by Mr. OKAZAKI Yuji, Director of Planning Division, Grant Aid Project Management Department, JICA, and the Study Team is scheduled to stay in the country from March 26 to April 14, 1997.

The Study Team held a series of discussions with the concerned officials of the GOB and conducted field surveys at the study areas.

In the course of discussions and field surveys, both parties confirmed the main items described on the attached sheets. the Study Team will proceed to further works and prepare the Draft Basic Design Report.

Dhaka, March 30, 1997

Mr. OKAZAKI Yuji
Leader,
Basic Design Study Team,
JICA

Mr. M. Azizul Islam
Deputy Secretary,
Economic Relations Division

Mr. Md. Nurul Hoque
Deputy Chief,
Roads and Railways Division,
Ministry of Communication

Mr. M. A. Jaigirdar
Superintending Engineer,
RHD

ATTACHMENT

1. **Attendants of the Discussions**

Attendants of the discussions are listed in ANNEX-1.

2. **Background and Objective of the Project**

By the construction of Meghna bridge and Meghna-Gumti bridge under Japan's Grant Aid, the traffic volume on Dhaka-Chittagong Highway is increasing tremendously. On the other hand, there are still some small bridges on Dhaka-Chittagong Highway which are old and deteriorated. The five bridges existing between the Meghna-Gumti bridge and Sitalakhya bridge are substantially damaged and some concrete floors are missing due to heavy traffic loads, causing the possibility of serious traffic accidents. So these bridges should be reconstructed urgently. For these reasons, the GOB requested Japan's Grant Aid for re-construction of these five bridges with two lanes. The objective of the Project is to contribute to easing traffic congestion, increasing traffic capability, by re-construction of five bridges on Dhaka-Chittagong Highway.

On the other hand, Asian Development Bank (hereinafter referred to as "ADB") has a road improvement project named "Jamuna Access Roads Project" (hereinafter referred to as "the ADB project"), and has completed detailed design including above mentioned five bridges. Estimated completion period of the ADB project is May 2000. These five bridges are a part of "Jamuna Bridge Access Roads Project".

3. **Responsible Organization and Implementing Agency**

Responsible Ministry : Ministry of Communications

Implementing Agency : Roads and Highway Department

4. **Project Site**

The Project site is as shown in ANNEX-2.

5. **Amendment of Bridge Design**

The Study Team proposed amended design of the bridges including the ones which will be constructed under ADB loan as shown in ANNEX-3. However, on the design specification which has been prepared by JICA, opinion will be sought from ADB. The GOB will amend the bridge design and drawings in accordance with the results of the JICA Basic Design Study subject to the concurrence of ADB for ADB portion.

6. Coordination with ADB

The Study Team, the GOB and ADB have confirmed that the coordination and efforts among three parties to their utmost are indispensable for smooth implementation of the Project, especially on the following items.

1) Work allotment
2) Implementation Schedule

7. Major Discussion Items

The major discussion items in accordance with the Inception Report are listed in ANNEX-4.

8. Japan's Grant Aid System

1) The GOB has understood the system of the Japan's Grant Aid explained by the Study Team; the main feature is described in ANNEX-5.
2) The GOB will take the necessary measures, described in ANNEX-6 for the smooth implementation of the Project on condition that the Grant Aid by the Government of Japan is extended to the Project.

9. Further Schedule of the Study

1) The Study Team will continue the study in Bangladesh until April 14,1997 and further study in Japan.
2) Based on the results of the Basic Design Study, JICA will prepare the Draft Basic Design and dispatch a team in the middle of July 1997 in order to consult with the GOB on outline of the Draft Basic Design.
3) Upon acceptance of the Draft Basic Design by the GOB, JICA will complete the Basic Design Study Report and forward it to the GOB around the end of October.

ANNEX-1 : LIST OF ATTENDANTS

Bangladesh Side

1) ERD

Mr. Azizul Islam	Deputy Secretary
Mr. Muhamad Saifullah	Senior Assistant Secretary

2) Ministry of Communication and RHD

Mr. Abul Quasem	Joint Secretary, Roads and Railways Division
Mr. Mahtab Uddin Ahmed	Chief Engineer
Mr. A.N.M. Serajul Islam	Joint Chief, RRD, MOC
Mr. MD. Nurul Hoque	Deputy Chief, RRD, MOC
Mr. A.K.M. Mosarraf Hussain	Deputy Chief, RRD, MOC
Mr. MD. Azizur Rahman	Deputy Secretary, RRD, MOC
Mr. Kamal Uddin Ahmed	Assistant Secretary, RRD, MOC
Mr. Mohammed Abdul Quadir	Research Officer, RRD, MOC

3) ADB, Bangladesh Resident Mission

Mr. Tord A. Rosengren	Officer-in Charge
Mr. John F. Brooks	Senior Project Implementation Officer

4) ADB Consultant

Mr. AKM Rafiquddin	Managing Director
Dr. Gholam Mostofa	Engineering Director
Mr. Hamid	Chief Engineer

Japanese Side

1) The Study Team

Mr. Yuji OKAZAKI	Leader
Ms. Kyoko YOKOTA	Project Coordinator
Dr. Masahisa KOMIYA	Chief Consultant/Road and Bridge Planner
Mr. Hiroshi HONDA	Bridge Planner
Mr. Nobuyuki OKABE	Hydrologist
Mr. Kazuo KATAOKA	Construction Schedule Planner/Cost Estimator

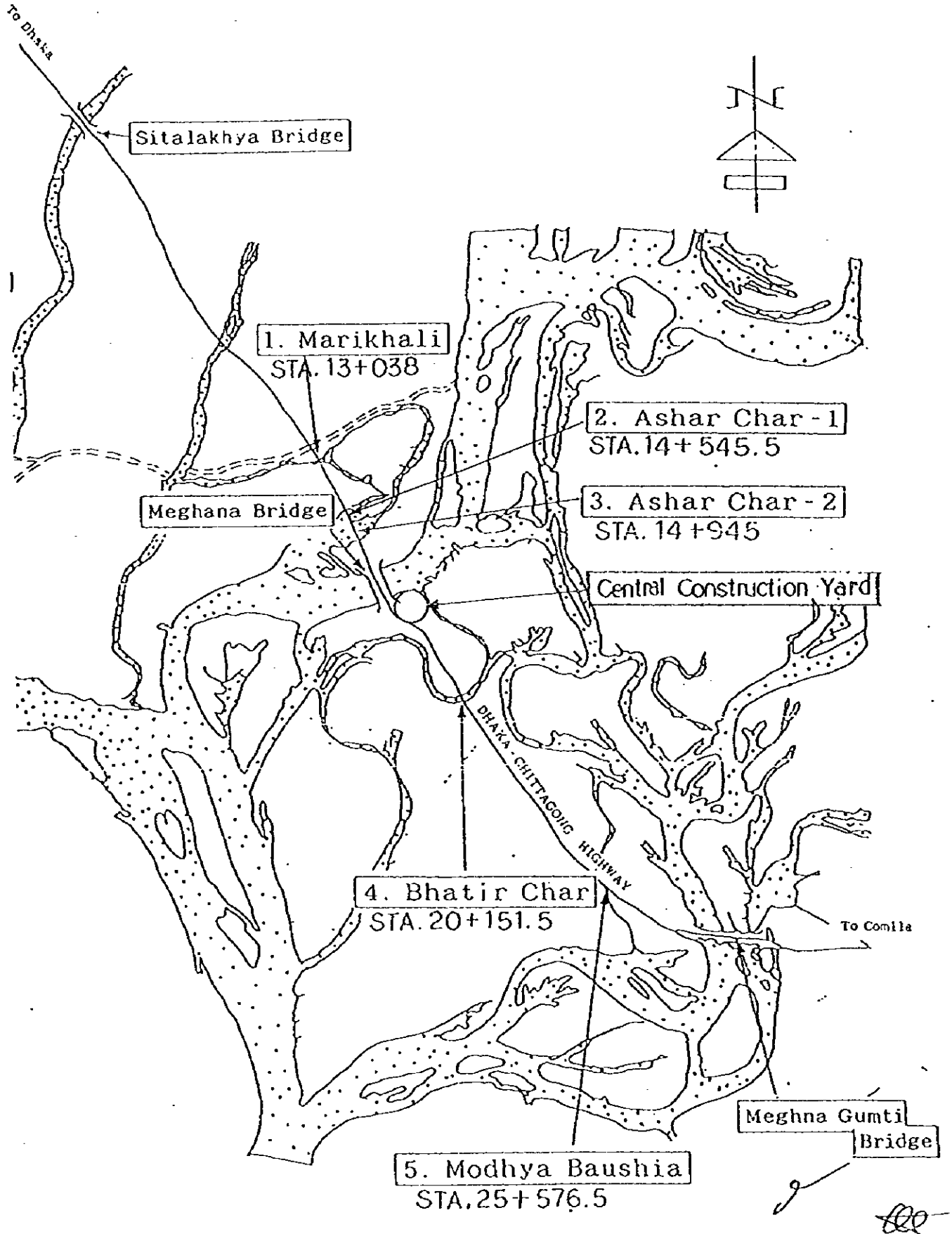
2) JICA Bangladesh Office

Mr. Yoshio FUKUDA	Deputy Resident Representative
Mr. Zulfiker Ali	Assistant Director

3) OECF Dhaka Office

Mr. Takeo MATSUZAWA	Chief Representative

ANNEX-2 : PROJECT SITE



ANNEX-3 : PROPOSED AMENDMENT OF ADB BRIDGE DESIGN

For the achievement of low cost and completing the Project within the schedule, D/D was reviewed by the Study Team for obtaining the quality of bridge structures, which is consistent with the international standard.

GOB has accepted the following proposals:-

1) Bridge Location and Span Length

Name	STA.	Bridge Length(m)	Span Length(m)
1. Marikhali	12+093 ~ 13+083	90.0	3@30.0
2. Ashar Char1	14+438 ~ 14+653	215.0	4@30.0+35.0+2@30.0
3. Ashar Char2	14+885 ~ 15+005	120.0	4@30.0
4. Bhatir Char	20+069 ~ 20+233	164.0	20.0+4@31.0+20.0
5. Madhya Baushia	25+546 ~ 25+606	60.0	2@30.0

2) Type of Superstructure
   - Simply supported T-beam with precast segmental construction method by erection girder
   - Modificated cross section of beams to reduce the self-weight

3) Pile foundation
   - ø1.0m diameter bore hole piles (cast in place RC piles)

4) Type of Abutment
   - Inverted T-type Abutment with equal height of ADB Design

5) Type of Pier
   - Multiple Column Pier similar to ADB Design

ANNEX-4 : MAJOR DISCUSSION ITEMS

1) Central Construction Yard

Central Construction Yard shall be prepared by GOB in addition to the Major Undertaking to be taken by Each Government. (refer Page 13 of Inception Report)

2) Aerial Inspection

The Study Team will carry out the aerial inspection to confirm the hydrological and topographical conditions at the project area.

The GOB is requested by the Study Team to arrange the aerial inspection in dry and rainy seasons. This inspection is expected to be carried out in April and July, 1997 while the Study Team stay in Bangladesh.

3) Construction Schedule

The Jamuna Bridge Project will be completed at June, 1998 while the Jamuna Bridge Access Roads Project financed by ADB and OECF is expected early completion. Also this Project is requested the early completion as much as possible. The Study Team replied that Japanese side will pay effort to complete the Project within fiscal year of 1999.

4) Scope of the Project undertaken by GOJ

- Construction of 5 bridges
- Buckfilling behind Abutment
- Temporally approach roads for construction of bridges
- River bank protection around the abutment

5) Demolition of Existing Old Bridges by GOB.

Existing old bridges shall be demolished within 5 years after completion of the 5 bridges, considering hydraulic aspects.

ANNEX-5; JAPAN'S GRANT AID SCHEME

1. Grant Aid Procedure

1) Japan's Grant Aid Program is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan & Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using Japanese consulting firms.

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Government of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

1) Contents of the Study

The aim of the Basic Design Study (hereinafter referred to as "the Study"), conducted by JICA on the requested project (hereinafter referred to as "the Project"), is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows:

a) confirmation of the background, objectives and benefits of the requested project and also institutional capacity of agencies concerned of the recipient country necessary for the project's implementation;
b) evaluation of the appropriateness of the project to be implemented under the Grant Aid Scheme from the technical, social and economic points of view;
c) confirmation of items agreed on by both parties concerning the basic concept of the Project;
d) preparation of a basic design of the Project; and

e) estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For the smooth implementation of the Study, JICA uses a consulting firm selected through its own procedure (competitive proposal). The selected firm participate the Study and prepare a report based upon the terms of reference set by JICA.

At the beginning of implementation after the Exchange of Notes, for the services of the Detailed Design and Construction Supervision of the Project, JICA recommends the same consulting firm which participated in the Study to the recipient country, in order to maintain the technical consistency between the Basic Design and Detailed Design as well as to avoid any undue delay caused by the selection of a new consulting firm.

3. Japan's Grant Aid Scheme

1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

3) "The period of the Grant" means the one fiscal year which the Cabinet approves the project for. Within the fiscal year, all procedure such as exchanging of the Notes, concluding contracts with consulting firms and contractors and final payment to them must be completed.

However, in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two

Governments.

4) Under the Grant, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

5) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability of Japanese taxpayers.

6) Undertakings required to the Government of the recipient country

a) to secure a lot of land necessary for the construction of the Project and to clear the site;
b) to provide facilities for distribution of electricity, water supply, drainage and other incidental facilities outside the site;
c) to ensure prompt unloading, tax exemption and customs clearance at ports of disembarkation in the recipient country and internal transportation therein of the products purchased under the Grant Aid.
d) to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.
e) to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.
f) to ensure that the facilities constructed and products purchased under the Grant be maintained and used properly and effectively for the Project, and
g) to bear all the expenses other than those covered by the Grant, necessary for the Project.

7) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign the necessary staff for operation and maintenance of them as well as to bear all the expenses other than those covered by the Grant Aid.

8) "Re-export"

The products purchased under the Grant Aid shall not re-exported from the recipient

country.

9) Banking Arrangement (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the verified contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of recipient country or its designated authority.

ANNEX-6: NECESSARY MEASURES TO BE TAKEN BY THE GOB

The following necessary measures should be taken by the Government of Bangladesh on condition that the Grant Aid by the Government of Japan is extended to the Project.

1. To secure the land necessary for the execution of the Project, such as the land for bridges, temporary offices, working areas, storage yards and others;

2. To undertake the incidental works, such as gardening, fencing, lightning and other incidental facilities in and around the Project sites, if necessary;

3. To ensure prompt unloading and customs clearance at ports of disembarkation in Bangladesh and internal transportation therein of the products purchased under the Grant;

4. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Bangladesh with respect to the supply of the products and services under the Verified Contracts;

5. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts such facilities as may be necessary for their entry into Bangladesh and stay therein for the performance of their work;

6. To maintain and use facilities constructed under the Grant properly and effectively for the Project;

7. To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commissions;

8. To bear all the expenses, other than those covered by the Grant, necessary for the Project; and

9. To coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.

8th April, 1997

BD97:006:kk

Mr. M. Azizul Islam
Deputy Secretary
Economic Relations Division
Government of Bangladesh

Dear Sir,

Re: Amendment of Minutes of Discussions on Basic Design Study
on the Project for Reconstruction of Five Bridges on Dhaka-Chittagong Highway

We would like to inform you that there are two mistake words in the Annex of the Minutes of Discussions dated Dhaka, March 30, 1997.

Please amend the words as follows:

1. Annex-2 Project Site

wrong	1.Marikhali	STA.13+038
correct	1.Marikhali	STA.12+138

2. Annex-3 1) Bridge Location

wrong	1.Marikhali	STA.12+093 ~STA.13+083
correct	1.Marikhali	STA.12+093 ~STA.12+183

Yours sincerely,

Dr. Masahisa Komiya
Chief Consultant
Basic Design Study Team, JICA

c.c. Mr. Md. Nurul Hoque
Deputy Chief, Roads and Railways Division, MOC

Mr. M. A. Jaigirdar
Superintending Engineer, RHD

4-2 Minutes of Discussions, April 7, 1997

Reconstruction of Five Bridges on Dhaka-Chittagong Highway

Meeting held on 7/4/97 at JBSI office, room No.641, Sonargaon hotel, Dhaka.
Members present:

Mr.Delowar Hussein	RHD
Mr.A.S.M Abdul Hamid	DDC(ADB Consultant)
Mr.Hiroshi Honda	JBSI (JICA Study Team)
Mr.Tsuyoshi Furukawa	JBSI (JICA Study Team)

Matters discussed

Item I of discussion items: Confirmation of height of Abutments and distance of existing and new design road

(1) Existing road level : Data ① and data ③ are correct, however these data should be checked with the survey work being carried out now.

(2) Design road level : Adopted values are correct.

(3) Clearance between girder bottom and high flood level:
Adopted clearances are similar to that of existing structures, so agreed.

(4) Height of Abutment : Agreed.

(5) Distance of existing road and design road:
Should not cause any problem a bridge approach road, then a new coordinates axis of approach road should be moved in parallel with original one. (refer to the Annex 1)
The JICA study team is of opinion that as the present bridges have detriment very much, so the new bridges should be constructed away from the exisiting bridges to avoid further damage.
Mr. Hamid is of opinion that present setting out of two bridges will not cause any problem.

Item II of discussion items: Basic design considerations for the bridge design:

1. Bridge Accessories : Expansion joint to be steel finger joint with sealing.

1.1 Superstructure : Railing should be similar to Meghna Gumti bridge's one.
Mr. Hamid is of opinion that Railing for JICA & ADB bridges should be similar.

1.2 Wind load : Wind load is obtained by JSCE Code as wind velocity is 50m/sec.

2.7 Thermal forces : Rigid frame pier ; ± 5°C
Shoes, Expansion joint ; ± 10°C(35°F)

2.11 Earthquake : Zoning should be according to Bangladesh Natural Building Code (BNBC). Design should follow AASHTO.
Equivalent design seismic coefficient is 0.06.

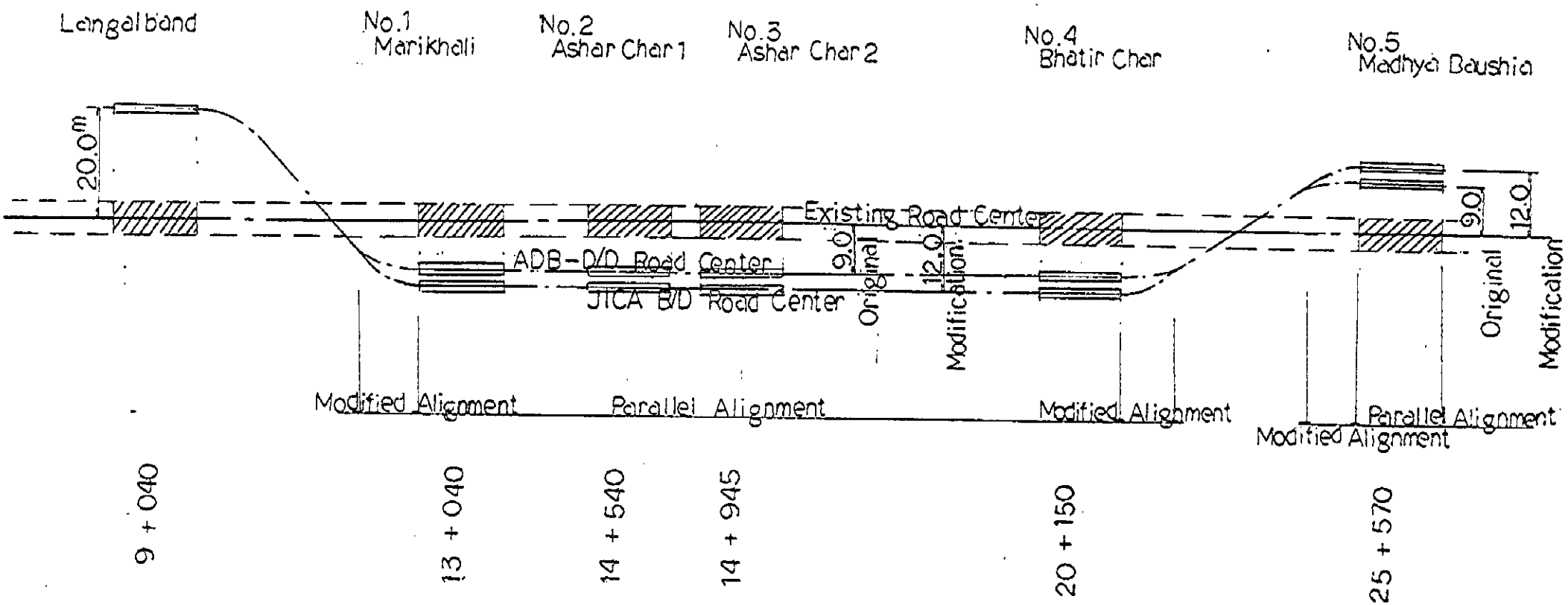
4.0 Properties of material : Concrete compressive strength for deck slab to be 25N/mm2 (3,600psi) at 28days according to ASTM C39.

5.0 The superstructure to be analyzed using grillage analogy. " Segmental Construction Method " should be omitted.

Item III of discussion items : Dimensions and Re-bar arrangement of Piers:

During Detail design stage closer spacing of two columns should be explored to reduce sagging moment and to balance sagging and hogging moment for Pier cross beam. Re-bar arrangement is agreed.

Annex. 1 : Distance of existing road and design road



MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY ON THE PROJECT FOR RE-CONSTRUCTION OF 5 BRIDGES ON DHAKA-CHITTAGONG HIGHWAY IN THE PEOPLE'S REPUBLIC OF BANGLADESH (CONSULTATION ON DRAFT REPORT)

In March 1997, Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study Team on the Project for Re-Construction of 5 Bridges on Dhaka-Chittagong Highway (hereinafter referred to as "the Project") in the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh"), and through discussions, field survey, and technical examination of the result in Japan, has prepared the draft report of the study.

In order to explain to the Bangladesh side on the draft report, JICA sent a Draft Report Explanation Team headed by Mr. OMOTE Shinichiro, Managing Director of Kyushu International Centre, JICA, to Bangladesh from July 27 to August 3, 1997.

As a result of discussions, both parties have decided to agree to the items described in ATTACHMENT subject to approval of the respective Governments.

Dhaka, July 31, 1997

Mr. OMOTE Shinichiro
Leader,
Draft Report Explanation Team,
JICA

Mr. M. Azizul Islam
Deputy Secretary,
Economic Relations Division
Ministry of Finance

Mr. Md. Nurul Haque
Deputy Chief,
Roads and Railways Division,
Ministry of Communications

Mr. M. A. Jaigirdar
Superintending Engineer
Roads and Highways Department