CHAPTER 10

EVALUATION OF ALTERNATIVE PLANS

CHAPTER 10 EVALUATION OF ALTERNATIVE PLANS

10.1 Evaluation of Alternative Plans

10.1.1 Evaluation on Route Alternatives

Table 10.1.1 summarizes the comparison of salient features and differences revealed in association with route alternatives of which route location will bring about impacts physically, technically, socially and economically.

The comprehensive evaluation reveals the superiority of Alternative-1 quantitatively and qualitatively. The superiority is summarized as follows:

(1) Rupsa Bridge has a complicated background and a number of relevant studies undertaken over a long span of time. Since it is very sure that substantial needs and social desire exist for the bridge over the Rupsa river locally as well as regionally, the Government of Bangladesh has firm intention to realize the project without any delay. The recommended plan has high land availability and least adverse social impacts so as to meet such requirements.

(2) Congested intersections at downtown of Khulna city as well as present Rupsa Ferry on National Highway No. 7 become traffic bottleneck so serious that it cannot sustain Mongla Port and future development at the port area, and Rupsa Bridge is designated to be a part of Khulna Bypass to facilitate solving such situation. The recommended plan has primary functions to bypass such traffic bottleneck and simultaneously to bring benefits to congested downtown of Khulna city by means of averting through traffic.

(3) Considerable volume of present local traffic at Rupsa Ferry may be forced to make detour. However, the recommended plan has advantages that following countermeasures are expected practically to cope with such situations so as to meet origin and destination of traffic.

1) to transfer existing facilities to Khulna City Corporation (KCC) to accommodate non-motorized traffic.
2) to build bus terminals at present ferry terminals and to provide circumferential bus services between two terminals through Rupsa Bridge.
3) to improve existing crossing roads including dike roads at both sides of the Rupsa River to formulate a road network to collect/distribute local motorized traffic.
4) to provide Rupsa Bridge with sidewalks as well as staircases and slope for bicycle pulling at pier-abutments to connect dike roads.

Table 10.1.1 Comparison of Salient Features of Each Alternative Route

Items	Alternative-1 : Urban Structure Scheme	Alternative-2 : Mobility Scheme	Alternative-3 : Accessibility Scheme
Outline of Alternative Route			
Road Length	10.034 km BP : 150 m from Weather Office on Satkhira Road EP : 4.8 km from Ferry Terminal at Rupsa East	9.234 km BP : 150 m from Weather Office on Satkhira Road EP : 3.6 km from Ferry Terminal at Rupsa East	7.758 km BP : 150 m from Weather Office on Satkhira Road EP : 1.8 km from Ferry Terminal at Rupsa East
River Crossing Point	2.6 km South from Rupsa Ferry	2.0 km South from Rupsa Ferry	1.0 km South from Rupsa Ferry
Land Area Affected (sq.m) in case of 36m ROW	363,600	338,400	295,200
Project Cost Estimates (Million Taka) 1) Construction Cost 2) Land Acquisition & Compensation 3) ES & SS Services 4) Total	 3,568.30 203.6 196.3 3,968.10	 3,479.30 255.4 191.4 3,926.10	 3,373.40 325.1 185.5 3,884.00
No. of Households Affected No. of Persons Affected	51 241	114 523	325 1,557
General Conditions of Land Use	1) Open spaces such as agriculture land, fishery ponds and shrimp farms spread widely. 2) Homesteads or residential area of single hut structure are scattered in local area.	1) Open spaces such as agriculture land, fishery ponds and shrimp farms spread widely except both sides of the Rupsa River. 2) Homesteads or residential area of bamboo houses are grouped in several areas.	1) Open spaces are limited and developed areas spread widely. 2) Densely inhabitated areas exist in the built-up area with semi-permanent structure houses.
1. Land Availability	1) **High** because the route is located in the periphery of urbanized area. 2) No difficult property or structure to be acquired is found.	1) **Uncertain** because the route will run to pass on the periphery of built-up area where scattered residential areas and homesteads exist.	1) **Poor** because the route will run to pass in the built-up area where residential areas and cluster of homesteads exist, and will violate public facilities such as primary school and mosque.
2. Social Impacts	1) **Lesser degree** because loss of cultivated lands will be limited to road right-of way acquisition and no resettlement plan will be required due to a few affected persons.	1) **Some Extent** because a number of affected persons may require to be relocated in groups due to no land availability to relocate within their own lot.	1) **Considerable** because a lot of affected persons may require to be relocated in groups due to no land availability to relocate within their own lot.
3. Construction Economy	1) **Medium** because road length is longer and land acquisition is wider but land price is cheaper and affected structures are less. 2) Less affected persons and structures make project implementation economical yet shorter.	1) **Medium** because costs of land acquisition and property compensation in developed area will increase project cost. 2) A resettlement plan will require time-consumed process, and it will result in less economy.	1) **Low** because road length is the shortest even though costs of land acquisition and property compensation in developed area will increase project cost. Site development for resettlement may increase the cost. 2) A resettlement plan will require time-consumed process, and it will result in less economy.
4. Development Impact	1) **Very high** to induce new urban development as well as to accommodate medium to long trip traffic in Khulna and its surroundings.	1) **High** because the road will bring considerable impacts to undeveloped areas along the route.	1) **Low** because the road will bring considerable impacts to limited undeveloped areas along the route.
Evaluation	**Superior** because it is practical yet implementable.	**Marginal** because it can achieve designated roles and functions of Khulna Bypass.	**Inferior** because it is far from practical yet implementable due to serious adverse social impacts.

10.1.2 Evaluation of Bridge Alternatives

10.1.2.1 Summary Cost for Rupsa Bridge

Table 10.1.2 Rupsa Bridge Cost

Unit: Million Taka

		Opt-1	Opt-2	Opt-3	Opt-4
Main	Superstructure	441.9	561.8	727.1	954.2
	Substructure	820.2	1079.1	862.7	1083.4
	Sub Total	1262.1	1640.9	1589.8	2037.6
Approach	Superstructure	260.0	240.6	171.7	240.6
	Substructure	320.6	373.3	267.8	373.3
	Sub Total	580.5	613.9	439.5	613.9
Total		1842.6 (1.00)	2254.8 (1.22)	2029.3 (1.10)	2651.5 (1.44)

10.1.2.2 Evaluation of Main Bridge Types

The four options of the Rupsa main bridge are summarized in Table 10.1.3, and evaluated from various aspects such as factors of construction cost, period, practicality, maintenance and aesthetic. Structural safety and geometrical requirements are excluded from the list of evaluation factors, not to mention they have to be satisfied. However, among these evaluation factors, their importance to the bridge may not be same. To take such differences of importance into evaluation, a ranking and scoring method is used to score the options numerically.

A denominator in the column of RANKING/INDEX for each option gives desirability ranking. Score for each factor is given by dividing full score for each factor, and summation of all scores for the factors signifies the total score assigned to each option. For this evaluation, 40% is given to construction cost and practicality respectively as full score over their importance. The remaining is allocated evenly to the other factors.

Option (1); 7 span PC Box girder with the highest score of 93 points is recommended, to proceed to Step 4: Design at a Detailed Level.

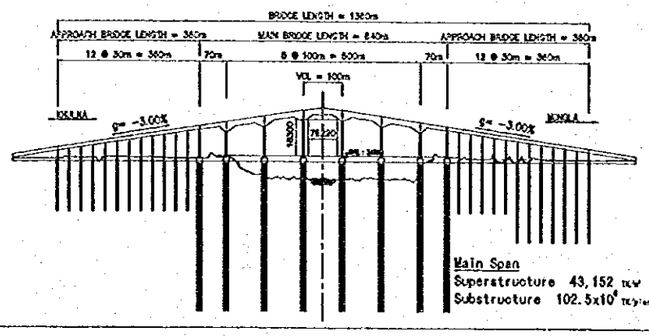
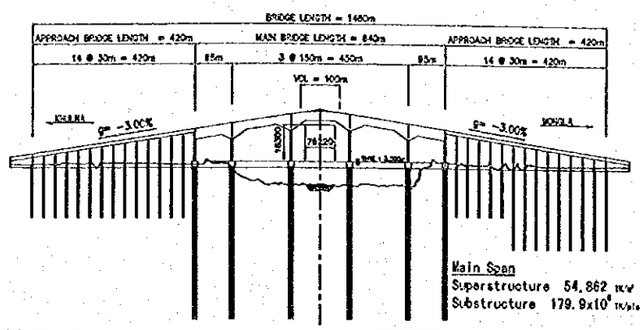
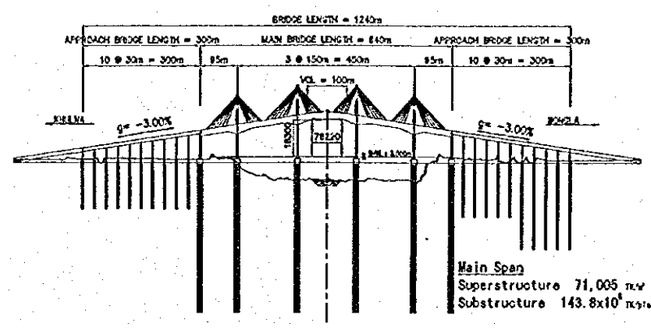
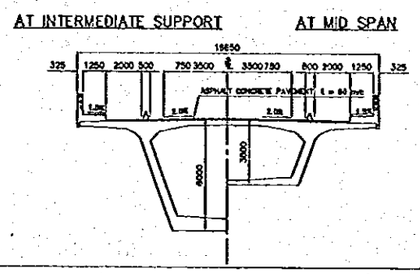
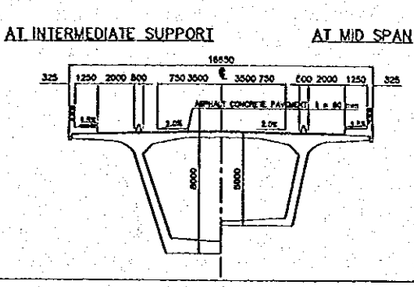
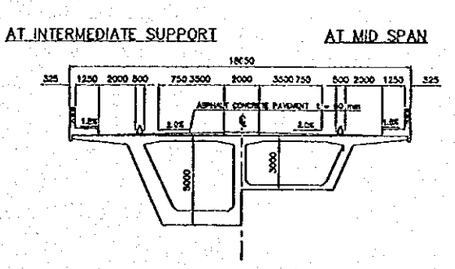
10.1.2.3 Comparison of Conventional and Extradosed PC Box Girder

Table 10.1.4 presents the qualitative Comparison at superstructures of Conventional and Extradosed PC Box Girder.

10.1.2.4 Approach and Canal Bridges

PC I-section girder of 30 m span length supported by RC bored piles in recommended to be the standard structure for the approach bridges. The canal bridges will be designed with the same structure in variation of girder spacing and span length.

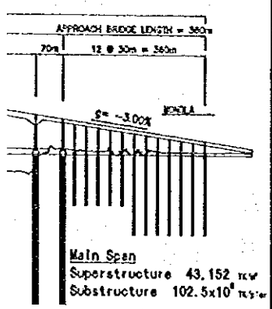
SUMMARY OF RUPSA BRIDGE TYPES ALTERNATIVES

ALTERNATIVE	(1) 7 – SPAN PC BOX GIRDER	(2) 5 – SPAN PC BOX GIRDER	(3) 5 – SPAN EXTRADOSED PC BOX GIRDER	(4)
SPAN ARRANGEMENT				
MAIN BRIDGE CROSS SECTION				

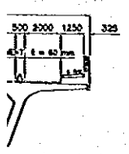
EVALUATION ITEM	Alloting Marks	NOTES	RANKING / INDEX	SCORE	NOTES	RANKING / INDEX	SCORE	NOTES	RANKING / INDEX	SCORE	
CONSTRUCTION COST	40	A. MAIN BRIDGE : MILLION TK. Superstructure 441.9 Substructure 820.2 Total (A) 1262.1(1.00) B. APPROACH BRIDGE : Superstructure 260.0 Substructure 320.6 Total (B) 580.5(1.32) TOTAL (A) & (B) 1842.6(1.00)	1/1.00	40	A. MAIN BRIDGE : MILLION TK. Superstructure 561.8 Substructure 1079.1 Total (A) 1640.9(1.30) B. APPROACH BRIDGE : Superstructure 240.6 Substructure 373.3 Total (B) 613.9(1.40) TOTAL (A) & (B) 2254.8(1.22)	3/0.33	13	A. MAIN BRIDGE : MILLION TK. Superstructure 727.1 Substructure 862.7 Total (A) 1589.8(1.23) B. APPROACH BRIDGE : Superstructure 171.7 Substructure 267.8 Total (B) 439.5(1.00) TOTAL (A) & (B) 2029.3(1.10)	2/0.50	20	A. MA Sup Sub Tot B. API Sup Sub Tot TOT
CONSTRUCTION PRACTICALITY	40	Conventional type in many countries including Bangladesh, in particular of 100 m long span class.	1/1.00	40	Conventional type in many countries including Bangladesh.	1/1.00	40	New technique practiced in limited countries but no experience in Bangladesh.	2/0.50	20	New t in Ban
CONSTRUCTION PERIOD	5	40 months.	2/0.50	3	38 months.	1/1.00	5	38 months.	1/1.00	5	44 m
BRIDGE MAINTENANCE	5	No particular maintenance problem found.	1/1.00	5	No particular maintenance problem found.	1/1.00	5	No particular maintenance problem found.	1/1.00	5	No pa
NAVIGATION MAINTENANCE	5	Minimum navigation width secured.	3/0.33	2	Extra side margin for navigation provided.	2/0.50	3	Extra side margin for navigation provided.	2/0.50	3	The v
AESTHETICS	5	Reasonably aesthetical.	2/0.50	3	Reasonably aesthetical.	2/0.50	3	Pylon and stay cable will be a land mark.	1/1.00	5	Pylor
TOTAL SCORE AND RECOMMENDATION	100	○	83			69			58		

SUMMARY OF RUPSA BRIDGE TYPES ALTERNATIVES

GIRDER

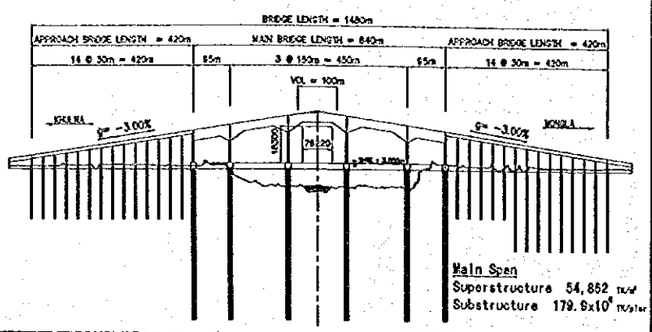


AT MID SPAN

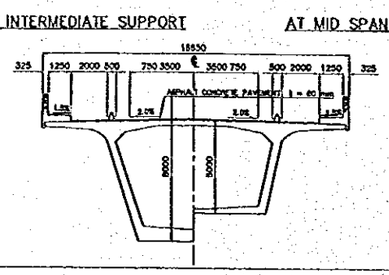


	RANKING / INDEX	SCORE	NOTES
TON TK. 1.9 0.2 2.1(1.00) 0.0 0.6 0.5(1.32) .6(1.00)	1/1.00	40	A. MAIN BRIDGE : MILLION TK. Superstructure 561.8 Substructure 1079.1 Total (A) 1640.9(1.30) B. APPROACH BRIDGE : Superstructure 240.6 Substructure 373.3 Total (B) 613.9(1.40) TOTAL (A) & (B) 2254.8(1.22)
gladesh, in	1/1.00	40	Conventional type in many countries including Bangladesh.
	2/0.50	3	38 months.
	1/1.00	5	No particular maintenance problem found.
	3/0.33	2	Extra side margin for navigation provided.
	2/0.50	3	Reasonably aesthetical.
	93		

(2) 5 – SPAN PC BOX GIRDER

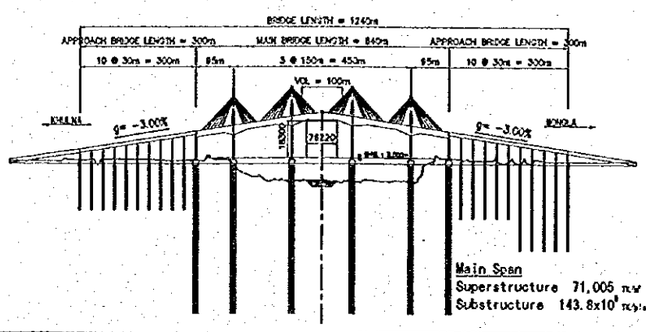


AT INTERMEDIATE SUPPORT AT MID SPAN

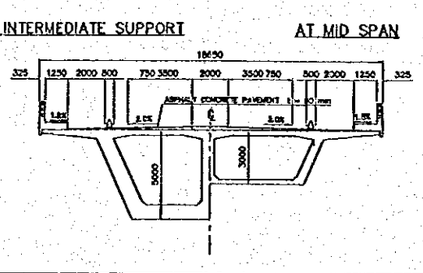


	RANKING / INDEX	SCORE	NOTES
	A. MAIN BRIDGE : MILLION TK. Superstructure 727.1 Substructure 862.7 Total (A) 1589.8(1.23) B. APPROACH BRIDGE : Superstructure 171.7 Substructure 267.8 Total (B) 439.5(1.00) TOTAL (A) & (B) 2029.3(1.10)	3/0.33	13
	New technique practiced in limited countries but no experience in Bangladesh.	1/1.00	40
	38 months.	1/1.00	5
	No particular maintenance problem found.	1/1.00	5
	Extra side margin for navigation provided.	2/0.50	3
	Pylon and stay cable will be a land mark.	2/0.50	3
		69	

(3) 5 – SPAN EXTRADOSED PC BOX GIRDER

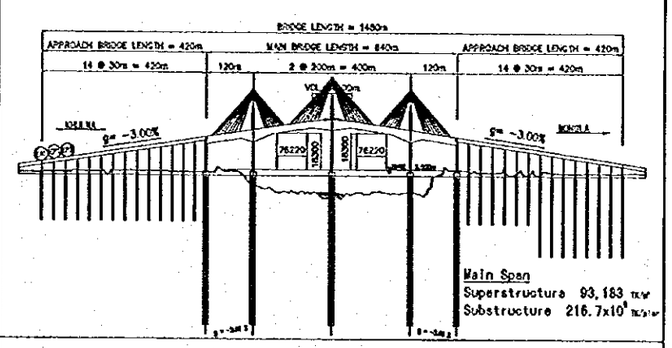


AT INTERMEDIATE SUPPORT AT MID SPAN

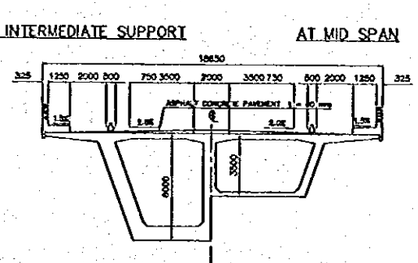


	RANKING / INDEX	SCORE	NOTES
	A. MAIN BRIDGE : MILLION TK. Superstructure 954.2 Substructure 1083.4 Total (A) 2037.6(1.61) B. APPROACH BRIDGE : Superstructure 240.6 Substructure 373.3 Total (B) 613.9(1.40) TOTAL (A) & (B) 2651.5(1.44)	2/0.50	20
	New technique practiced in limited countries but no experience in Bangladesh.	2/0.50	20
	44 months.	1/1.00	5
	No particular maintenance problem found.	1/1.00	5
	The widest navigation width preserved.	2/0.50	3
	Pylon and stay cable will be a land mark.	1/1.00	5
		58	

(4) 4 – SPAN EXTRADOSED PC BOX GIRDER



AT INTERMEDIATE SUPPORT AT MID SPAN



	RANKING / INDEX	SCORE	NOTES
	A. MAIN BRIDGE : MILLION TK. Superstructure 954.2 Substructure 1083.4 Total (A) 2037.6(1.61) B. APPROACH BRIDGE : Superstructure 240.6 Substructure 373.3 Total (B) 613.9(1.40) TOTAL (A) & (B) 2651.5(1.44)	4/0.25	10
	New technique practiced in limited countries but no experience in Bangladesh.	2/0.50	20
	44 months.	3/0.33	1
	No particular maintenance problem found.	1/1.00	5
	The widest navigation width preserved.	1/1.00	5
	Pylon and stay cable will be a land mark.	1/1.00	5
		46	

Table 10.1.4 General Consideration on Conventional and Extradosed PC Box Girder

No.	Item	Conventional Type	Extradosed Type
1	Familiarity	Already having been experienced in Bangladesh; RHD well acquainted with this type.	First experience, if achieved, and thus RHD not familiar to this type.
2	Impact	No fresh impression expected as being conventional type.	Can be a good landmark in Khulna area.
3	Technology transfer	Technology having been already transferred, hence efficiently constructed.	Quite a new technology not only in Bangladesh but in other countries, thus expected to take sufficient time for technology transfer.
4	Maintenance	Cables encased deeply enough inside concrete, no damage expected nor ordinary maintenance for cable required, if correctly constructed. Easy repair on concrete able to be made by Bangladesh personal.	Coated cables exposed to the air outside of the box girder. The most suitable coating materials to be selected for protection against natural environment. Furthermore as cables generally being anchored at deck level, easy to be approached and thus very much possible to suffer from chemical and physical damages such as by fire, cut or scratch of accidental or intentional natures, even if correctly constructed.
5	Apllied span length and girder depth-to-span ratio	Segmental box girder mostly applied to a span of 50 to 150 meters long, depth-to-span ratio at support to be approximately 1/17	Applied to 150 to 200 meters long span, depth-to-span ratio usually to be 1/35, thus possible to reduce girder depth and overall bridge length.
6	Wind effect	Statical examination for wind effect to be enough before design.	Girder slenderness, the apparent advantage of extradosed girder, ought to be examined against aero-dynamic stability. Also diagonal cables to be examined against vibration by the strong wind in Khulna.
7	Deck width	One-cell trapezoidal box girder, the most economical and aesthetically preferable, be possible.	In order to secure space for installation of pylons and for anchorage of diagonal cables, the deck ought to be widened by approximately 2 meters from 16 to 18 meters, thus two-cell box section required with wall in the center of the box, then not more economical than expected.

10.1.3 Study Approach and Summary of Evaluation

Fig. 10.1.1 shows the study approach up to Step-3 and the scope of work for succeeding Step-4 & 5.

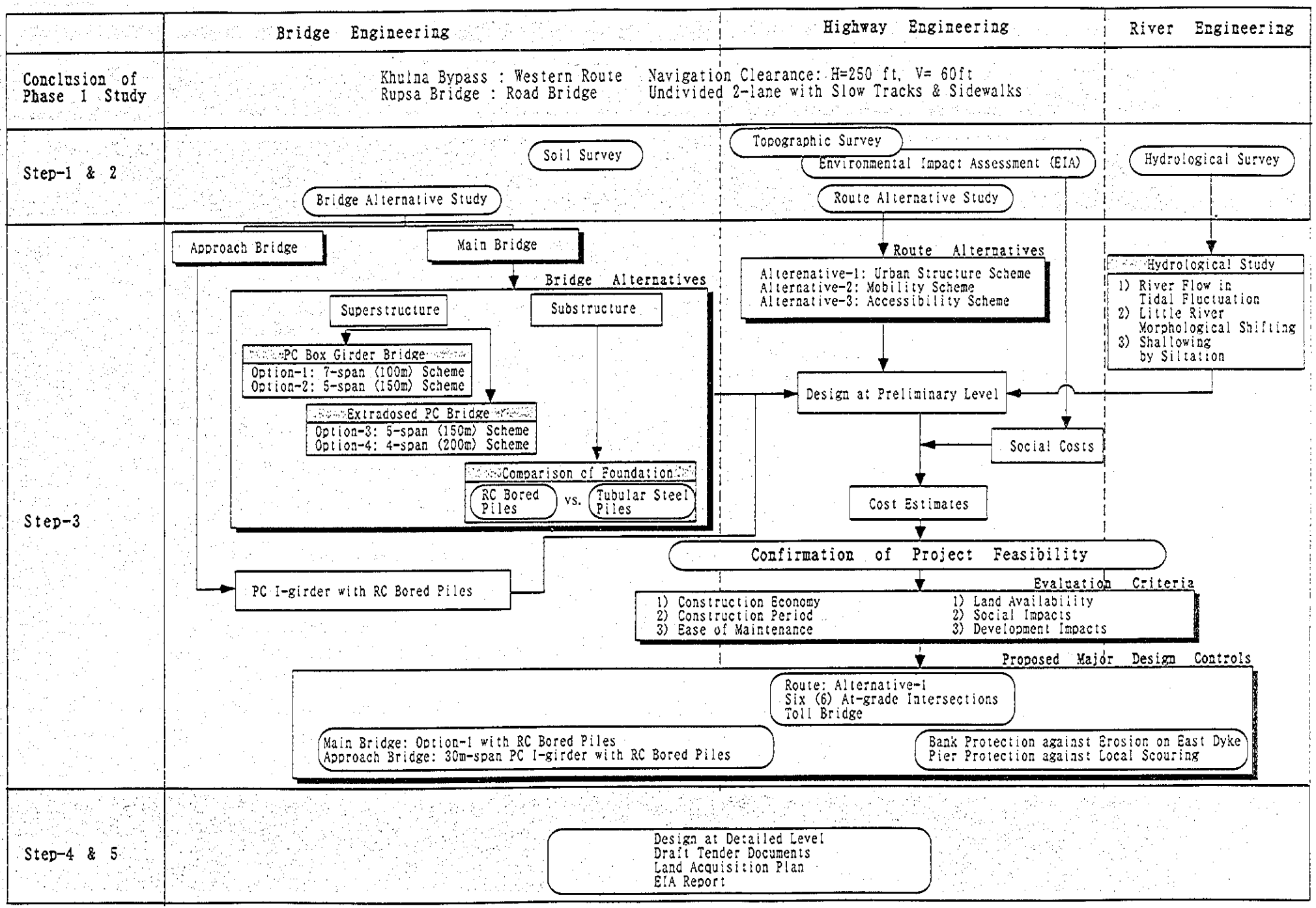


Fig. 10.1.1 The study approach up to Step-3 and the scope of work for succeeding Step-4 & 5

CHAPTER 11
CONSTRUCTION PLANNING

CHAPTER 11 CONSTRUCTION PLANNING

11.1 Introduction

The construction planning is to be studied for the establishment of construction method so as to meet technical requirements based on the selected plans of route location and bridge type. While a construction time schedule is to be estimated on the assumption that the project should be implemented based on the proposed construction planning and the recommended scheme of contract package. Furthermore, these two elements of construction planning and scheme of contract package have close relationship each other and the construction cost estimates are to be made in consequence of these two elements.

The construction planning is studied as a whole to cover these major works and three construction sections are deliberated from the viewpoints of dominant work components and accessibility as shown in Fig. 11.1.1.

11.2 Construction Planning

11.2.1 Components of Construction Planning

The Rupsa Bridge Construction Project is to develop the Southern Section of Khulna Bypass that is designated undivided 2-lane 10,039m long National Highway to connect Khulna-Satkhira Road to Khulna-Mongla Road in the south of Khulna City.

The project comprises the following major works:

1) 1,360m Rupsa Bridge
2) Two (2) canal bridges of 90m long Hatia Canal Bridge and 30m long Molonghata Canal Bridge
3) Nine (9) box culverts
4) 8,559m long stretch of roadwork section including six (6) at-grade intersections
5) One (1) toll plaza
6) River revetment on the east bank and pier protection against scouring

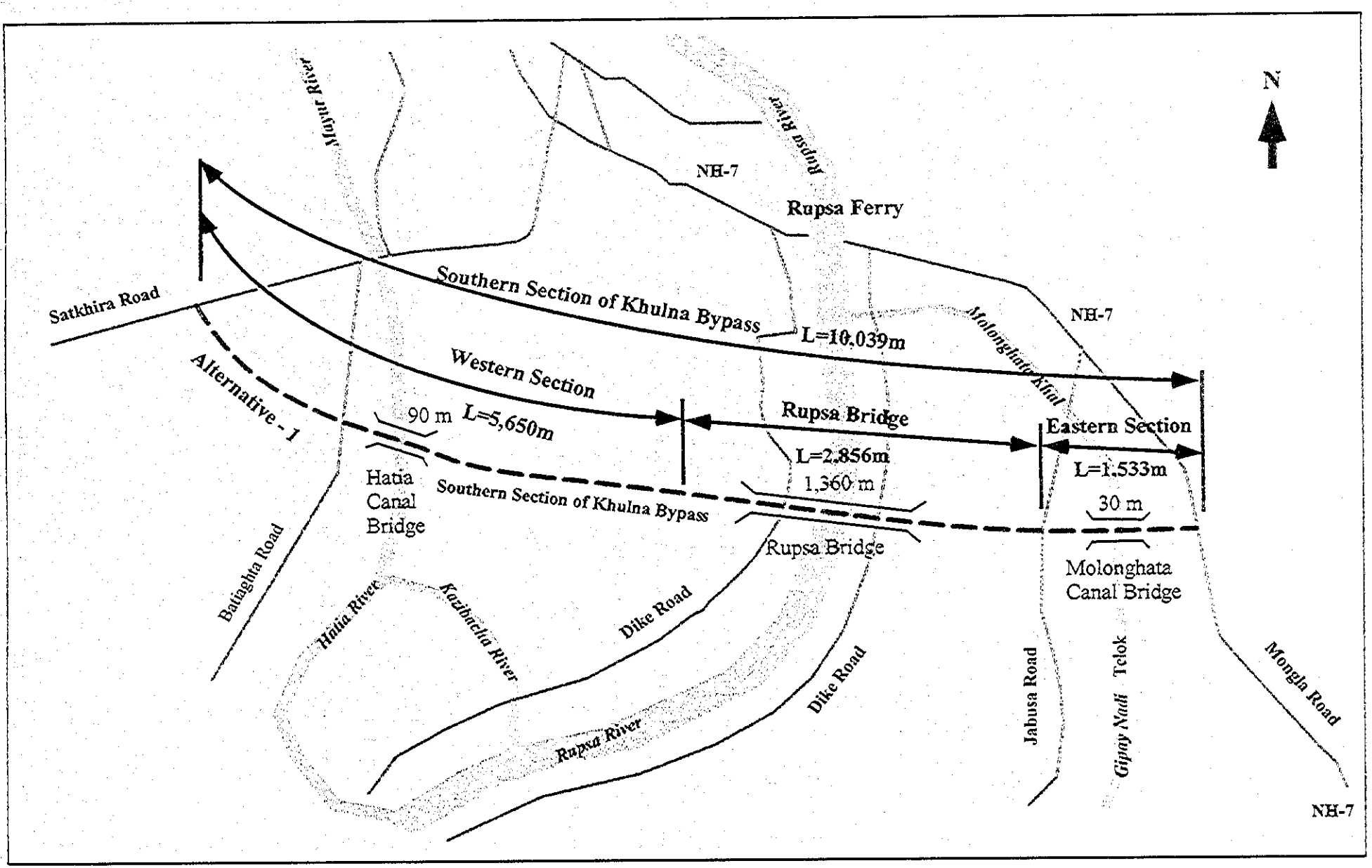


Fig. 11.1.1 Construction Planning and Each Possible Section

11.2.2 Basic Assumptions of Construction Planning

(1) Rupsa Bridge Section (Sta. 6+650 ~ Sta. 9+506, L=2,856 m)

The Rupsa Bridge Section comprises three components, namely Main Bridge, Approach Bridge and Approach Road. The followings are salient design features:

1) Rupsa Main Bridge (16 m effective width)

Superstructure : Cast-in-situ 7-span PC Box Girder with span length of
70m + 5@100m + 70m = 640m
Substructure : RC Bored Piles and Pile-cap on water level
Staircases : Both sides and both ends of the Main Bridge

2) Rupsa Approach Bridge (Viaduct : 16 m effective width)

Superstructure : Standard PC I-girder composite with RC deck slab,
2 x 12 x 30m = 720m
Substructure : RC Bored Piles

3) Approach Road L= 1,496m (West Road: Sta. 6+650 ~ Sta. 6+880 L=230m,
East Road: Sta. 8+240 ~ Sta. 9+506 L=1,266m)

Through Traveled Way

Roadway Width	: 21.5 m
Through Traveled Lane	: 2 x 3.5m
Space for Slow-moving Vehicles	: 2 x 2.5m
Median	: 5.5m including 2 x 1.0m inner shoulder
Sidewalk	: 2 x 2.0m

Service Road (Both sides of the Through Traveled Way)

Roadway Width	: 15.0 m
Pavement Width	: 7.0 m
Sidewalk	: 2.0m

At-grade Intersections: 3 Locations (at Eastern and Western Dike Roads and Jabusa Road)

Toll Plaza: 1 Location

(2) Western Section (Sta. 1+000 ~ Sta. 6+650, L=5,650 m)

1) Hatia Canal Bridge at Sta. 2+850 (2 x 9 m effective width)

Superstructure : Standard PC I-girder composite with RC deck slab
3 x 30m = 90m
Substructure : RC Bored Piles

2) Box Culverts: 8 Locations

Station	Name	Unit	Length	Height	Width	Remarks
3+219	Alutala Canal	M	25	1.5	4.0	2-Cell
3+760	Aralia Canal	M	27	2.0	7.5	3-Cell
4+659	Narikal Baria Canal	M	36	5.0	16.5	3-Cell
5+436	Karate Canal	M	23	2.0	4.0	2-Cell
5+643	Laurir Canal	M	23	3.5	14.0	4-Cell
5+880	Moyur Canal	M	23	4.0	12.0	3-Cell
6+263	Khetra Canal	M	23	4.0	12.0	3-Cell
6+496	Malekana Canal	M	30	2.0	12.5	5-Cell

3) Roadwork

Roadway Width	: 21.5 m
Through Traveled Lane	: 2 x 3.5m
Space for Slow-moving Vehicles	: 2 x 2.5m
Median	: 5.5m including 2 x 1.0m inner shoulder
Sidewalk	: 2 x 2.0m

4) At-grade Intersections: 2 Locations (at Satkhira Road and Batiaghata Road)

(3) Eastern Section (Sta. 9+506 ~ Sta. 11+039, L=1,533 m)

1) Molonghata Canal Bridge at Sta. 10+340 (2 x 9 m effective width)
Superstructure : Standard PC I-girder composite with RC deck slab
1 x 30m = 30m
Substructure : RC Bored Piles

2) Box Culverts: 1 Location

Station	Name	Unit	Length	Height	Width	Remarks
9+860	Besar Canal	M	30	4.0	8.0	2-Cell

3) Roadwork

Roadway Width	: 21.5 m
Through Traveled Lane	: 2 x 3.5m
Space for Slow-moving Vehicles	: 2 x 2.5m
Median	: 5.5m including 2 x 1.0m inner shoulder
Sidewalk	: 2 x 2.0m

4) At-grade Intersections: 1 Location (at Mongla Road)

11.2.3 Quantities of Major Construction Works

Construction planning should be made based on quantities of each main construction work item and selection of construction methods in a site condition. The quantities of main construction works are summarized in Table 11.2.1.

Table 11.2.1 Quantities of Main Construction Works

DESCRIPTION	UNIT	QUANTITY
Common Excavation	M^3	171,349
Borrow Material	M^3	232.327
Free-Draining Material	M^3	155,440
Permeable Backfill	M^3	17,828
R.C. Pipe Culverts	M	3,642
U-Ditch	M	6,946
R.C. Box Culverts	M	238
Hatia Canal Bridge	M^2	1,620
Molonghata Canal Bridge	M^2	540
Pier Protection	M^2	5,810
River Revetment	M^2	9,000
Granular Subbase	M^3	54,435
Mechanical Stabilized Base	M^3	17,747
Asphalt Treated Base Course (t=10cm)	M^2	135,463
Asphalt Concrete Surface (t=15cm)	M^2	135,463
Cast - In - Place Concrete Pile (D = 900mm)	M	8,160
Cast - In - Place Concrete Pile (D = 2,000mm)	M	7,200
Structural Concrete (High Design Strength)	M^3	12,400
Structural Concrete (Low Design Strength)	M^3	11,768
Reinforcing Steel, Deformed	TON	2,821
Prestressing Steel	TON	671
Guardrail	M	9,739
Regulatory & Warning Sign	EACH	84
Guide Sign	EACH	34
Road Marking	M^2	34,847
Brick Paving	M^2	37,173
Street Lighting Unit	EACH	281

11.2.4 Establishment of Construction Methods

(1) Construction Method of Rupsa Bridge Section

1) Introduction

The construction time schedule is carefully studied on the assumption that major components of construction works should govern critical time requirement so as to make construction cost reasonable. While major works of bridge construction should be done in sequence as proper combination of heavy equipment and erecting materials should be utilized repeatedly several times.

The construction of Main Bridge is to be one of the major components for Rupsa Bridge Construction Project because of its scale and technical difficulties, and the Approach Bridges are also to be another because of voluminous fabrications of

standard I-girder.

Both bridge construction works require full-equipped construction planning, comprising crushing plant, concrete batching plant, transit mixer, erection cranes, concrete pumping machine and so forth. Especially for cast-in-situ bored piles by a reverse circulation method, such a full-equipped construction planning is indispensable to pour necessary volume of cement concrete into bored holes within limited time.

2) Site Development for Construction Yard

The construction yard is required to be developed on the eastern side of the Rupsa River where only Jabusa Road can accommodate land access by dump trucks and comparatively wide road Right-of-Way will be acquired for the approach road, service roads and toll plaza. To develop a part of construction yard with temporary jetty, 1,650m long access road is first developed from Jabusa Road toward the Rupsa River, taking into consideration construction practicality and material supply. The full-scale yard will be developed using river deposits dredged from the Rupsa River after treatment facilities for dredged material are completed. Necessary erecting materials and heavy equipment including plants will be mobilized by riverine transportation. Another construction yard will be also developed on the western side of the Rupsa River by dredging river deposits.

These construction yards will consist of the followings:

- Crushing Plant
- Concrete Batching Plant
- Asphalt Mixing Plant
- PC I-Girder Fabrication Yard
- Fabrication Yards for Miscellaneous Precast Concrete Structures
- Stock Yards for Fabrication and Erection Materials
- Site Offices

3) Bridge Construction Method

Total construction period of the Main Bridge is estimated 42 months for works of foundation, pile cap, pier body, superstructure and bridge deck in sequence including preparatory works, provided that an exclusive set of plants should be prepared.

The fabrication of standard I-girder is also crucial for construction planning as a whole. The Approach Bridge is located at both sides of Rupsa Bridge, and such bridgework requires to build 12 piers with one abutment and to fabricate 84 PC I-girders at least. A fabrication yard together with a set of plants is to be constructed nearby bridge location. Each construction period of bridgework is estimated 18 months for parallel works of foundation/pile cap/pier body and fabrication of girders and subsequent works of

erection of girder and bridge deck. Accordingly, it will take more than 36 months to complete Approach Bridge at both sides, provided that a full-equiped fabrication yard should be prepared to produce PC I-girders systematically.

It should be noted that two (2) canal bridges require the same deep bored piles as that of the approach bridges pertaining to Rupsa Bridge and it requires a set of plants to pore necessary volume of cement concrete into bored holes within limited time.

(2) Establishment of Roadwork

1) Introduction

Since fill material from side borrow is not suitable for upper road bed and sufficient volume of qualified fill material cannot be expected from common excavation, imported materials such as borrow materials and dredged river deposits are deemed crucial for road earthwork. Accordingly, a potential access road is indispensable to make a construction planning for roadwork. As for about 4,400m long stretch in between the Hatia Canal Bridge and the western dike of the Rupsa River, no potential access road is found and only dredged river deposits are deemed available for the purpose. Furthermore, there exist eight (8) drainage channels in this stretch and box culverts are designed to keep opening for such watercourses. It is the most practical way that an access road is developed along the route alignment from the western dike of the Rupsa River together with the construction of box culverts.

2) Construction Method

Road Earthwork

Road earthwork consists of site clearing and embankment works and a set of heavy equipment combination of Swamp Bulldozer, Bulldozer, Back Hoe, Tire Roller and Dump Trucks works in sequence. Average hauling distance is the key factor to determine work efficiency.

About 4,400m long stretch in between the Hatia Canal Bridge and the western dike of the Rupsa River is surely critical to estimate the construction time schedule due to limited imported materials and access road as well as a number of box culvert construction.

Three sets of the equipment combination may not become crucial to complete roadwork within the most crucial construction time schedule of the Main Bridge, provided that the same contractor should be involved in the Eastern and Western Sections.

Granular Subbase and Base Course

The road paving works may follow the road earthwork with good accessibility, and a set of heavy equipment combination of Motor Grader, Macadam Roller, Tire Roller, Tank Truck with Sprinkler, Dump Trucks works in sequence. Supply of quality-controlled granular materials will become critical to estimate the construction time schedule, and accordingly crushing plant and proper size of stockyards are indispensable.

Asphaltic Concrete Base and Surface Course

A set of heavy equipment combination of Bituminous Spreader, Asphalt Finisher, Macadam Roller, Tandem Roller, Tire Roller, Dump Trucks works in sequence. Supply of quality-controlled asphaltic concrete will become critical to estimate the construction time schedule, and accordingly crushing plant, proper size of stockyards and asphalt mixing plant are indispensable.

11.2.5 Construction Time Schedule

The workable days are mainly influenced by the precipitation. Taking in consideration of annual average rainfall in Khulna from 1969 to 1998, the number of working days for earthwork and the construction of pavement is estimated as shown in Table 11.2.2.

Table 11.2.2 Number of Working Days

Item	Dry Season; Nov.~ Apr.(6 months)	Rainy Season May~ Oct.(6months)	Annual
Number of Rainy Days	5.0days/month	12.7days/month	106days
Working Efficiency on a Rainy Day	70%	25%	38%
Number of Holidays	4.3days/month	4.3days/month	52days
Number of Working Days	24.2days/month	16.2days/month	242days
Working efficiency	81%	54%	67%

The construction planning for the project is made on the assumption that 42-month construction time schedule for the Main Bridge should be crucial as shown in Fig. 11.2.1. Therefore, alternative scheme of contract package is deliberated within the framework of construction planning to attain optimum investment schedule.

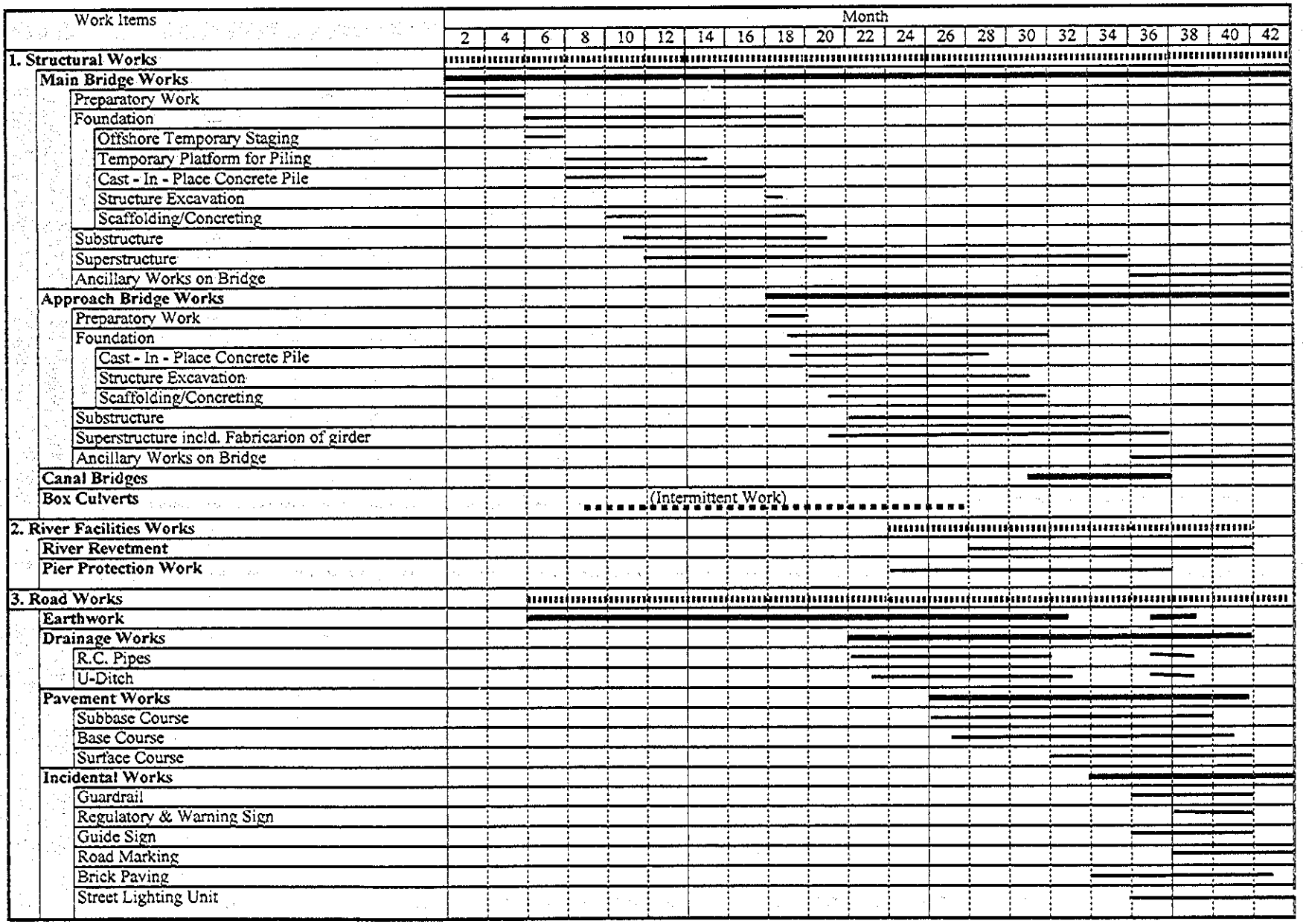


Fig. 11.2.1 Construction Time Schedule

11.3 Scheme of Contract Package

11.3.1 Alternative Scheme

Two (2) schemes of contract package are deliberated, single contract package and separate contract package.

A single package denotes that one (1) contract lot shall cover a whole project. While separate contract package denotes that one shall cover Rupsa Bridge and its approach roads due to its salient features and required expertise, and another shall cover the eastern and western section of the Southern Section of Khulna Bypass, having mainly canal bridges, box culverts, earthwork and pavement. It is possible furthermore to separate the eastern section from the western section to make two (2) separate contract packages. However, it should be noted that two (2) canal bridges still remain individually at these sections.

11.3.2 Comparison of Alternatives

A single package contract may have the following superiorities and advantages against separate package scheme;

1) It is possible to make construction planning rational and practical due to suiting methods of access to work components, land access for earthwork and pavement and riverine access for bridge works.
2) It comes in reality to share heavy construction equipment in order to ensure quality of work as well as to keep substantial progress although Rupsa Bridge shall require comparatively small volume of earthwork and pavement and other road sections shall require bridge works including comparatively deep bored piles and small number of standard span of PC girders.
3) It is easy to prevent construction work as a whole from conflicting of adjoining contract sections such as disturbing hauling vehicles and reinstating damaged works.
4) It enables to make cost estimates reasonable and economical due to simple construction planning as well as averting unnecessary works.

On the other hand, separate package scheme may have the following advantages and disadvantages against single package scheme;

1) It is possible to increase number of contract lots and to decrease contract amount of one lot so as to allocate works to more than one (1) contractor as well as comparatively medium to small scale contractors.

2) It will enable contractors to compete with each other in terms of quality and progress in spite of forcing complicated construction planning and quality control.

3) Due to inefficient utilization of equipment, separate package scheme requires more sets of heavy equipment combination as tabulated in Table 11.3.1.

Table 11.3.1 Required Number of Equipment Combination

Equipment Combination for	Single Scheme	Separate Scheme
1. Road Earthwork	3	4
2. Granular Subbase/Base	1	3
3. Asphaltic Base/Surface	1	3
4. Reverse Circulation Drill	2	4
5. Form for PC I-Grider	2	4
6. Erection Girder	2	2
7. Concrete Batching Plant	2	4
8. Asphalt Mixing Plant	1	3
9. Fabrication Yard	2	4
10. Temporary Jetty	2	4

Note: The separate scheme denotes that three (3) contract packages are assumed, namely Rupsa Bridge Section Eastern Section and Western Section.

4) The most crucial road earthwork section in between the Hatia Canal Bridge and the western dike of the Rupsa River requires individual jetty and exclusive access road along the route alignment to bring adverse social impacts to adjacent inhabited area.

5) It is obvious that inefficient utilization and more number of equipment result in increase of construction costs.

11.3.3 Evaluation and Conclusion

The scheme of single contract package is evaluated superior yet suitable from the following aspects:

1) Construction Practicality

The single package has technical soundness and steady construction practicality to complete the construction period of 42 months with the economical justification.

2) Construction Period

It is well balanced and reasonable for the scheme of single contract package that the most expensive contract section of the Rupsa Bridge becomes critical and crucial for

the construction planning.

3) Construction Economy

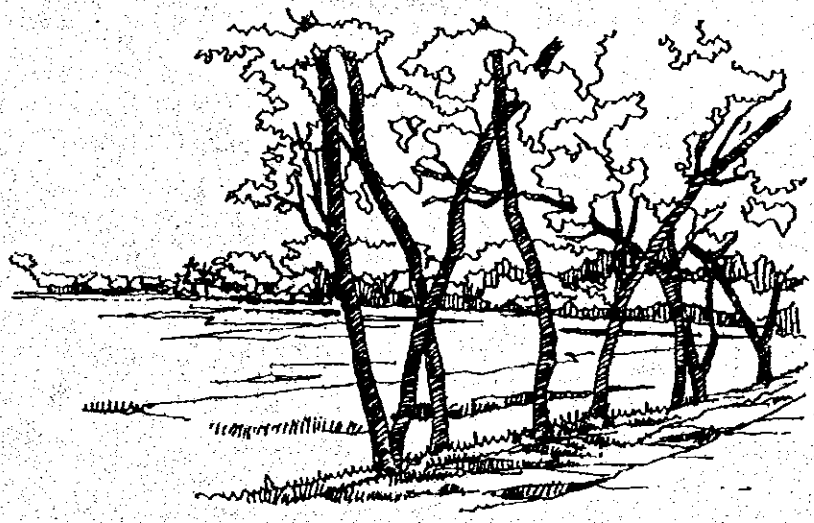
The highest efficiency and the least number of equipment as well as the smallest construction yards surely result in the most economical way.

4) Social Impacts

It surely contributes to minimize adverse social impacts to adjacent inhabited area that well balanced yet reasonable construction planning be made.

CHAPTER 12

MAINTENANCE AND OPERATION PLAN



CHAPTER 12 MAINTENANCE AND OPERATION PLAN

12.1 Background

Institutional strengthening of the roads sector in Bangladesh is largely driven by the Institutional Development Component (IDC) of the Road Rehabilitation and Maintenance Project (RRMP). The UK Department for International Development (DFID) provides funding for IDC and the World Bank provides funding for RRMP. The Government of Bangladesh provides counterpart funding for both projects. The IDC program commenced in 1994 and the initial phase (IDC1 and IDC2) was completed at the end of 1998. The second phase (IDC3) commenced in January 1999 and is expected to continue for a period of four years up to December 2002. IDC is attached to the Government of Bangladesh, Ministry of Communications (MOC). IDC operates in MOC, the Roads and Highways Department (RHD) and the Bangladesh Road Transport Authority (BRTA). The IDC3 project has a total value of US$7 million.

The requirements of IDC3 are as follows:

- Develop further MOC's and RHD's policy and planning capability.
- Improve RHD's organization and management.
- Develop capacity in the RHD zones to implement planned maintenance programs.
- Address major road safety problems and prepare a separate road safety program.

12.2 IDC3 and Beyond (2000 to 2010) – The Way Forward (main elements)

(1) Ministry of Communications (MOC)

MOC has a small staff of about 115 persons. An important task for MOC is to re-define its role so as to concentrate more on strategic issues and spend less time on detailed matters. The development of a long-term strategic plan to cope with future transport demand is a high priority. Also, there is an urgent need for a comprehensive Management Information System to assist in planning and management functions.

(2) Bangladesh Road Transport Authority (BRTA)

BRTA is the premier government regulatory agency for road transport in the country. Its main responsibilities are: registration of vehicles; licensing of drivers; collection of road user taxes and fees; and issuing and renewing vehicle fitness certificates and route permits. BRTA is a small organization consisting of a workforce of 264 persons.

There is an opportunity for the Government to boost revenue collection in the roads sector by providing BRTA with more resources and at the same time by linking future BRTA budgets to improvements in revenue collection and service standards. Also BRTA will pursue a number of initiatives including: improved and modernized licensing and new inspection and testing systems.

(3) Road Safety

In response to the growing road safety problem in Bangladesh, the National Road Safety Council (NRSC) was formed in 1995 under the chairmanship of the Minister of Communications. NRSC was assigned responsibility for formulating national road safety policies with the goal of reducing road traffic accidents. To this end, NRSC, in collaboration with IDC, BRTA, the Police, RHD and LGED, developed the National Road Safety Strategic Action Plan. The Plan set out a two-year program of activities in a number of specified road safety sectors including: accident data; road engineering; traffic legislation; traffic enforcement; driver training and testing; vehicle safety; education and publicity; and medical services. NRSC has now made successful starts in nearly all of the specified road safety sectors.

However, it is now recognized that the full development of the road safety initiatives cannot be achieved under a sub-component of IDC. Rather, a fully-fledged road safety program is required. Such a program would be too large for a single technical assistance project. Thus, a multi-donor co-ordinated program is planned with a core project being built around NRSC and with other components being taken up under associated projects. The planned road safety program would require donor support for a range of components which could include: community road safety projects; institutional reform, training and equipment for the Traffic Police; and the design and implementation of road safety schemes. IDC3 will continue to build on the road safety foundations provided by IDC2. Importantly, IDC3 will assist with the formulation of the fully-fledged road safety program.

(4) RHD Management

Following an interim re-organization of RHD in mid 1998 the headquarters of RHD now consists of two Wings (network management and technical services) and a Mechanical Zone. There are also four Wings that have been set up to manage major foreign aided projects. At the field level the organization is divided into seven Zones, 20 Circles, 65 Divisions and 131 Sub-Divisions. It is now considered that this organizational structure has a number of problems including: too many officers report directly to the Chief Engineer; foreign aided schemes tend to operate at the edge of

the organization and contribute little to the overall development of RHD; and the Zones carry out a wide range of tasks which often have conflicting priorities.

Under IDC3 re-organization of RHD will be one of the early topics to be considered. The main aim will be for the structure to reflect the different functional requirements and budgetary allocations. There will also be an intention to devolve decision making to the lowest appropriate level. The present Zonal structure is suitable for routine and minor periodic maintenance operations but is not well suited to machine intensive periodic maintenance or major construction (especially bridges). Neither does the current structure reflect the differing requirements of national/regional highways and feeder roads.

(5) RHD Staffing

RHD currently employs nearly 20,000 staff. However, only about seven per cent of these are Class 1 and 2 degree and diploma level staff. Over half of RHD's staff are work charged or master roll casual laborers. The current workforce is not therefore of the right profile to manage a modern organization. There has been virtually no recruitment in the lower staff grades for the last 10 years and the Government has banned all recruitment of master roll and work charged staff. As a result most staff are now above 40 years old. This means that staff numbers in the lower grades are already reducing as a result of retirement and this trend will continue. RHD must therefore learn to live with smaller numbers of staff in some grades and re-structure its operations accordingly. With increasing use of technology there is a greater need for more skilled and trained staff.

(6) Network Management

Until recently planning of RHD's annual programs had to be based on perceived needs rather than on analysis. Now, however, RHD has access to an extensive body of computerized data from surveys. This data can be used with inventory data to determine the future budgetary needs for road maintenance and rehabilitation. At the core of this system is the Highway Development Model (HDM) that provides an economic ranking of options. The system is now operational but there are some areas requiring further attention.

There is a lack of clarity and transparency in the various types of maintenance expenditure. It is intended that in future RHD's budgets will provide separate allocations for each type of major maintenance activity:

- **routine:** small-scale activities that must be carried out frequently.

- **periodic:** planned activities that are related to age or condition.
- **rehabilitation & improvement:** work on failed roads & bridges (due to poor construction or lack of maintenance) or improvements to meet increasing demands.
- **emergency:** activities that respond to an event caused by unforeseen circumstances.

RHD's annual Revenue budget (currently about $50 million) is largely expended on routine and periodic maintenance of roads, bridges and buildings. In addition it is used to fund operations (salaries, overheads, etc.) and maintain equipment and ferries. RHD's Annual Development Program (ADP) budget (currently about $230 million) is largely allocated to upgrading, rehabilitation and new development works. Some of these items may be considered as periodic maintenance.

The tools are in place to enable rational planning and budgeting of future maintenance and rehabilitation projects. Establishing procedures to enable this to take place efficiently are a priority. Rational planning must include the equitable distribution of funds to all Zones, and allocation of sufficient funds to enable maintenance projects to be undertaken to completion (as opposed to doing a little in a number of places which wastes money). The execution of maintenance works should include an expanded periodic maintenance requirement that would create a major new demand for the larger local contractors. It is estimated that on the national and regional highway network, about 700 km of thin overlay or other bitumen surface treatment should be undertaken each year.

Maintenance practices will have to be upgraded to cope with the increased demand. Contracts for major machine-based periodic maintenance will be required for improved National and Regional roads. Periodic maintenance on other roads could remain under small-scale contractors using improved labor-based methods. Quality of all works must be ensured so that the product fulfils the design criteria and the overall objectives. There is an urgent need to finalize standard RHD contract documents for both construction and maintenance works. Another need is a timetable for the establishment of design standards, design guides and checking procedures.

12.3 Operation and Maintenance Plan for the Project

RHD will be the Executing Agency for the Project. To facilitate day to day implementation of the construction of the Rupsa Bridge and the 10 km southern section of the Khulna bypass road, RHD will open a Project Office in Khulna. The Project Office will be headed by a Project Director (PD), who will be supported by a Project Manager (PM), a Deputy Project Manager (DPM) and various other staff including engineers, accountants and administrative staff. In total there will be about 37 staff: 14 in the PD's office, 14 in the PM's office and 9 in the DPM's office. On

completion of the construction work, the Project Office will be closed and all equipment including vehicles used in construction supervision services will be handed over to RHD.

It is proposed that RHD's Khulna Zone (through its Khulna Road Division) will be responsible for managing the operation and maintenance of the Project facilities. Routine and periodic maintenance will be based on the contractor's maintenance manual, and will be carried out through a combination of in-house works and contracted out works as determined by the Road Division. The operation of the toll system on the main Bridge will be undertaken in-house by the Road Division unless satisfactory financial and other arrangements for contracting out to the private sector (including auditing) can be put in place. The main Bridge will use a closed toll system with barrier-type toll collection. The need for additional toll booth facilities will be reviewed based on actual traffic data collected after the opening of the Bridge.

Given the economic importance of the Project, it is envisaged that annual budgets for routine and periodic maintenance will be specifically allocated to the Project (i.e., dedicated) rather than being part of a zonal/block budget allocation. It is proposed that routine maintenance should be funded from the Revenue budget while periodic maintenance should be under an ADP allocation. It is envisaged that JBIC will require separate audited accounts for the Project (for construction, O & M, and toll collections). Based on the existing law, the toll collections cannot be directly dedicated to finance maintenance expenditure. For road safety matters along the Project route, the Khulna Zone will seek advice and assistance from RHD's Road Safety Unit.

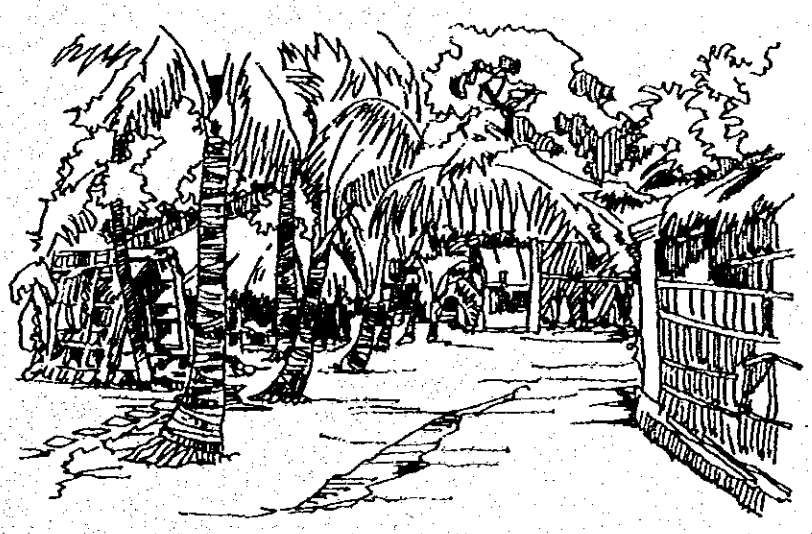
Six roads will cross the 10 km southern section of the bypass. Responsibility for maintaining and developing the crossing roads will be as follows:

- RHD will be responsible for: Khukna-Mongla Road (national highway); Khulna-Satkhira Road (regional highway); and Batiaghata-Dacope Road (feeder road type "A").
- WDB/KCC will be responsible for the Labanchora Road and the Rupsa-Kharabadh Road (both known as Dike Road).
- LGED will be responsible for the Jabusa (Bhangon Paar) connecting road.

RHD will be responsible for the river training works but will seek advice as necessary from the Water Development Board.

CHAPTER 13

INSTITUTIONAL ARRANGEMENT FOR THE PROJECT IMPLEMENTATION



CHAPTER 13 INSTITUTIONAL ARRANGEMENTS FOR THE PROJECT IMPLEMENTATION

13.1 Background

Due to attracting a great deal of public attention in Khulna as well as in Bangladesh, the project is highly expected smooth implementation to enter into construction phase.

To avoid delays in Project implementation, it will be necessary for RHD and other concerned government agencies to pay close attention to the numerous Project processing steps that are standard practice for foreign aided projects.

This chapter is prepared to make it clear the due procedures for an investment project in general as well as the sequent yet time-bound procedures for the implementation of Rupsa Bridge Project in particular.

13.2 Administrative Rules and Procedures

(1) General Flow Concept

Fig. 13.2.1 shows the flow diagram of the administrative rules and procedures for Rupsa Bridge in the inclusion of the Annual Development Programme.

The project of Rupsa Bridge Construction may have a general flow concept of implementation as shown in Fig. 13.2.2, provided that the project should be implemented under JBIC ODA Loan proceeds. It is expected that the Study will provide necessary information and data for consummation of institutionally due procedures in the nick of time, and accordingly it will be able to assist the Government of Bangladesh to make the project implementable in compliance with the rules and procedures for approval of an investment project set forth administratively.

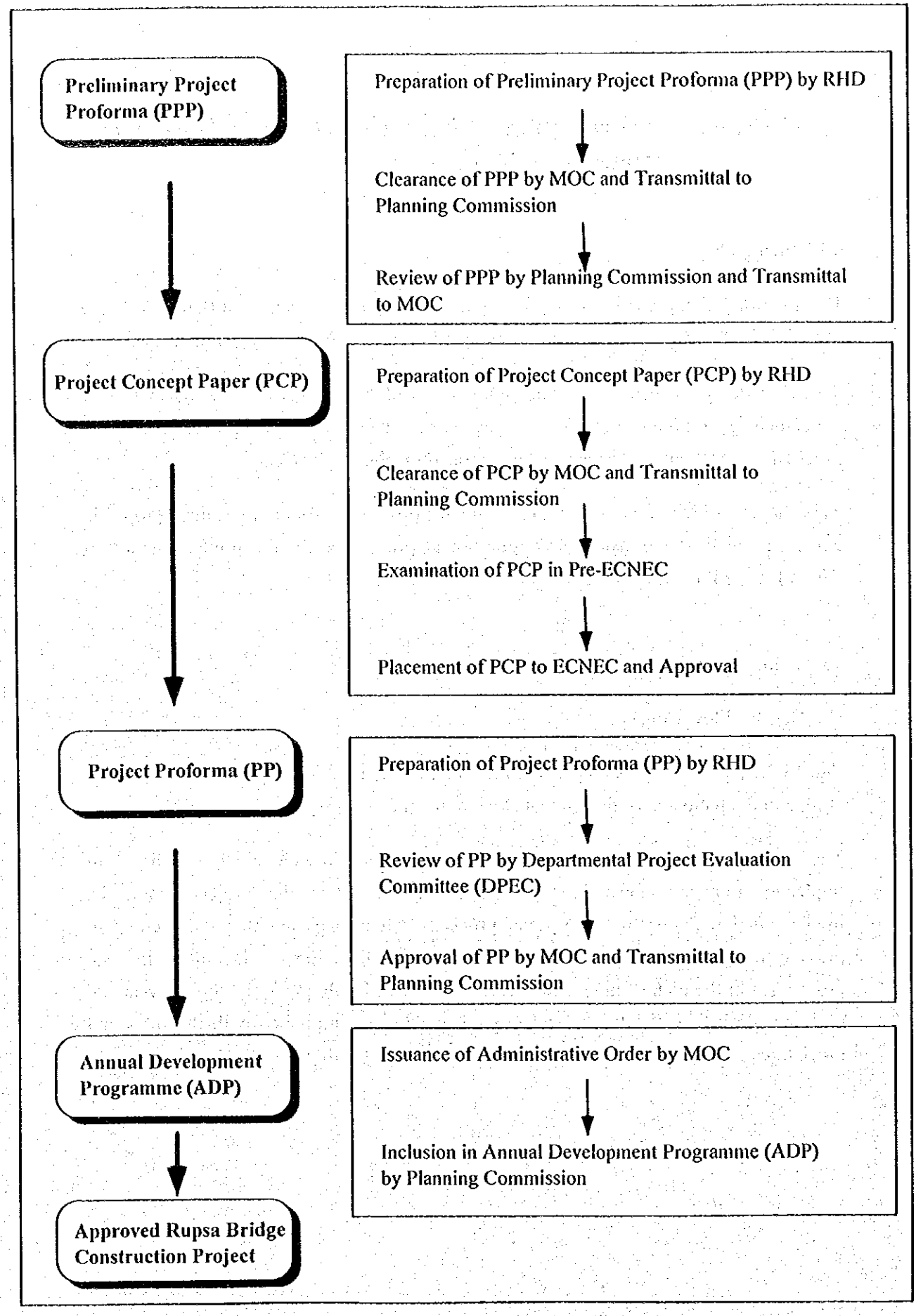


Fig. 13.2.1 Approval Procedure of an Investment Project

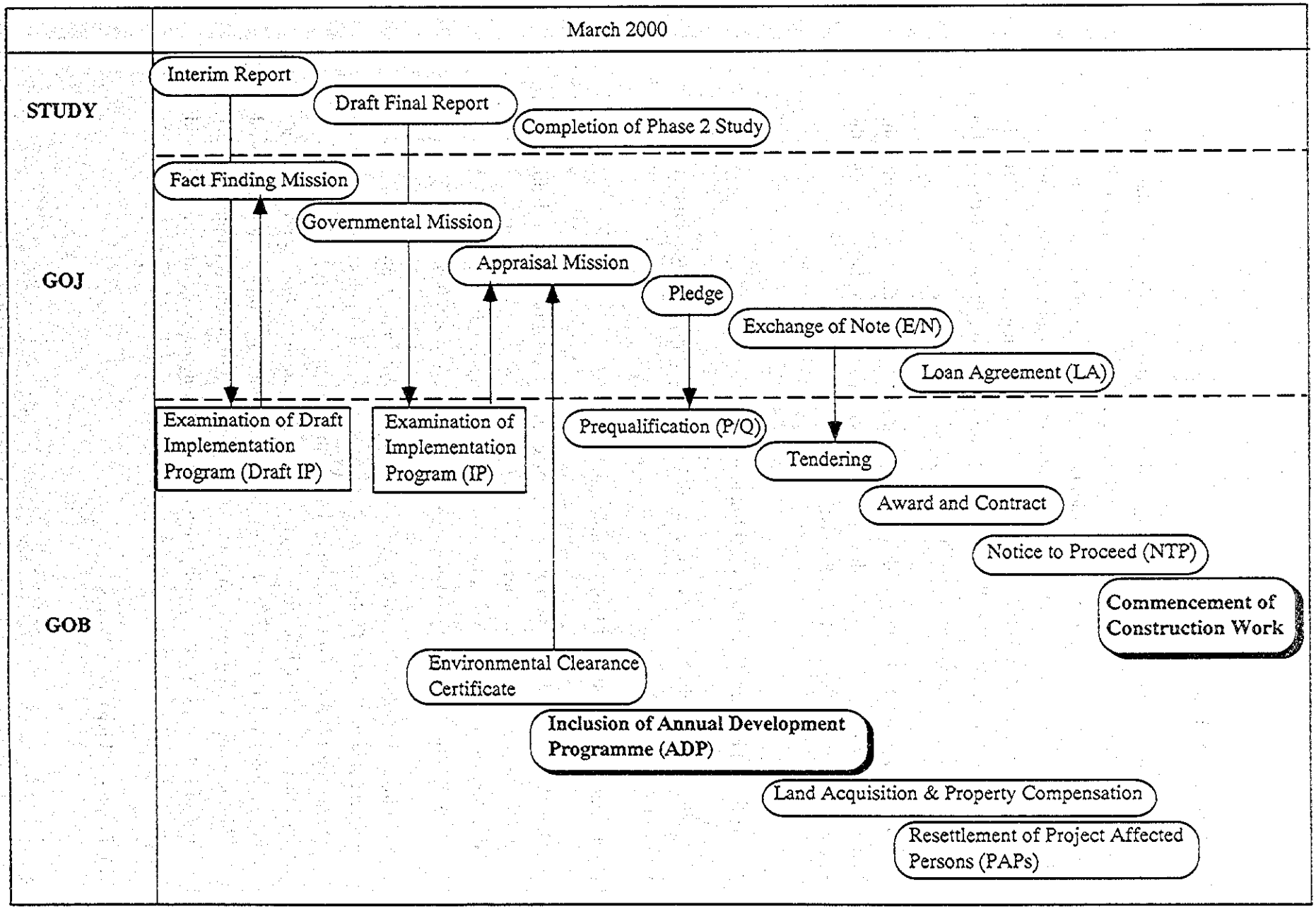


Fig. 13.2.2 General Flow Concept of Project Implementation for Rupsa Bridge Construction in case of JBIC ODA Loan

(2) Indicative Milestones

The Interim Report which is scheduled to submit to the Bangladesh side in the middle of October, 1999 will contain all necessary information and data for preparation of Draft Implementation Program (Draft IP). The Draft IP will be submitted to the Fact Finding Mission of OECF for reference. Following the Annual Consultation between the Government of Bangladesh (GOB) and the Government of Japan (GOJ), the Appraisal Mission of OECF will examine the Implementation Program (IP) together with the Environmental Clearance for review.

It is usually allowed that a Prequalification for contractors may be advertised after the Pledge will be made. It is also allowed that a Tender Call may be made after the Exchange of Note (E/N) will be exchanged.

13.3 Technical Requirements for Project Implementation

The following technical aspects are required to make Rupsa Bridge Project more implementable.

(1) Uninterrupted Process of Project Implementation

One of the major factors to make road project implementation difficult is that it is apt to lay itself open to interfere implementation phases. Since infrastructure development may necessitate a long span of time to realize, it is always pointed out delay or suspension by interference as a weak point of realization.

As old saying of "strike while the iron is hot", uninterrupted process of project implementation could facilitate most of well-known difficulties such as land acquisition problem, cost overrun and so forth. On the contrary, slow process of documentation could expose increase of risk against the approved plan. Perceptional risks are rising in land prices, escalation of construction costs and additional administrative expenditure during delay or suspension. As a matter of fact, loss of potential benefits brought from a project during delay or suspension should also be taken into account as a major part of loss.

(2) Propitious Preparatory Works

A good preparatory work in the nick of time as well as quality assurance of works at each implementation phase are crucial to the way how to keep uninterrupted process of project implementation.

There are separate time-bound schedules for activities that include bidding, evaluation, approval, contract awards for appointment of the consultants as well as contractors. Finalization of the above activity-schedule is done during aid negotiation followed by their inclusion in the aid agreement. Prior to these activities, other important activities like land acquisition, establishment of project office and appointment of the project staff etc. should be completed adequately.

(3) Preparation of Implementation Program (IP)

A Draft Implementation Program (IP) has already been prepared by RHD. As Project processing proceeds and more information comes to light, it will be important for RHD to update the IP.

One of the usual bottlenecks is the preparation of the Land Plan for spelling out matters pertaining to land acquisition, compensation and resettlement. However, the Land Plan for the Project is well under way and is not seen as a major bottleneck.

CHAPTER 14

CONCLUSION AND RECOMMENDATIONS

CHAPTER 14 CONCLUSION AND RECOMMENDATIONS

14.1 Technical Soundness

Technical risks of the Project have been minimized to the extend possible by having a series of technical designs at a different level by each study phase based on various engineering site surveys, full-scaled natural condition surveys and social and environmental surveys. Technical designs and associated cost estimates were carried out by two-phase study undertaken by JICA in the period of 1998 to 2000. Emphases were put on route selection against adverse social impacts, type of superstructure against design wind, foundation design against sub-surface soil conditions, river revetment against erosion and pier protection against scouring. In the course of these studies, land acquisition plan was prepared based on topographic survey along the selected route and due procedure to acquire future Road Right-of-Way is in process.

Accordingly, technical soundness for the Project is warranted from all technical aspects.

14.2 Financial and Economic Feasibility

Major quantifiable benefits accruing from the Project consist of savings in transport costs for present and future traffic in and around Khulna, especially at Rupsa Ferry. Benefits from generated and attracted traffic in the socio-economic framework are included in the economic evaluation. The annual traffic growth rate during the planning period is forecasted 9% for buses, cars and motorcycles and 11% for trucks. The base EIRR for the Project is 26.4%, with various sensitivity scenarios raging from 19% to 24%.

When a new bridge with a length of less than 1,500 m replaces an existing ferry, RHD's policy is that the ferry tolls should be applied to the new bridge. In the financial analysis, this approach has been adopted and the resulting estimated FIRR (for Rupsa Bridge only) of 2.4% appears low but full cost recovery is reached. The cash flow analysis (for the SSKB including Rupsa Bridge) is in real terms and indicates that tolls revenues would be sufficient to cover interest and O/M expenses and about 80% of loan repayments.

14.3 Social Justification

The Rupsa River severs the Southwestern region of Bangladesh and disrupts community of Khulna Division with 12.7 million population in regional as well as Khulna Former District with 5.3 million in local, and it causes serious traffic congestion at Rupsa Ferry. The bridge construction is deemed a drastic measure to improve such adverse social situation.

In the course of these studies, EIA & SIA report was prepared based on IEE & ISIE in accordance with the environmental policy and laws of Bangladesh as well as environmental guidelines of international institutions including JICA and JBIC.

RHD as the executing agency for the Project has submitted the environment clearance application to DOE based on the EIA & SIA report, and due procedure is in process to obtain Environmental Clearance Certificate. Therefore, it is obvious that social justification for the Project will be confirmed officially in a short time.

14.4 Conclusion

The EIA and SIA concluded that there are no substantial or irreversible adverse environmental and social impacts arising from the Project.

The Project will realize strategic corridors by non-river interruption in terms of regional context and will relieve traffic congestion at present Rupsa Ferry drastically as well as alleviate other traffic bottlenecks on National Highway No. 7 in local. The Project will also strengthen Khulna-Mongla Road so as to stimulate Mongla Port to induce incremental demand of domestic freight as well as transit cargo to Nepal and other landlocked countries. This transformation will bring considerable degrees of both direct and indirect benefits in Khulna as well as the southwestern region of the country, especially by minimizing transport constraints and reducing transport costs.

The Project has been given high priority in the Fifth Five-Year Plan (1997 – 2002) and both its technical and economical feasibilities have been confirmed in the course of JICA studies. The technical design and prequalification/tender documents for the Project are scheduled to be approved by the Government of Bangladesh in March 2000.

It may be concluded that the institutional arrangement for project implementation should be taken without interruption.

14.5 Recommendations

The following recommendations are made for the implementation of the project:

1) It is vital that the northern section of Khulna Bypass should be implemented to meet the implementation time schedule of the southern section of Khulna Bypass.
2) It is quite important that the development within and along the proposed Right-of-Way should be effectively controlled to facilitate the land acquisition process.
3) RHD Khulna Zone should immediately commence due procedure for land acquisition, and simultaneously try to get BWDB's consent for the construction of river revetment, pier protection in the Rupsa River and the installation of bridges and box culverts to canals, branches and tributaries.
4) It is necessary for RHD to procure a consultant for supervisory services who may review the technical design to hold a professional liability. Since tender documents have close relation to the design, the procurement of consultant should be made prior to starting the pre-qualification process for contractors.
5) It is recommended that RHD should raise the bid security from prevailing 2% of Engineer's estimates up to the same rate of Performance Security, taking into

consideration the case of Paksey Bridge.

6) It is desirable that connecting roads will be improved to meet the implementation time schedule of the southern section of Khulna Bypass and a city planning road will be developed accordingly.

7) Existing Rupsa Ferry will be closed after opening of Rupsa Bridge. However, existing ferry terminals should be utilized effectively as follows:

   - to transfer existing facilities to Khulna City Corporation (KCC) to accommodate non-motorized traffic.
   - to build bus terminals at present ferry terminals and to provide circumferential bus services between two terminals through Rupsa Bridge as shown in the Appendix.