5-3-2 Selection of Bridge Type

(1) General

Flow chart for selecting the bridge type is shown in Fig. 5-2.

(2) Preliminary selection

Several possible alternatives of the bridge type have been proposed in terms of the number of spans and steel structure or concrete structure. Firstly, single span bridge type was given a priority, and four span bridge was disregarded because of the construction difficulties of many piers in the river and their large disruptions against the river flow.

Two span bridge has an advantage over one span bridge in superstructure construction, but it is at a disadvantage when compared with 3 span bridge in substructure construction. Consequently a two span was not selected and one span bridge and three span bridge have been taken up for the purpose of comparison. (See Table 5-2)

As a result of the above discussion, seven alternative bridge types (5 one span bridge types and 2 three span bridge types) have been proposed as stated below:

1) One span bridge

Prestressed concrete girder bridge
Cable-stayed prestressed concrete bridge
Cable-stayed steel girder bridge
Steel Warren Truss bridge
Steel Langer Girder bridge

2) Three span bridge

Prestressed concrete girder bridge
Continuous steel girder bridge

Among these seven possible alternatives, three alternatives were taken up for final comparison as shown in Fig. 5-3. The items considered for the final selection are detailed in Table 5-2.

Fig. 5-2 FLOW CHART FOR SELECTING BRIDGE TYPE

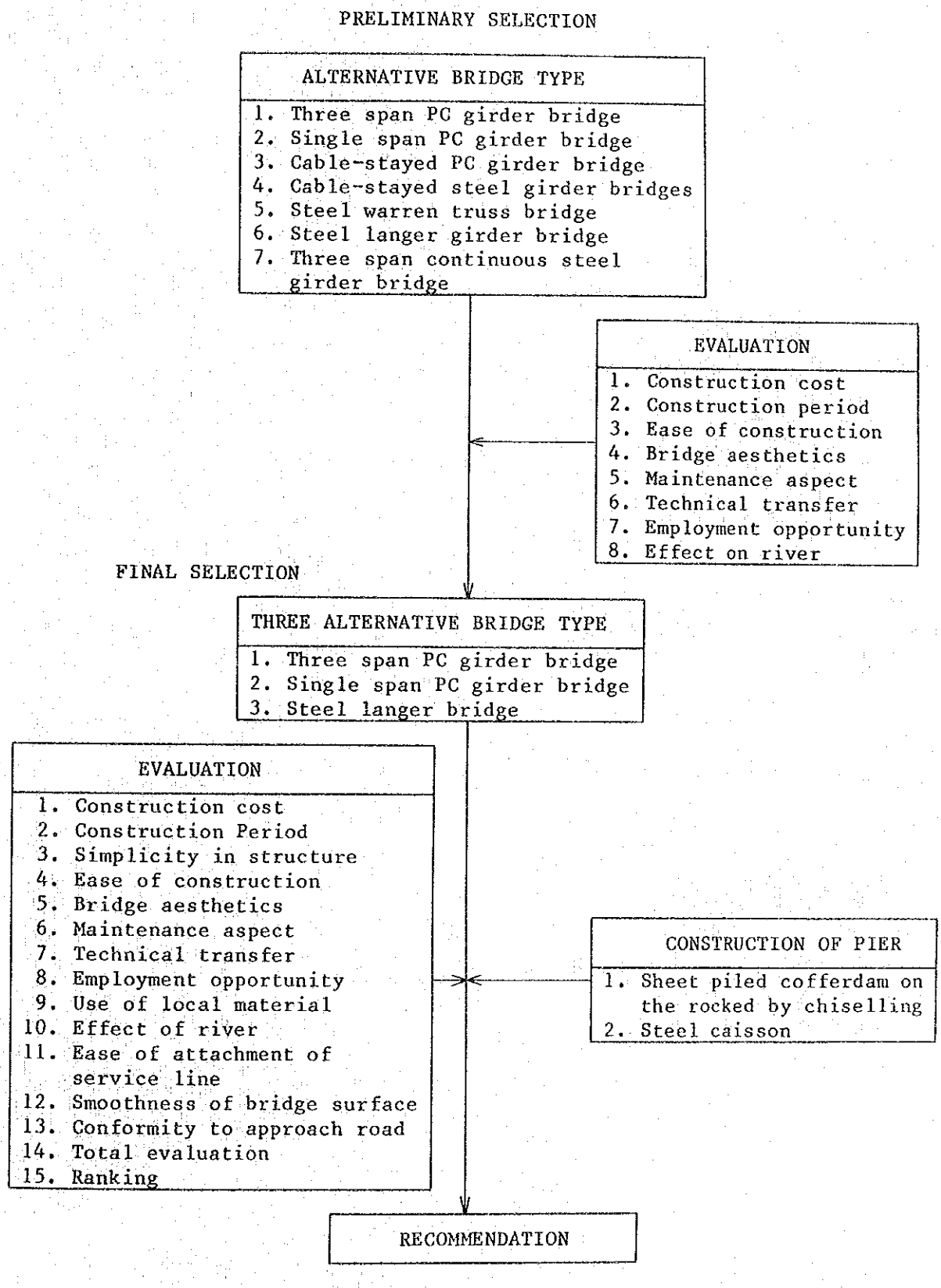
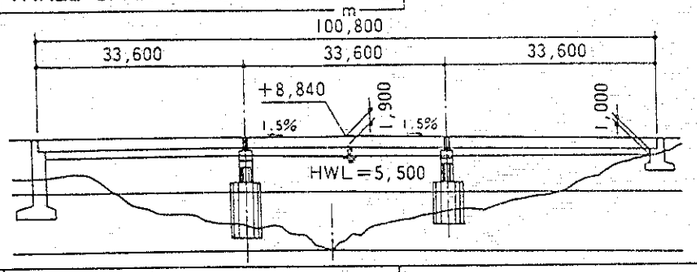
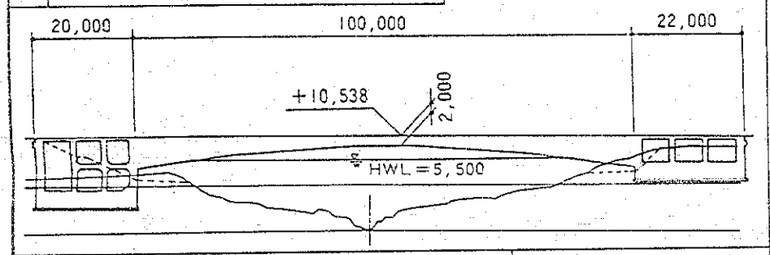
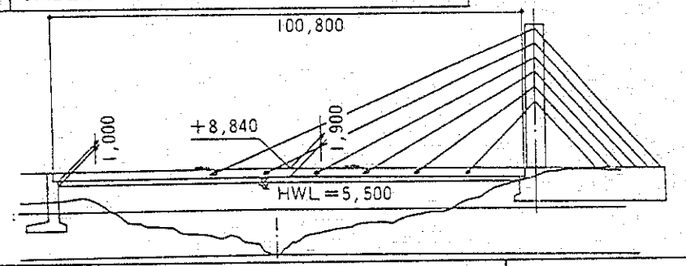
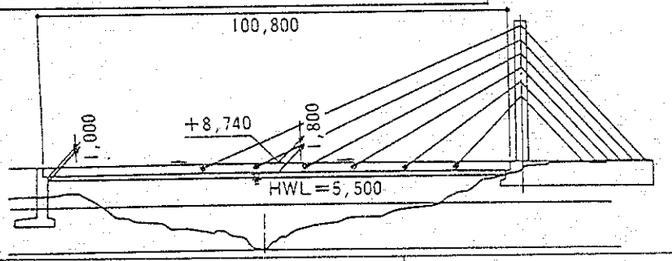
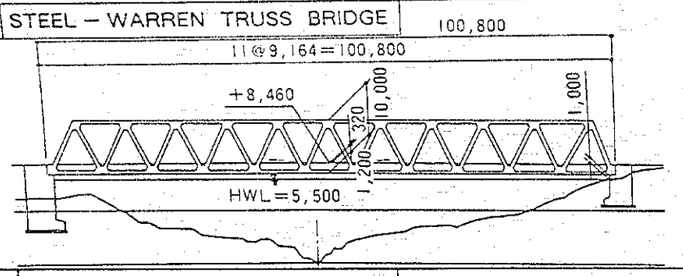
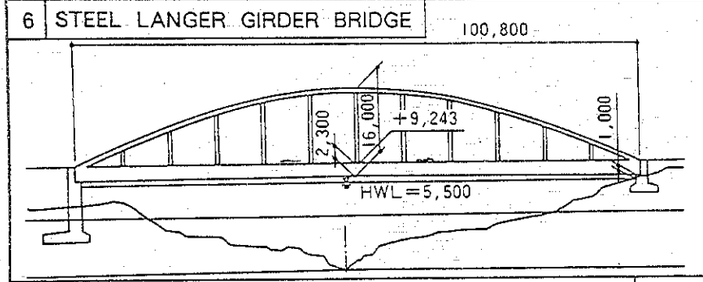
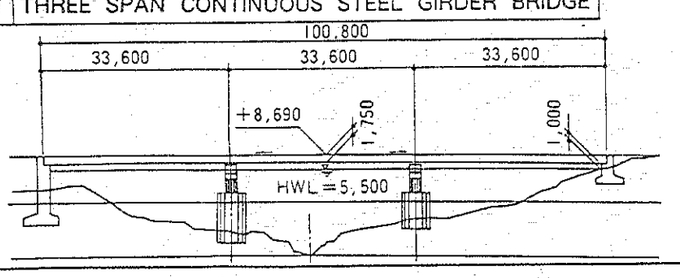


Table 5-2 EVALUATION OF ALTERNATIVE BRIDGE TYPES (FIRST STAGE)

1. CONSTRUCTION COST
2. EASE OF CONSTRUCTION
3. CONSTRUCTION PERIOD
4. BRIDGE AESTHETICS
5. MAINTENANCE ASPECT
6. TECHNICAL TRANSFER
7. EMPLOYMET OPPORTUNITY
8. EFFECT ON RIVER

ELEVATION OF BRIDGE	1	2	3	4	5	6	7	8	DESCRIPTION
1 THREE SPAN P.C GIRDER BRIDGE 	△	△	△ 22 Months	△	◎	◎	◎	△	Too simple in appearance as a monumental work. High cofferdam costs and extended construction period due to difficult construction access and construction problem with piers. Reduction in flow area results possible scour problem and increased water level. Advantages include ease of maintenance and availability of technical transfer and employment opportunity. ○
2 ONE SPAN P.C GIRDER BRIDGE 	◎	○	◎ 18 Months	◎	◎	◎	◎	○	Provides attractive appearance with simple and clean lines. No construction risk and disruption to the river flow due to cantilever erection method. Least cost and construction period among the alternatives. No maintenance work. Technical transfer and employment opportunity are expected. Higher free board will give safety margin for floating debris during flood. ◎
3 CABLE – STAYED P.C GIRDER BRIDGE 	△	○	△ 23 Months	○	○	○	○	○	Provides good appearance by itself but does not blend with the existing bridge. No construction risk and no disruption to the river flow due to cantilever erection method. Relatively low maintenance cost. Technical transfer and employment opportunity are relatively minimal. △
4 CABLE – STAYED STEEL GIRDER BRIDGE 	△	○	○ 21 Months	○	△	△	△	○	Not harmonized with existing bridge in appearance. No construction risk and desruption to the river flow due to cantilever erection method. Highest cost among the alternatives. Require longer period in fabrication and erection. Periodic maintenance is required. Technical transfer and employment opportunity would not be expected. △
5 STEEL – WARREN TRUSS BRIDGE 	○	△	○ 21 Months	△	△	△	△	○	Aesthetically does not blend with the existing bridge. Requires large – scale erection equipment which shall cause extended construction period. Advantage of no desruption to river flow. cost and construction period are ranked fourth among the alternatives. Periodic maintenance is required. Technical transfer and employment opportunity would not be expected. △
6 STEEL LANGER GIRDER BRIDGE 	○	△	○ 22 Months	○	△	△	△	○	Same as for steel warren truss bridge. ○
7 THREE SPAN CONTINUOUS STEEL GIRDER BRIDGE 	△	△	△ 21 Months	△	△	△	△	△	Too monotonous a structure for a monumental work. High cofferdam cost and extended construction period due to difficult construction access and construction problem with piers. Reduction in flow area results in possible scour problem and increased water level. Periodic maintenance is required.Technical transfer and employment opportunity would not be expected. △

(3) Final Selection

The three alternatives are:-

1) Three span prestressed concrete girder bridge,
2) One span prestressed concrete box girder bridge, and
3) Three span continuous steel girder bridge

Two construction methods for piers have been examined for the cases 1) and 3) as shown on Table 5-3, and the steel caisson-pier has been provisionally employed for the purpose of comparative study.

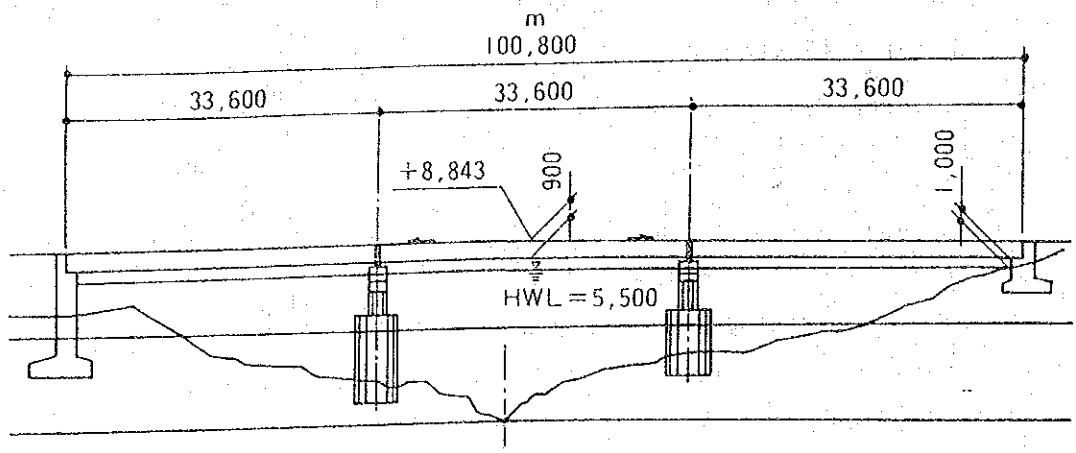
Evaluation of three alternatives was conducted in 15 comparative items as shown in Table 5-4, thus, the type of one span prestressed concrete girder (Cantilever girder bridge) has been finally selected for the basic design.

Although there are some construction methods for the prestressed concrete bridge, especially in the manner of stressing of the steel bar or wire, it is assumed to employ the Dywidag system because it is most popular in Japan.

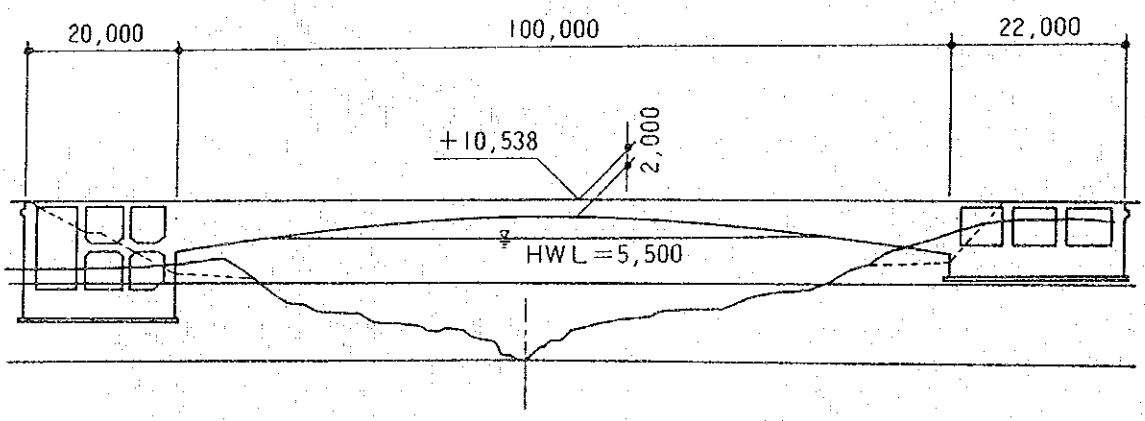
Table 5-3 COMPARISON OF CONSTRUCTION METHOD FOR PIER

	COFFERING BY SHEET PILES	STEEL CAISSON
1. Construction cost	△	○
2. Construction period	△	○
3. Easy construction	△	○
4. Bridge aesthetics	○	○
5. Technical transfer	○	○
6. Local employment opportunity	○	△
7. Maintenance Aspect	○	△
8. Influence on river	△	○
Total comparative evaluation:	Coffering by the sheet-piles is relatively difficult, due to the difficulty of driving them into hard GNEISS foundation. Higher cost and longer period.	Rock excavation by blasting be required. This is superior to the coffering by sheet piles. Less impedence on the flow of river.

THREE SPAN P.C. GIRDER BRIDGE



ONE SPAN P.C. GIRDER BRIDGE



STEEL LANGER BRIDGE

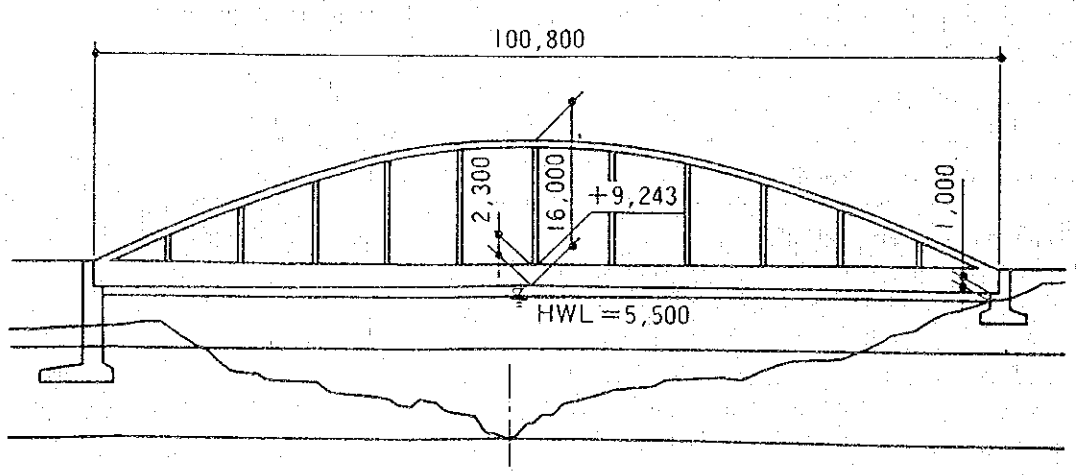


Fig. 5-3 THREE ALTERNATIVE BRIDGES

Table 5-4 EVALUATION OF THREE ALTERNATIVE BRIDGE TYPES

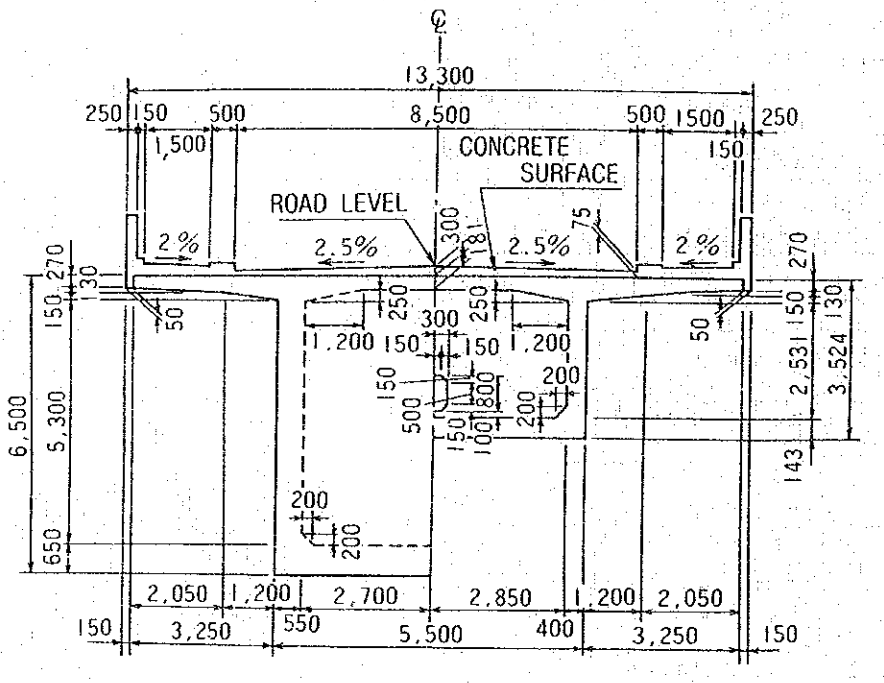
EVALUATION			
Bridge Types / Criteria	THREE SPAN P.C. GIRDER BRIDGE	ONE SPAN P.C. GIRDER BRIDGE	STEEL LANGER BRIDGE
1. Construction Cost	△	◎	○
2. Construction Period	△	◎	○
3. Simplicity in Structure	◎	◎	○
4. Ease of Construction	△	○	○
5. Bridge Aesthetics	△	◎	○
6. Maintenance Aspect	◎	◎	△
7. Technical Transfer	◎	○	△
8. Employment Opportunity	◎	◎	△
9. Use of Local Material	◎	◎	△
10. Effect on River	△	◎	◎
11. Ease of Attachment of Service Lines	○	◎	○
12. Smoothness of Bridge Surface	○	◎	◎
13. Conformity to Approach Road	◎	○	◎
14. Total Evaluation	High cofferdam cost and most extended construction period among alternatives. Reduction in flow area and this will result in increased water level and possible scour problem. Construction problem with piers due to overwater construction.	Least cost and construction period among the alternatives. Generally preferable to the other two alternatives.	Cost and construction period are ranked next to the best alternatives. Less preferable in terms of maintenance aspect, Technical transfer, Employment opportunity and Use of local material.
15. Ranking	3	1	2

5-3-3 Typical Standard Section

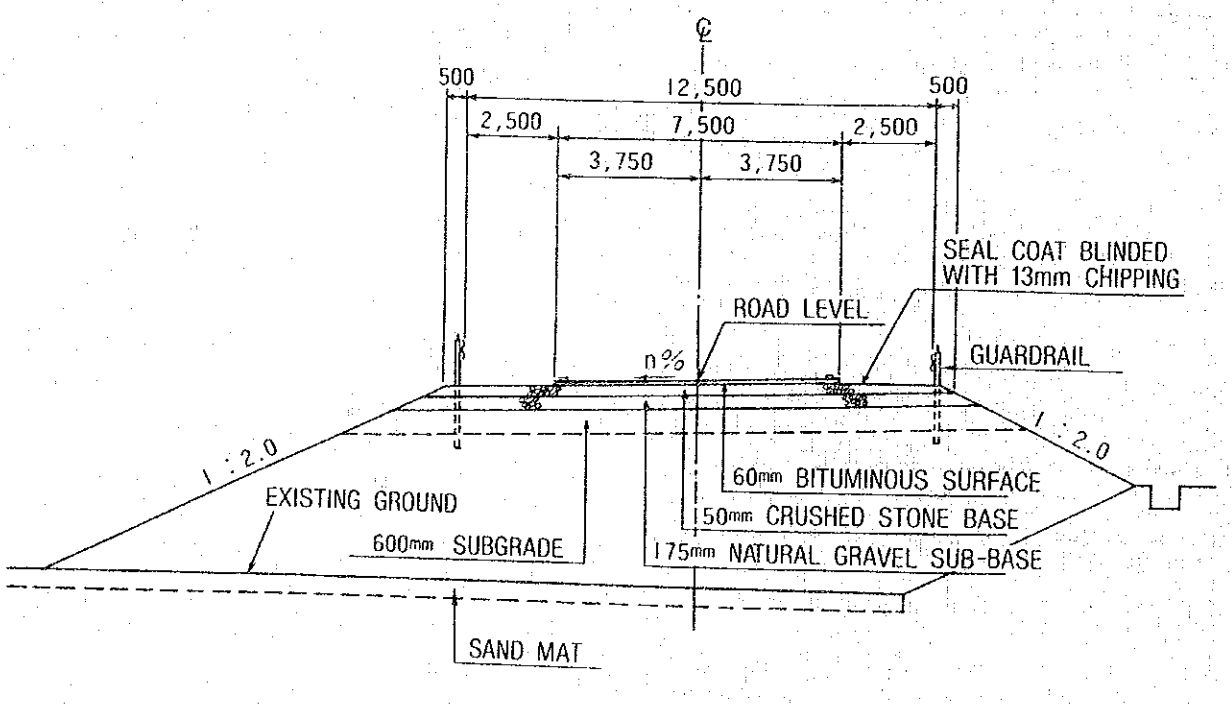
Typical bridge section and approach road section were determined as summarized hereof.

TYPICAL SECTION

BRIDGE



APPROACH ROAD



5-3-4 Design Standard and Criteria

The following basic design criteria were applied.

(1) Design Standards:

The current Japanese Standards "Specifications for Highway Bridges" mainly applied together with the "Guide for Bridge Design" by GHA.

(2) Bridge type:

One span Prestressed Concrete Box Girder

(3) Construction Method:

Cantilever erection method

(4) Bridge Length: 142.0 m

(5) Clear Span between abutment faces: 100.0 m

(6) Width of Bridge:

Overall width; 13.3 m
Carriageway; 8.5 m (Curb to Curb)
Sidewalk; 3.0 m (1.5 x 2)
Barrier strip; 1.0 m (0.5 x 2)
Parapet; 0.8 m (0.4 x 2)

(7) Live load:

The decks are designed in order to carry T-20 loading, and L-20 loading for the main girders, to Japanese Standard "Specification for Highway Bridge". The structure has to be checked for 35 units of H.B. loading.

Collision load on parapet 6.5 ton

(8) Design Flood Level: MSL + 5.5 m (50-years return period)

(9) Seismic Loading: 0.1G of horizontal surface acceleration

(10) Materials and Allowable Stress:

1) concrete for main girder;

	Substructure & Curb	Main Girder
Specified compressive strength (kg/cm^2)	$\sigma ck = 240$	$\sigma ck = 350$
Young's modulus (kg/cm^2)	2.7×10^5	3.25×10^5
Unit weight (t/m^3)	2.5	2.5
Flexural extreme fiber stress (kg/cm^2)	80	125
Axial compressive stress (kg/cm^2)	65	85
Shear stress (kg/cm^2)	3.9	5.0

2) Prestressing bar

For Main bar, sheer bar and lateral tensioning bar, SBRP 95/120, ϕ32 will be used.

3) Reinforcing bar

Reinforcing bar conforming to SD35 of JIS G3112 (Deformed steel bar) or equivalent will be used.

Allowable stress is shown below.

For ordinary members (kg/cm^2): 1,800
For slab (kg/cm^2): 1,400
For members in water or below ground-water level (kg/cm^2): 1,600
Yield stress: $\sigma sy = 3,500$ kg/cm^2

(11) Backfill Material

Unit weight: $r = 2.0$ t/m^3
Internal friction angle: $\phi = 30^o$
Cohesion of soil: $c = o$
Earth pressure coefficient in passive earth pressure between concrete wall and soil:
In normal case; kah = 0.304 kav = 0.054
At the time of earthquakes; kah = 0.374 kav = 0

(12) Stability

Stability against overturning:
In normal case; $e < B < 6$
At the time of earthquakes; $e < B < 3$

Stability against sliding
In normal case; $F<1.5$
At the time of earthquakes; $F<1.2$

Stability for bearing:
In normal case; qa = 100 t/m^2
At the time of earthquakes; qa = 150 t/m^2
Coefficient of friction between foundation ground and bottom of foundation; $\mu = 0.6$

(13) Rock Anchoring
Safe factor of anchoring against uplift: F = 3.0
Coefficient of friction between anchor bar and surroundings: $\tau = 120 t/m^2$

(14) Applicable Standard:

"Specifications for Highway Bridges" issued by Japan Road Association.

I. Common specifications
II. Concrete Bridge
III. Substructures

"Guide for Bridge Design" issued by Ghana Highway Authority.

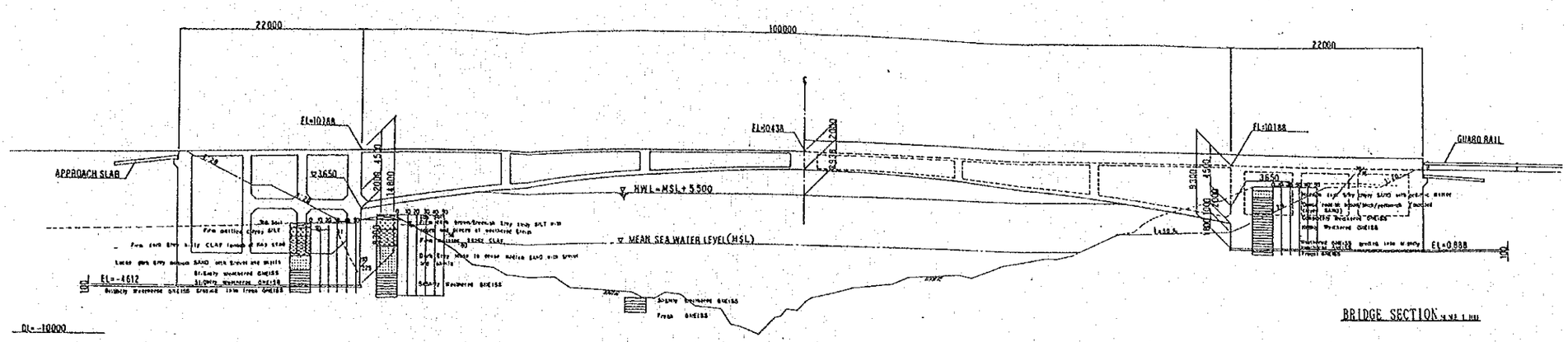
5-3-5 Preliminary Bill of Quantity for the Works

Rough estimate of quantity of the principal pay item is made as per attached tables.

Item	Description	Class	Unit	Quantity	Remarks
(I)	Foundation				
	Excavation	Common	m^3	3,610	
		Rock	m^3	2,880	
	Backfilling		m^3	3,270	
	Anchoring				
	Prestressing steel		kg	14,700	
	Grounting		m	1,680	
	Sheath		m	920	
(II)	Substructure (Abutments)				
	Concrete	$\sigma ck=350kg/cm^2$	m^3	1,270	
		$\sigma ck=240kg/cm^2$	m^3	2,676	
		$\sigma ck=180kg/cm^2$	m^3	1,000	
	Formworks		m^2	2,816	
	Prestressing steel	$\phi 32$	kg	34,850	
	Grounting		m	5,520	
	Reinforcing steel		kg	322,500	
(III)	Superstructure				
	Concrete Main girder	$\sigma ck=350kg/cm^2$	m^3	1,032	
	Curb & Parapet	$\sigma ck=350kg/cm^2$	m^3	294	
	Formworks		m^2	4,249	
	Prestressing steel	$\phi 32$	kg	90,579	
	Grounting		m	14,355	
	Reinforcing steel		kg	130,395	
	Expansion Joint		m	13.3	
	Shoe		EACH	1	
(IV)	Approach Road				
	Excavation	Topsoil	m^2	9,800	
	Sand mat		m^3	5,000	t=70cm
	Fill from borrow pit		m^3	30,900	
	Pipe culvert	$\phi 1.5$	m	22	
	Box culvert	1.5x1.5	m	30	
	Natural gravel sub-base	t=175mm	m^2	8,700	
	Crushed stone base	t=150	m^2	5,000	
	Tar macadam	t= 60mm	m^2	4,770	
	Stone pitching		m^2	1,000	
	Side dith	U-0.5x0.5	m	290	
		U-1.0x1.0	m	285	
	Guard rail			420	

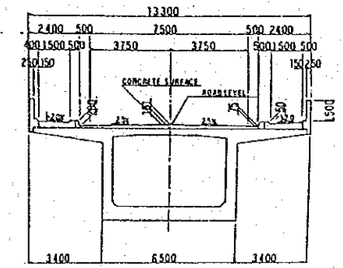
5-3-6 Basic Design Drawing

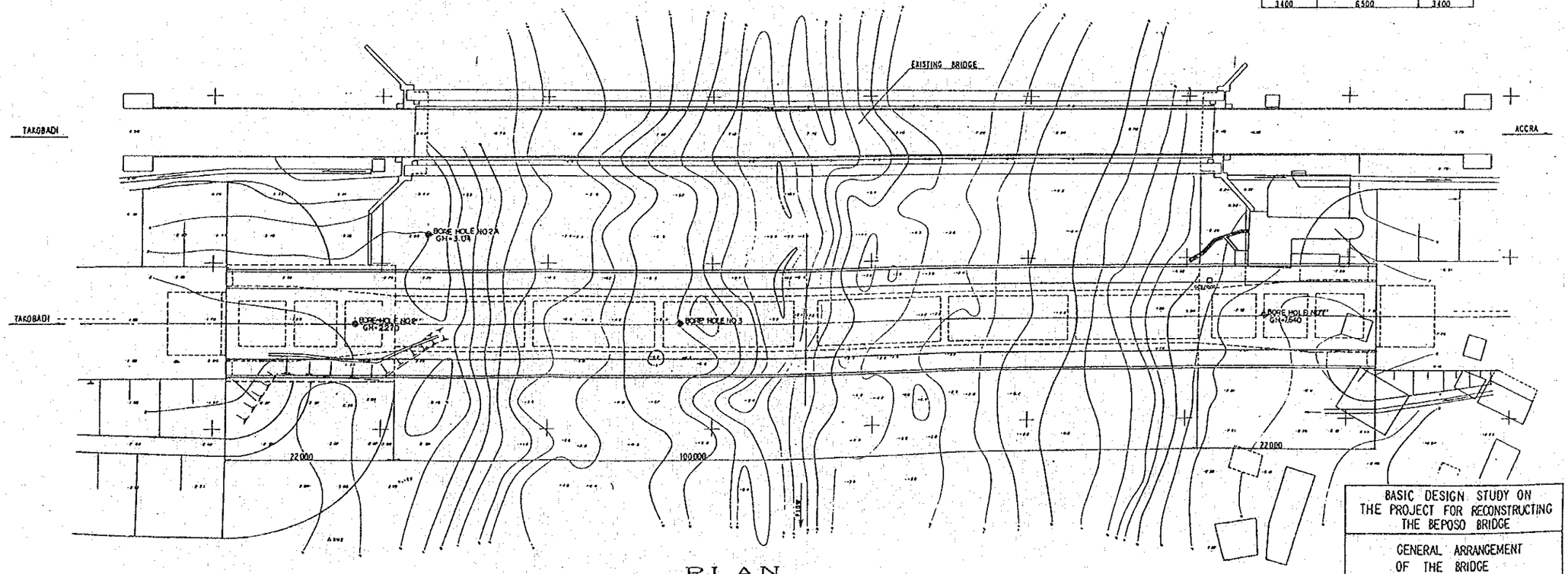
General layout and sections of the bridge are given hereof.



PLOFILE
SCALE 1:200

BRIDGE SECTION

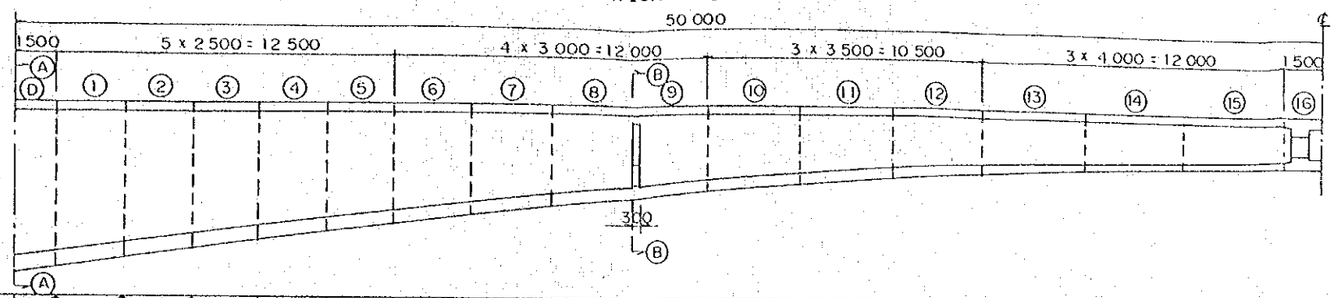




PLAN
SCALE 1:200

BASIC DESIGN STUDY ON THE PROJECT FOR RECONSTRUCTING THE BEPOSO BRIDGE		
GENERAL ARRANGEMENT OF THE BRIDGE		
DRAWN	CHECKED	APPROVED
SCALE AS SHOWN	DRAWING NO	
	DATE DEC. 1988	

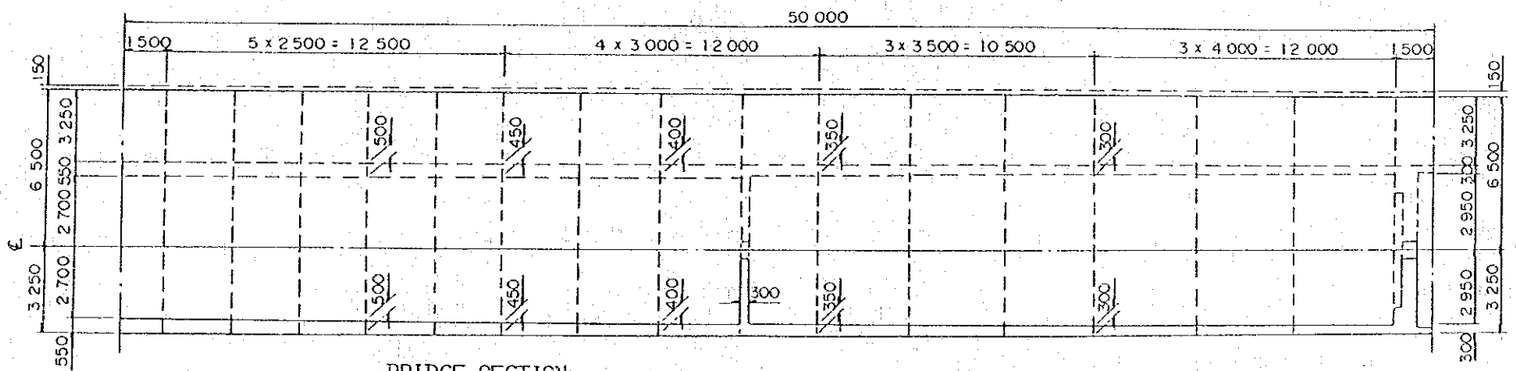
ELEVATION S = 1/100



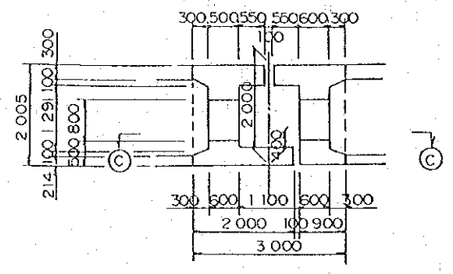
Upper Slab	650	550	637	550	614	550	592	550	569	500	547	500	524	450	497	450
Web	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
Lower Slab	6 500	6 288	5 956	5 587	5 245	4 909	4 584	4 209	3 855	3 524	3 220	2 901	2 627	2 399	2 199	2 067
Girder Height	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300

Upper Slab	450	400	400	350	350	300	300	300	300	300	300	300	300	300	300	300
Web	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
Lower Slab	2 005	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000
Girder Height	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214

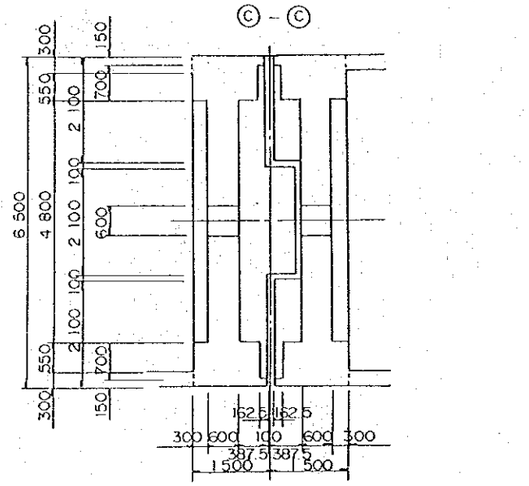
PLAN S = 1/100



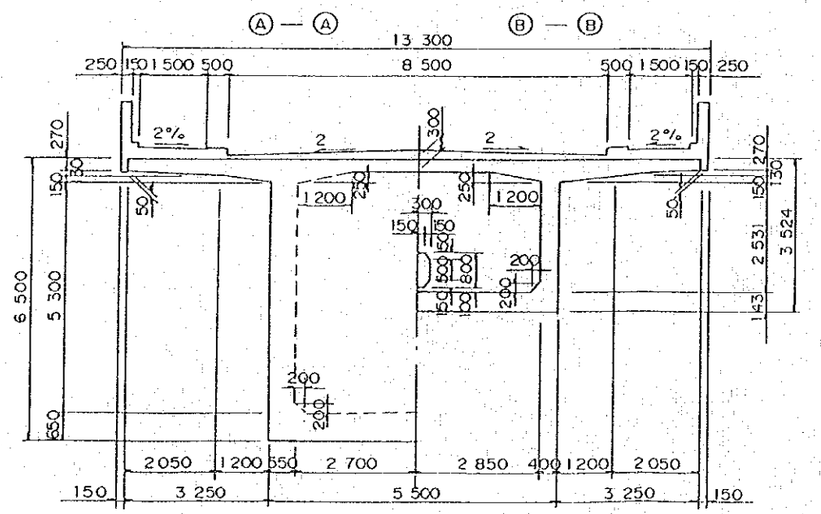
HINGE SECTION S = 1/50



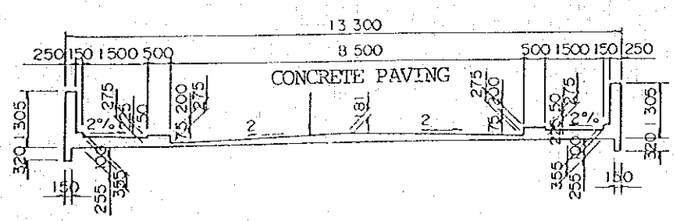
C — C

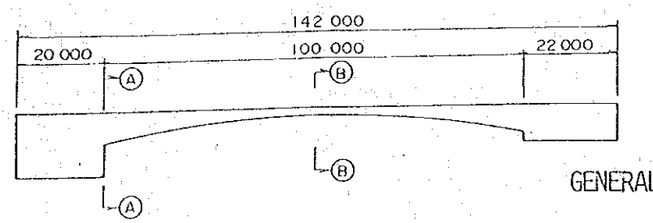


BRIDGE SECTION S = 1/60

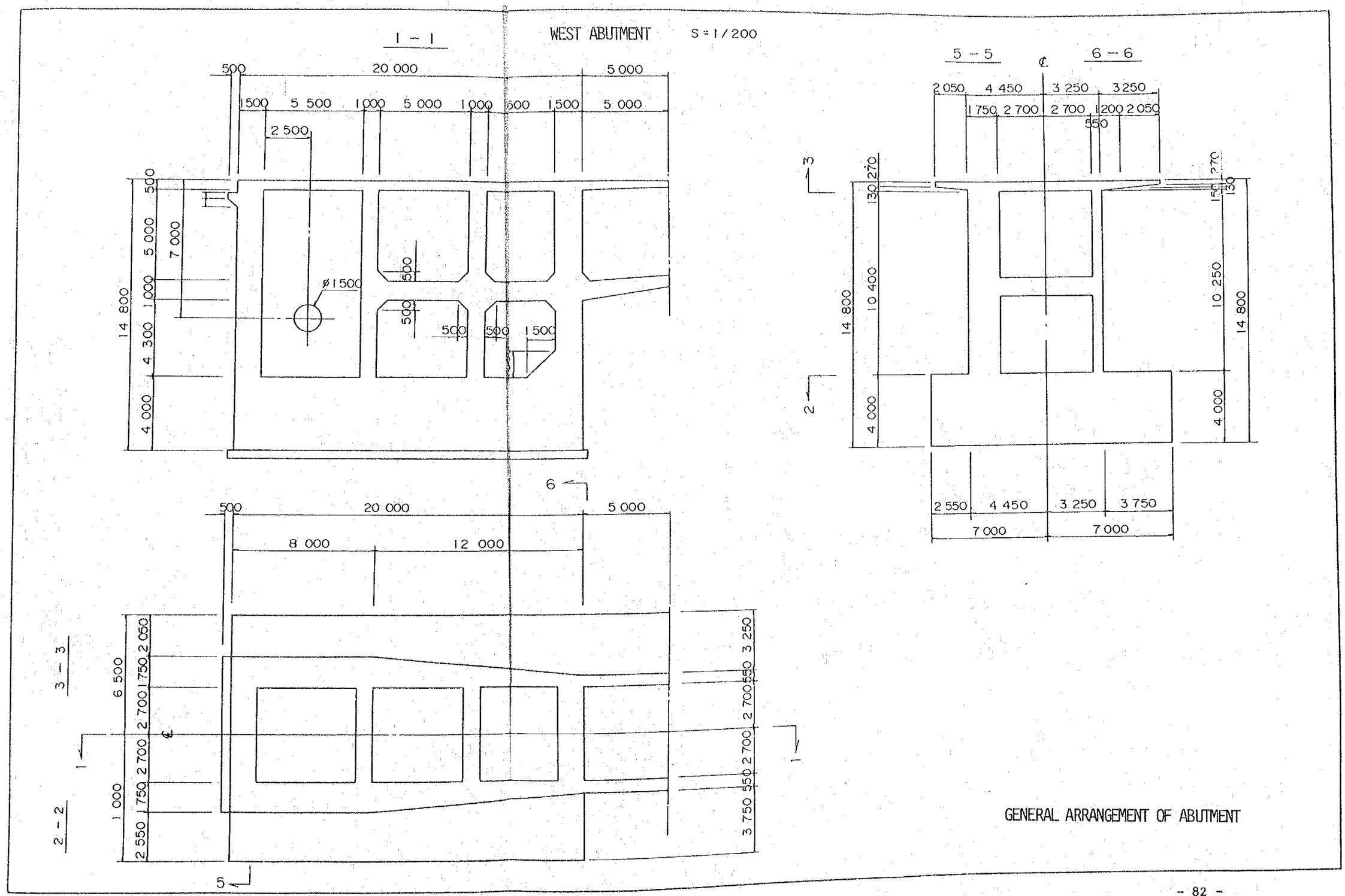


DETAIL OF SURFACING S = 1/50



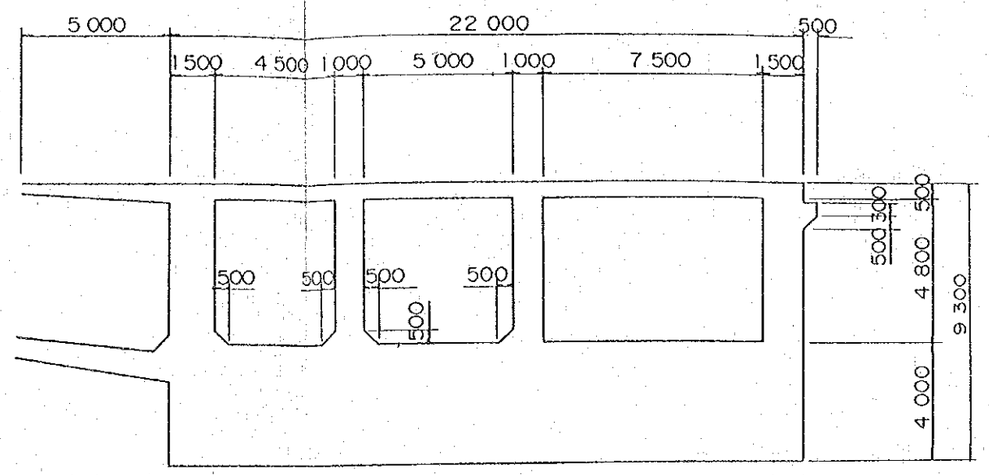


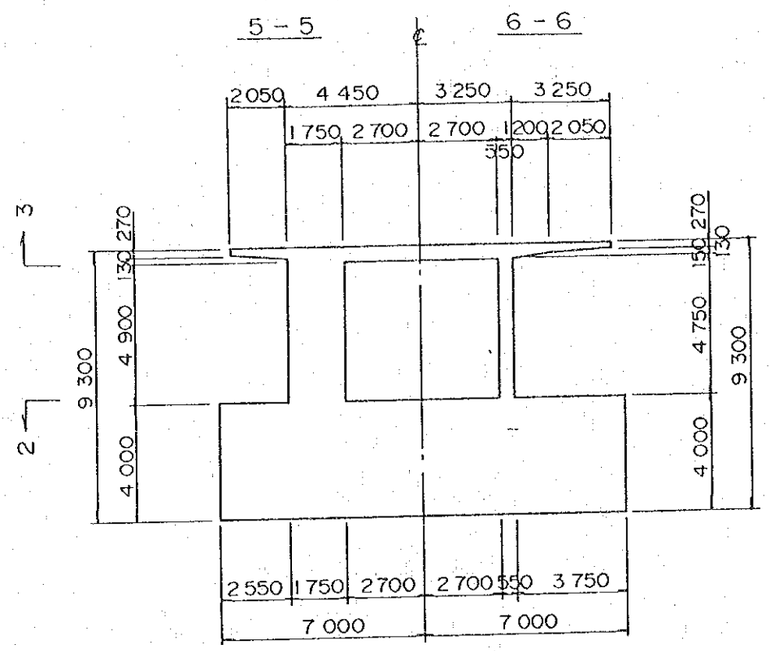
GENERAL ARRANGEMENT OF SUPERSTRUCTURE

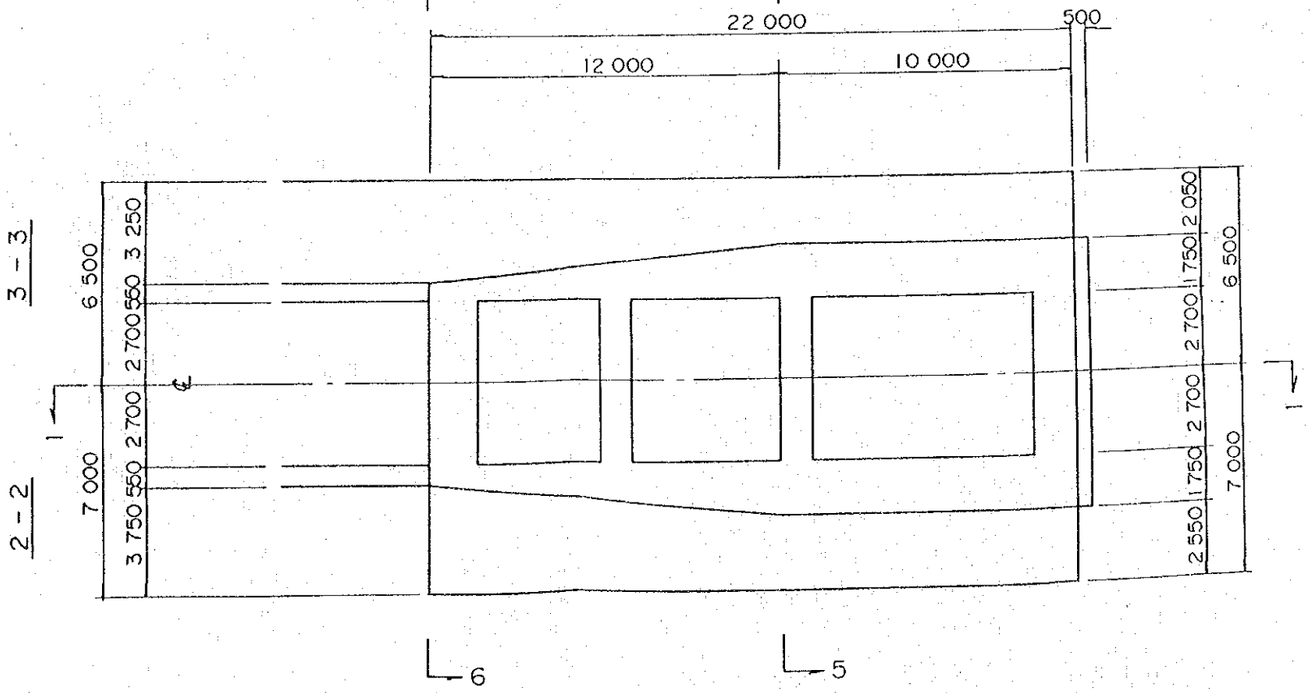


GENERAL ARRANGEMENT OF ABUTMENT

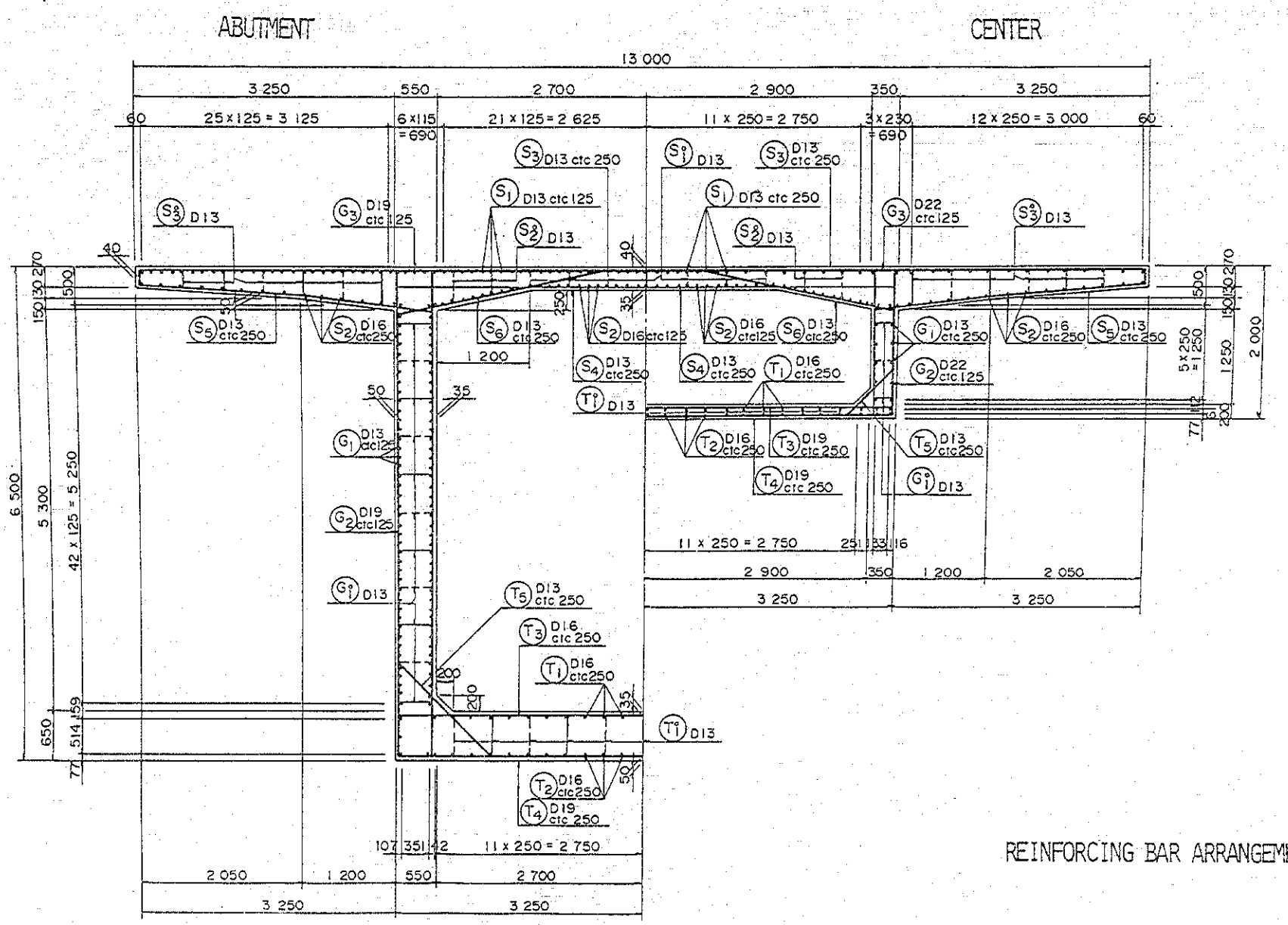
EAST ABUTMENT S = 1/200





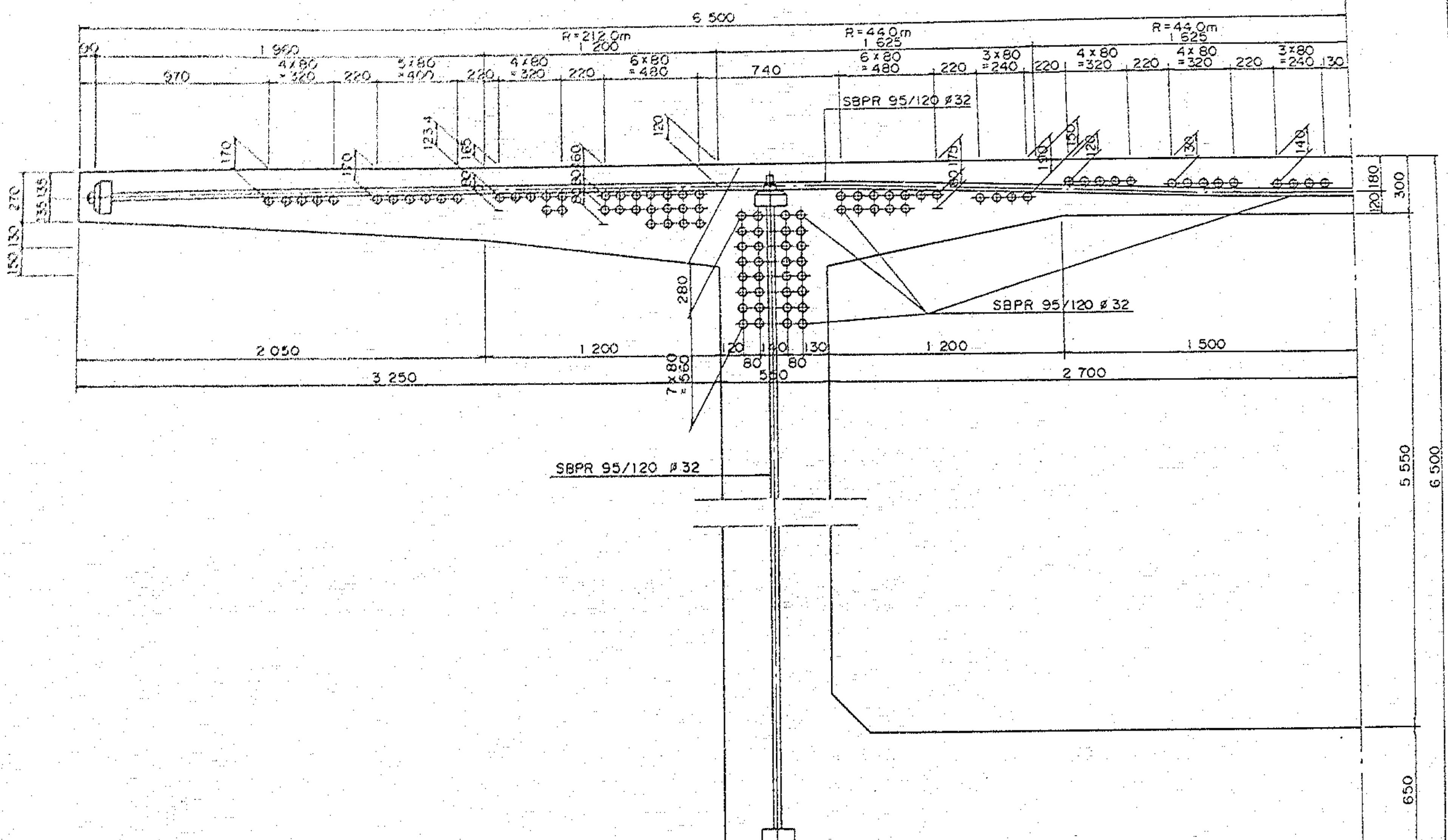


GENERAL ARRANGEMENT OF ABUTMENT

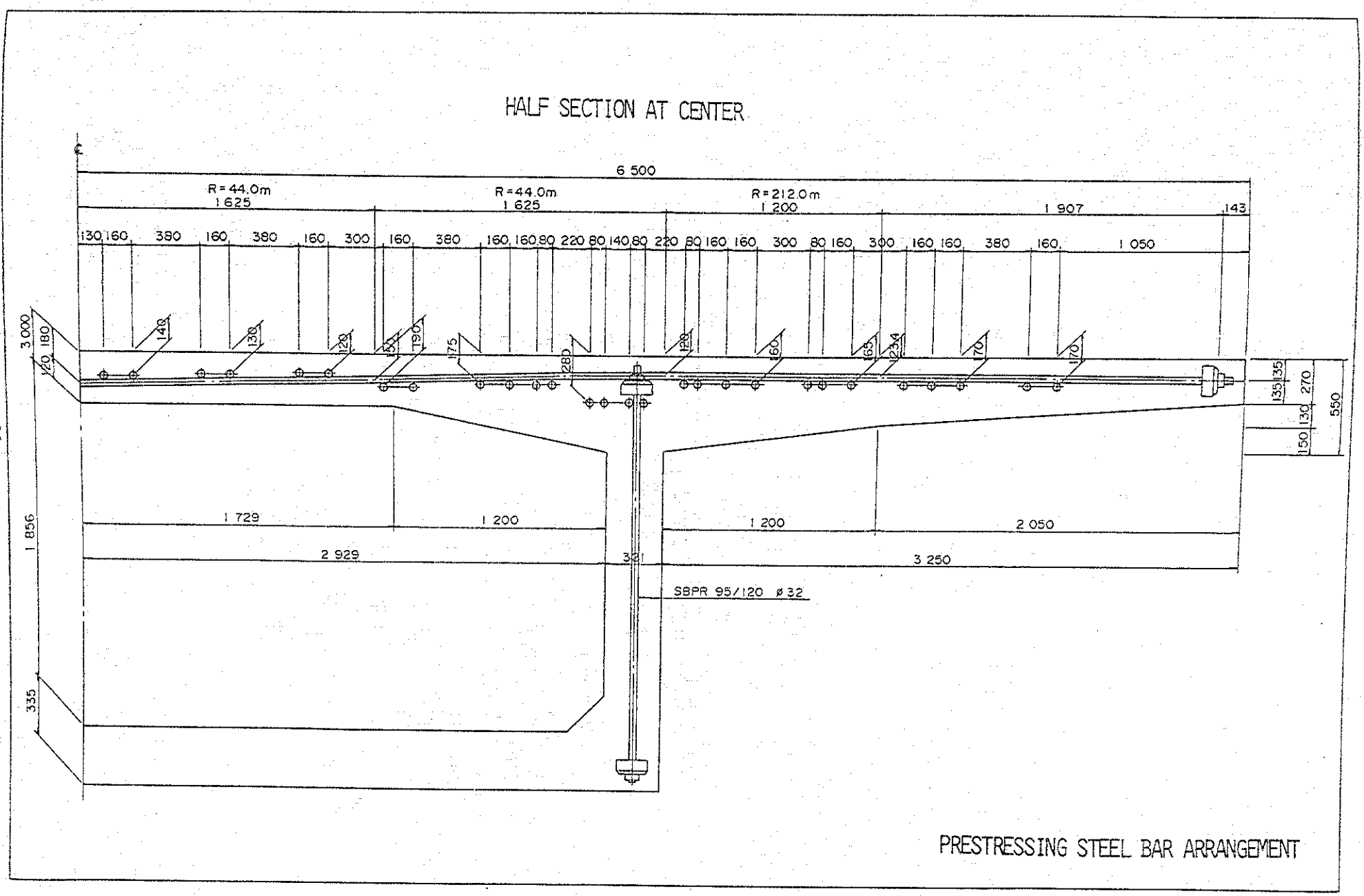


REINFORCING BAR ARRANGEMENT

HALF SECTION AT ABUTMENT



PRESTRESSING STEEL BAR ARRANGEMENT


HALF SECTION AT CENTER
6 500
R=44.0m
1 625
R=44.0m
1 625
R=212.0m
1 200
1 907
143
130 160 380 160 380 160 300 160 380 160 160 80 220 80 140 80 220 80 160 160 300 80 160 300 160 160 380 160 1 050
3 000
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120
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190
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135
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270
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150
550
1 856
1 729
1 200
2 929
381
1 200
2 050
3 250
335
SBPR 95/120 ø32
PRESTRESSING STEEL BAR ARRANGEMENT

CHAPTER 6

PROJECT CONTROL

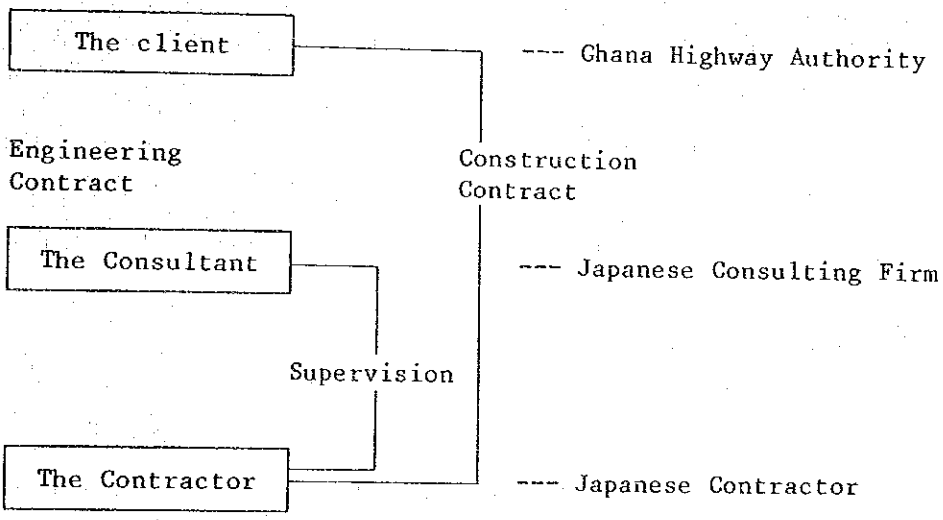
CHAPTER 6

PROJECT CONTROL

6-1 Implementing Agency

The Ghana highway Authority (GHA) will be the agency to superintend Project for Reconstructing the Beposo Bridge under the jurisdiction of the Ministry of Roads and Highways.

The Project implementing organization is defined as follows:



6-2 Execution of Works

The responsibilities of the Japanese and Ghana Governments are identified below:

(1) Responsibilities of Japanese Government

1) Construct a bridge facility of about 142 meters.
2) Construct river protections around the abutments of bridge
3) Construct relocated approach roads of about 620 meters.
4) Construct drainage facilities across road embankments.
5) Provide engineering and consulting services.

(2) Responsibilities of Ghana Government

1) Provide yards for the temporary works.

2) Provide a right-of-way for the Project, and clear/demolish buildings and any other facilities from the project site.

3) Provide facility to the consultant and contractor for custom clearance of materials/equipment imported for the Project, and exempt them from import taxes and duties which may be levied thereon.

4) Exempt them from valued added taxes which may be levied on materials and equipment purchased in Ghana for the Project.

5) Exempt from any taxes, duties or levies which may be imposed on persons of the consultant or contractor disembarking in Ghana in order to carry out the duties described in the verified contracts related to the Project.

6) Provide necessary facilities to personnel of the consultant or contractor disembarking and staying in Ghana in order to carry out the works related to the Project.

7) Provide facilities to the contractor for procurement of construction water.

8) Provide facility to the consultant and contractor for acquisition of telephone lines to the accommodations in Takoradi and liaison offices in Accra in connection with the Project.

9) Provide site to the contractor for quarry and borrow works operation related to the Project.

10) Provide facility to the contractor for procurement of aggregate and bituminous products from the local quarries/plant managed for other Government projects.

11) Acquire the necessary official permission and authorization to begin the construction works of the Project in Ghana, and bear the relevant procedural costs if any thereto, and bear the charges for banking arrangement and issuance of an "authorization to pay" in connection with the implementation of the Project.

6-3 Construction Programme

6-3-1 Basic Policy

Taking into account that the Project will be implemented under the Japanese grant aid system, the construction policy will be as follows:

(1) Recruit a competent construction organization capable of providing the good efficient and safe construction works, taking into account the current social and economic conditions of Ghana.

(2) Maximize the procurement of labour, materials and equipment in Ghana so as to augment employment opportunity, facilitate technological transfer and provide positive impact to the local economy.

(3) Establish communicable relationships between GHA, consultant and contractor for the proposed Project to proceed as efficiently as possible.

6-3-2 Special Consideration

(1) Labour Law

The contractor shall effect adequate labour and safety control and prevent conflict with local labourers, by respecting the governing labour laws in Ghana.

(2) Capacity of Ghanaian Contractors

Subletting of primary part of the works to local contractors will not be allowed, as they do not have qualified engineering personnel and logistics to manage construction of Project of this nature. There are many small-size contractors in Ghana providing labour only and the expatriate contractor shall procure the work force in Ghana through them in order to avoid the immediate involvement in labour conflicts.

(3) Procurement of Construction Materials

The local available materials and equipment are:

Coarse aggregate, fine aggregate, crushed stone, bitumen, timber, galvanized corrugated iron sheet, common portland cement

Materials such as reinforcing bar, steel products for temporary works, electric wire, steel pipe, article of cast metal, etc. are sometimes available imported from EEC and eastern countries, but are often in short supply on local market.

Thus, almost all the primary construction materials will be, in principle, procured in Japan except for the cements and tensile reinforcing bars from Britain.

(4) Construction Equipment

Principal equipment and instrument will be mobilized from Japan except for some earth moving machines which can be hired from local sources.

(5) Labour Costs and Prices of Local Materials

The prices of materials are soaring by some 30% and, labour wages rise by some 15% per annum.

(6) Rainy Seasons

There are two rainy seasons in Ghana, one spans from May through June and the other October through November, when the working efficiency of construction generally declines considerably.

And as there often occurs floods during the rainy seasons due to the heavy rains, special attention shall be paid to the submergible works.

(7) Mobilization

At least 4 months shall be required to crate, ship at Japanese port, mobilize, clear custom at Tema and deliver to the Site, materials and equipment.

Thus, close cooperation and support of GHA will be indispensable in unloading and custom clearance at Tema port in order to save the expended during such mobilization period.

(8) Security at Site

The public order is generally well observed in Ghana, however, as the site is very remote from the urban area, special protection by the local police will be required to secure the persons connected

with the project and protect the materials and equipment delivered to the Site from being stolen.

6-3-3 Execution Plan

(1) Preparatory Works

1) Temporary work yards

Some 18,000 sq.m of temporary work yards will be reclaimed at the point along the National route 1, 1 km west of the site in order to accommodate the site offices, concrete mixing plant, trommel, store house and area for motor pool and workshop.

The yards will be paved by crushed stones and surrounded by barbed wire fence to prevent thefts of the materials and equipment brought to site.

2) Contractor's staff houses, Liaison office and labourers' houses

Japanese staff houses will be arranged on rental basis in Takoradi, 34 km off the Site. Contractor's liaison staff will be stationed in the office to make custom clearance of the imported materials and equipment, and to procure the local labour and materials.

Labourers' houses will be erected on Site.

3) Electricity for construction

One 200 KVA portable or stationary generators will be installed for the operation of trommel and concrete mixing plant, and one 300 KVA generator for the vibrohammer.

4) Water for construction

It is intended to take water from Pra River for washing of sand and mixing of conrete. Chemical analysis of samples of groundwater and river water, however, indicates that the concentration of chloride ion was quite high, ranging between 1,000 ppm and 2,000 ppm. Chloride content of the prestressed concrete mixed with the water then would be 200 - 400 g. Chloride in reinforced concrete shall rust the steel deterioration of the bridge. It is specified in "Standard Specification for concrete" that maximum chloride content

should be less than 300 g per cubic metre of concrete for prestressed concrete.

Sea water contamination may vary in relation to the time and water depth. It is usual for the tidal waves of the sea to cause backflow of the river up to and beyond the Beposo Bridge.

Careful examinations are required for analysis of water and method for drawing water before use. Chemical test results conducted during second study, are summarized in the Annex 3.2 (3).

Water for mixing concrete, then will be transported from water plant at Daboasi water and Sewerage station, 5 km upstream of existing bridge.

5) Communication facility

Short wave radios will be used for communications between the Site office, staff houses in Takoradi and Liaison office in Accra.

(2) Substructure

1) Foundation of east bank abutment

As excavation will be made in exposed sound gneiss an open cut method by blasting will be applicable.

The blasting will be carried out on a bench about 75 cm high.

The excavated material will be collected by backhoe, loaded by cramshell onto the dumptrucks, and transported to a dump.

After excavating down to the designed depth, the layer will be inspected by the Engineer to ascertain whether it could provide the specified bearing capacity or not.

2) Foundation of west bank abutment

Temporary coffering by steel sheet piles will be required because the excavation for foundation will be executed down to sound rock strata below the considerably thick soft layers. Sheet piles of 11 m long FSP IV Type of JIS will be driven by Vibro-hammer with Generator 300 KVA mounted on 50 ton crawler crane.

As the excavation proceeds by the cram shell down to the proposed depth (gneiss stratum), temporary sheet piling and struts of steel beams H300 x 300 x 10/15 will be erected to sustain the construction space.

Since the excavated layers are composed of strata of medium size sands accumulated on hard gneiss stratum, it will be difficult to drive the sheet piles deeper into the gneiss enough to sustain themselves and thus, it will be almost impossible to prevent heavy leakage of water into the work spaces from the river. For the purpose of leakage prevention, special chemical grouting will be executed by skilled workers dispatched from Japan, who will train the local workers and conduct the works.

3) Footing and Body of Abutment

Formwork, reinforcement steel, and concrete works will be performed by local labour. In order to give special technical training to these people, skilled workmen will be brought in from Japan to train them.

Local wooden panels will be employed for the formworks. Reinforcement steel shall conform to Class SD35 of JIS G3112 or equivalent.

Concrete will be produced at concrete plant to be set up in the temporary work yard. Trommel will be used to provide quality sands by washing.

4) Rock anchoring of abutment concrete

After being placed, the abutment body will be anchored by the PC wire prestressed into the foundation rocks.

Drilling holes into the rocks for fixing the cables will be made through 115 mm dia. steel pipe embedded vertically in the concrete.

Prestressing steel are bonded to the concrete by grouting.

This work will be conducted by local labour under supervision by Japanese skilled workmen.

(3) Superstructure

1) Construction

Girder will be constructed by means of travelling cantilever erection system with Vorbau wagen. 32 mm prestressing bar will be used in Dywidag System.

Girder is to be constructed of 2 x 15 blocks ranging from 2.5 m to 4.0 m, 2 x 1.5 m blocks at the top of abutments and 2 x 1.5 m block at the bridge centre (See relevant figures). Working cycle of one block is expected to be 8 days using rapid hardening portland cement. The first girder block will be supported by means of temporary bracket metal fixed on abutment wall.

Top 6.5 m section of the abutment will be constructed together with the girder as one piece because prestressing steel should be placed in the abutment.

2) Formwork

Steel panel will be used for outer face and wooden panel for inner face of the girder. 15 times and 5 times of re-use are expected for steel panel and wooden panel respectively. Timber plate will be used in the end section.

Skilled carpenters from Japan will be employed to give special training to the local labour.

3) Reinforcing bar work

Reinforcing bars fabricated in the temporary yard will be transported to the site and positioned in place using truck crane. The work will be done by local labor under the control of Japanese skilled workmen.

4) Arrangement of Prestressing Steel

Pre-fabricated prestressing steel will be placed by truck crane. As high experience will be required for placing, tensioning, grouting of the prestressing steel and travelling Vorbau wagen form for this work, skilled workmen will be mobilized from Japan.

5) Concrete placing

Concrete will be mixed by batcher plant in the temporary work yard and transported to site by transit mixer. Water-reducing admixture will be used to lower water-cement ratio less than 50% together with liquidity-increasing admixture to maintain workability of concrete respectively.

6) Introduction of tensioning and grouting

After confirmation of concrete strength more than 260 kg/cm^2, tensioning of the prestressing steel will be commenced. Japanese engineer shall be present at site during the works. After tensioning, grouting conducted.

7) Ancillary works

Parapet will be constructed using travelling form. Carriageway will be paved with concrete. The work will be manual.

(4) Approach Roads

About 70 cm thick of sand mat will be placed on the road area of the proposed west approach road before starting fill works in order to improve soft ground and obtain higher trafficability for construction equipment.

First 2.5 m of the embankment will be left for considerable duration as a surcharge for accelerating consolidation of soft ground layers. Thereafter, a construction rate of about 0.3 m/week will be applied.

Fill material will be transported from borrow pits within about two kilometres from site. Crushed rock base material is available from quarry near the site. Earth moving equipment will be hired in Ghana.

6-4 Construction Material and Equipment

Major construction materials and equipment to be employed in the project are as follows:

(1) Material and Equipment Available in Ghana

1) Material

Ordinary portland cement, timber, gravel sand, crushed stone, fuel, oxygen, acetylene, bitumen, gravel. Sand and crushed stone are available from quarries near the site below:-

Construction Pioneer Quarry (CPQ),
Cape Coast Quarry (CCQ),
General Development Co. Quarry (GDCQ), and
State Construction Corporation Quarry (SSC)

The distances of these quarries from the project site are:-

CPQ	29 km
CCQ	49 km
GDCQ	23 km
SCCQ	25 km

The locations of the quarries are shown on Fig. 6-1. Samples of crushed aggregates from these quarries were collected and subjected to the following tests:-

1) Los Angeles abrasion,
2) Impact,
3) Particle Size Distribution,
4) Flakiness, and
5) Elongation

The test results are summarised in the attached Annex 3.2 (6).

Fine aggregate for concrete (uncrushed sand) may be obtained from Asemasa, about 6.5 km from the bridge site. Special care will be required to remove shell, grass mud etc. from sand for use.

Use of crushed aggregate (quarry dust) with sand from Asemasa would improve the grading to meet the requirements for fine sand.

Material marginally satisfying the requirements for use as natural gravel subbase may be obtained at Kafodzidzi, about 16 km from the bridge site. The test results are shown in attached Annex 3.2 (7).

2) Equipment

Macadam roller, tyre roller, bulldozer, motor grader, shovel loader, tractor, dump truck 8-12 ton, truck, and trailer truck.

(2) Material and equipment mobilized from Japan

1) Material

Prestressing steel, sheathes for prestressing steel, Metal form, Timber panel, Steel timbering and support, Concrete admixture, H-section steel, L-section steel, -sectio steel, Sheet pile, Expansion joint, Name plate, Drain box, Chemicals for grouting, Lighting

2) Equipment

Crawler crane (50 ton), Vibratory hammer (90 kw), Generator (300 kw, 200 kw, 100 kw) Drilling unit, Truck-mounted drill, Clam shell bucket, Hydraulic excavator (0.8 m^3), Welding sets, Truck mixer (4.5 m^3) Steel bar cutter, Steel bar bender, Jack hammer, Wheel loader (2.3 m^3), Hydraulic jack for prestressing, Compressor (17 m^3), Grouting pump, Chemical injection pump, Chemical mixer, Truck crane (30 ton) Travelling form for box girder, Grout mixer, Concrete vibrator, Concrete bucket, Mini bus, Saloon car

As all equipment mobilized from Japan shall be used on daily basis, will be, in principal, sent back after works.

(3) Construction Material from Other Countries

Rapid curing portland cement from the U.K.
High tensile deformed bar from the U.K.

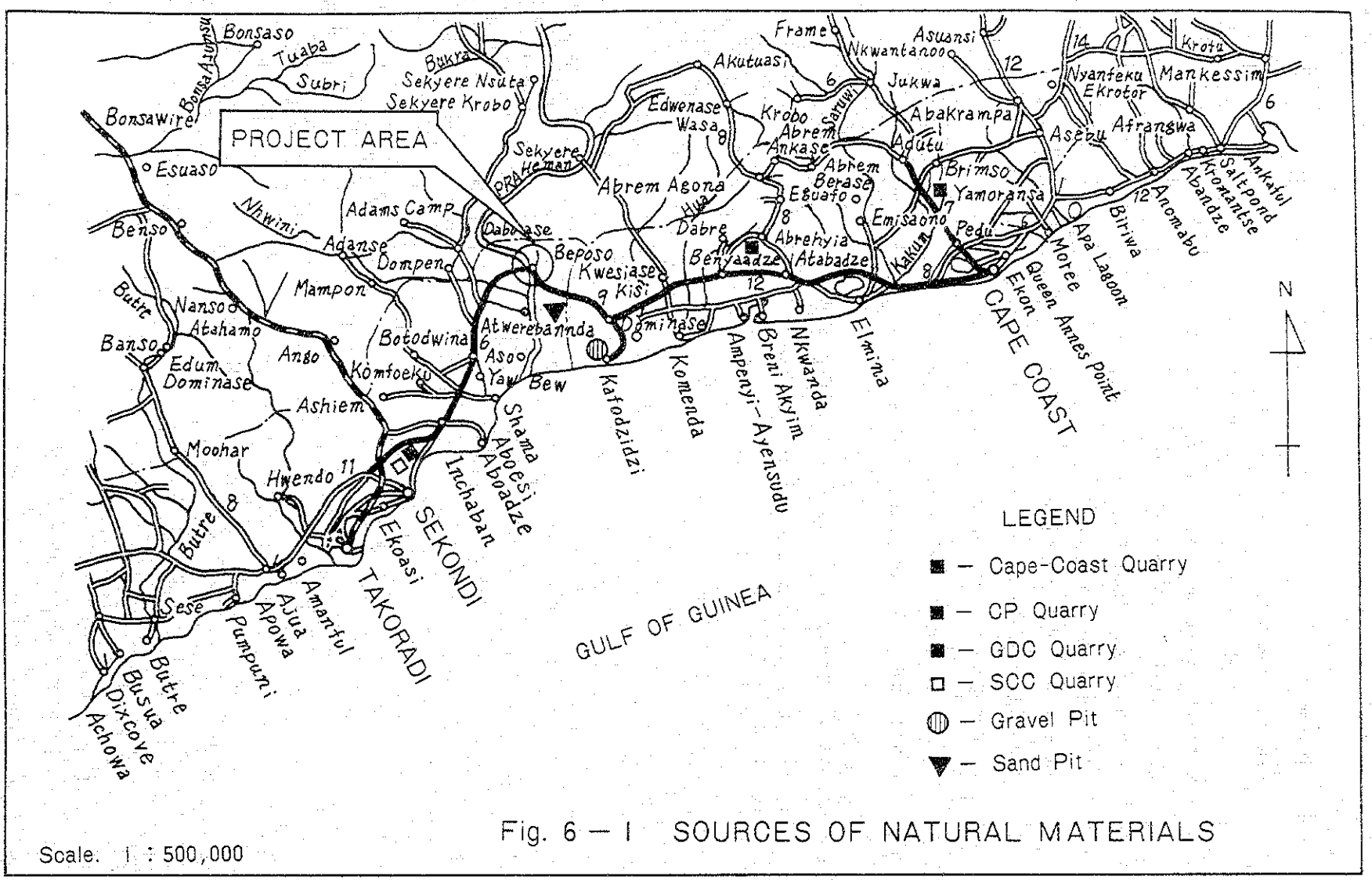


Fig. 6 — 1 SOURCES OF NATURAL MATERIALS

6-5 Implementation Schedule

The Project will start after the exchange of notes between the Governments of Japan and Ghana. GHA will be the implementation agency and shall conclude a contract with Japanese consulting firm which will accomplish the engineering services of the Project.

(1) Detailed Design

Consultant shall carry out detailed design of the Project facilities based on the basic designs together with preparation of tender documents such as drawings, specifications and other relevant documents required for tender.

Draft tender documents shall be forwarded to the Government of Japan for its study and approved.

(2) Tendering

Ghana Highway Authority shall select a Japanese firm to implement the project through an open tender. Consultant shall assist GHA on the following tasks:-

1) Bid Announcement
2) Prequalification
3) Preparation for tendering
4) Tendering
5) Tender evaluation

(3) Construction

GHA concludes a contract with a selected Japanese firm, which shall be approved by the Government of Japan, and the contract shall come into force after its approval.

6-6 Estimate of Project Cost

The proportion of project cost to be borne by the Government of Ghana will be about 5 million cedis (2.65 million Yen) and this will be used secure right-of-way, clear the site and provide the relevant works and services for implementation of the Project.

6-7 Maintenance Programme

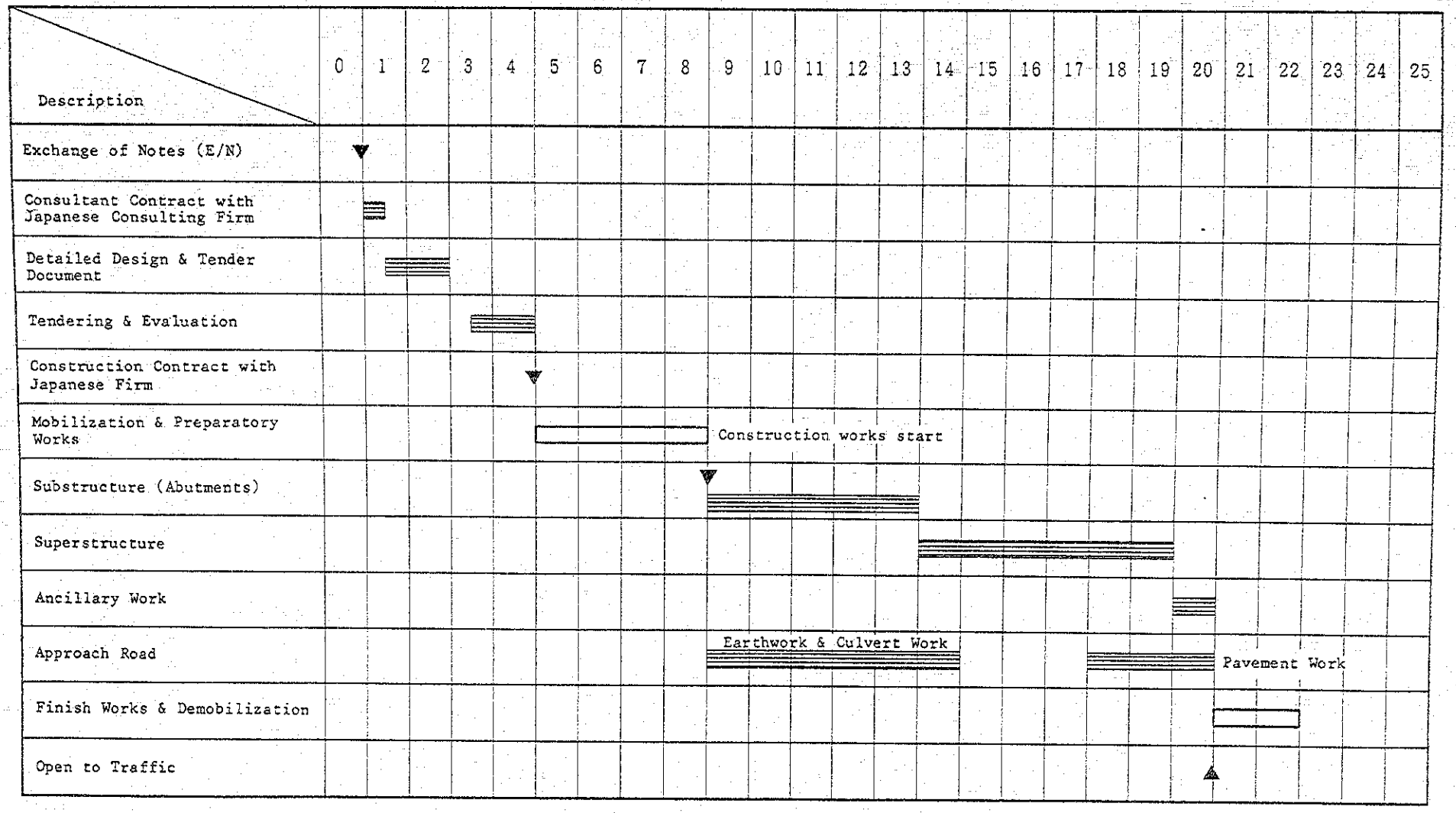
Prestressed concrete type of bridge will minimize maintenance cost of the facilities after completion. Reinforcing steel should be protected with sufficient concrete cover from salt attack as proposed site lies near the coast.

However, maintenance should be undertaken as follows:

1) Regular inspection of deck drainage system
2) Regular cleaning of deck surface
3) Regular inspection of expansion joint

Routine and periodic maintenance shall be required for the relocated approach roads. Maintenance department of GHA is responsible for these maintenance operations after the Project facilities are completed.

Table 6-1 IMPLEMENTATION SCHEDULE



CHAPTER 7

PROJECT EVALUATION

CHAPTER 7

PROJECT EVALUATION

7-1 Project Benefits

The present Beposo bridge, a 100 meter long suspension bridge, is located at the point where National Route 1 crosses Pra River. The National Route 1 is a trunk road passing along the southern coast of Ghana from the eastern boundary with Togo to the western border with Ivory Coast, through Accra/Tema capital city, Tema (import) port, Cape Coast Sekondi/Takoradi industrial area, and Takoradi (export) port. This road assumes a very important function together with the National Route 4 connecting Kumasi, Accra/Tema and Sekondi/Takoradi.

Although present Beposo Bridge is a sole crossing means on a National Route 1 on Pra River, an alternative one-way traffic control, however, has been operated to-date because of a one-lane bridge width. As both approach roads has a two lane carriage way, the bridge becomes a bottleneck for the vehicular traffic.

Furthermore, the bridge is 54 years old and is generally worn out. Weight limit regulation for vehicles loaded with merchandise has been applied in addition to the above alternate one-way control, although there has been an increase in unit vehicle weight and traffic volume recently. The bridge, currently, is a very critical condition having reached its limit of physical life.

In order to resolve the above aggravating problems, the Government of Ghana has proposed three alternatives as to how the present traffic and physical marginal situation be improved:

1) Overall reinforcement and repair of the present Beposo Bridge (one-lane),
2) An additional one-lane new bridge construction together with overall reinforcement and repair of the present bridge. In this case, three new approach alignment, one each on the immediate downstream and upstream, and one at 2.4 km downstream from the resent bridge were considered.

3) New two-lane bridge construction at immediate downstream of the present bridge

The comparative studies were conducted on the basic of technical and economic viability and a final decision was made to employ the alternative of new two-lane bridge construction taking into consideration the dangerous physical condition of the present bridge for the increasing volume of traffic. Thus the Government of Ghana requested the Government of Japan to implement the reconstruction of the existing Beposo Bridge under the Grant Aid Programme. The Project is, therefore, expected to generate variety of benefits both directly and indirectly as enumerated below.

7-1-1 Direct Benefit

(1) Vehicle Operation Cost Savings

Since establishing an Economic Recovery Programme in 1983 (First EPR 1984/86), the Government of Ghana has been carrying out a series of road development projects such as a Road Rehabilitation and Maintenance Programmes (First to Fourth), Transport Rehabilitation Project and so on, with the assistance of the World Bank. In this context, a Ghana Bridge Development Program/Feasibility Study has been undertaken continuously since 1983 in order to obtain a country-wide bridge inventory and thus, prioritize the bridge projects. The Government of Ghana has, consequently, been implementing bridge improvements, in principle, subject to the order of priority set forth therein.

The Beposo Bridge improvement was included in the 44 priority bridges selected for the objectives of Second Feasibility Study that was conducted in 1986. The report demonstrated the economic benefit factors accruing from the implementation of the Beposo Bridge improvement in 1986 as follows:-

1) Benefit/Cost ratio (B/C): 94
2) Net present value: 434 million US$
3) Internal economic rate of return: 1,800%

These economic indicators were quantified based upon the following hypotheses:-

In the case of continuing to use the present bridge without any improvements (i.e. without project), the future vehicular traffic would have to use a long detour which would cause an increase in vehicle operating costs(VOC).

Thus, in the case of improving the bridge (i.e. with project), there will be savings in VOC and the VOC saving could be regarded as benefit accruing from the project.

A recent World Bank appraisal report on Transport Rehabilitation Project in November, 1987 discussed and evaluated positively the results of the above feasibility study on Ghana Bridge Development Programme. As a consequence, the Bank summed up that each project showing IERR of 100% or more will be uniformly given a 70% of IERR, and is given top priority among the Programme.

The Basic Design Study team carried out traffic survey on the existing Beposo Bridge in order to supplement the result of the feasibility studies, and estimated, thereupon, VOC savings. The unit VOCs, per km by category of vehicles and road roughness conditions are based on a Computation of Vehicle Operation Cost (see the attached appendix). Composition of vehicle was derived from the sampling data of the traffic survey.

Table 7-1 shows 189% of IERR in the case of a detour distance of 150 km (Annual traffic increase rate: 2%). This means the vehicles make detour from eastern Cape Coast towards the northern direction, and arrive at Twifo Praso, passing over the present railway bridge, and returning southwards down to Daboasi Junction. If based on 10% of discount rate, the net present value and benefit/cost ratio will be estimated at 41.4 billion cedis and 22% respectively, which are identical with the magnitude of the economic impacts quantified in the aforementioned feasibility studies.

(2) Traffic time savings

In the case of "With Project", the future traffic will save the time for detouring of 150 km long. For example, in the year 2,000 (the 11th project year), the yearly traffic time saving will reach approximately 1.64 million vehicle hours (2,252 vehicle x 365 days x 2 hr per Vehicle).

Other tangible direct effects that will accrue from the Project implementation are enumerated as follows:

(3) Decrease of cargo damages and saving of packing cost,

(4) Decrease of traffic accidents,

(5) Increase of traffic volume and traffic efficiency by removing weight-limit control on the present bridge,

(6) Decrease of waiting time by removing one-way traffic control, and

(7) Saving of maintenance cost of the present bridge.

In addition to the above, intangible direct costs shall be as follows:

(8) Elimination of the strain from long driving by the decrease in trip distance, and

(9) Improvement in driving comfort.

7-1-2 Indirect Benefit

(1) Stabilization of Transport Commodities

The project shall secure transport means for National Route 1 to across the Pra River semi-permanently. To the west of Beposo, there is Secondi/Takoradi industrial area, and Takoradi port, main export port, dealing with principal export products of Ghana such as, timber, cocoa, manganese, and bauxite, etc. The timber and cocoa are obtained in Kumasi area located in the northern part of National Route 1, and transported to Takoradi port through the Beposo Bridge. Most of manganese and bauxite are transported by railway, however, 10% of the total products are hauled on the road through Beposo to Takoradi port.

On the other hand, the commodities from Sekondi/Takoradi industrial zone, one of the vertex of the golden triangle, are transported to Accra/Tema capital and industrial zone through the Beposo Bridge, as well as the agricultural and mineral materials from an internal part of the golden triangle which are located to the north of the National Route 1.

The Beposo Bridge project, therefore, is expected to facilitate and stabilize transport efficiency on the overall road network particularly the National Route 1, which will be a strategic import/export corridor of Ghana.

(2) Resource Development Effect

For example, the project will secure the transportation means for future mineral products to be obtained near Twifo Praso to the north of Beposo. The products will be transported to Accra/Tema through Beposo.

(3) Rationalization of Distribution of Economy

Sekondi/Takoradi and Accra/Tema are large distribution markets. The Project will secure stable flow of commodities for the above two great production and consumption cities.

7-2 Evaluation of Operation and Maintenance Capacity of GHA

The type of bridge will be semi-permanently maintenance free structure. The maintenance for appurtenant facilities and access roads will be carried out within the manualized maintenance management system under the supervision of the Maintenance Department of GHA. Furthermore, reinforcement of the present organization, staff, and budget will be made for effective operation and maintenance of the Project bridge. Hence, it is justified that there should be no serious constraints in operation and maintenance of the project bridge.

7-3 General Appraisal

The implementation of the proposed Project will secure semi-permanently the transportation means for National Route 1 to cross over Pra River. The large direct and indirect benefits are

Table 7-1 INTERNAL ECONOMIC RATE OF RETURN

CASE I : DETOUR DISTANCE 150 KM
TRAFFIC INCREASE 2 %/ANN.
SAVINGS OF VOC 51.09 C/KM.VEHICLE

PROJECT LIFE	YEAR	TRAFFIC FORCAST	CONSTRUCTION COST (MILL C)	MAINTENANCE COST (MILL C)	TOTAL (MILL C)	BENEFIT SAVINGS ON VOC (MILL C)	RESULTS OF ECONOMIC ANALYSIS	
a)	1987	1,741					EIIR =	188.53 %
1	1990	1,848	1759.36		1,759.36	b)		
2	1991	1,885	439.84		439.84	2,636.34		
3	1992	1,922		5.00	5.00	5,376.18	NPV AT DISCOUNTED RATE OF	5 % 66,334.75 MILL C
4	1993	1,961		5.00	5.00	5,485.27		10 % 41,448.21 MILL C
5	1994	2,000		5.00	5.00	5,594.36		15 % 27,765.61 MILL C
6	1995	2,040		15.00	15.00	5,706.24		
7	1996	2,081		5.00	5.00	5,820.93		
8	1997	2,122		5.00	5.00	5,935.61	B/C AT DISCOUNTED RATE OF	5 % 31.92
9	1998	2,165		5.00	5.00	6,055.89		10 % 21.64
10	1999	2,208		5.00	5.00	6,176.17		15 % 15.67
11	2000	2,252		15.00	15.00	6,299.24		
12	2001	2,297		5.00	5.00	6,425.12		
13	2002	2,343		5.00	5.00	6,553.79		
14	2003	2,390		5.00	5.00	6,685.25		
15	2004	2,438		5.00	5.00	6,819.52		
16	2005	2,487		15.00	15.00	6,956.58		
17	2006	2,536		5.00	5.00	7,093.64		
18	2007	2,587		5.00	5.00	7,236.30		
19	2008	2,639		5.00	5.00	7,381.75		
20	2009	2,692		5.00	5.00	7,530.00		

NOTES : a) Base Year for Traffic Forecast (1987)

Table 7-2 INTERNAL ECONOMIC RATE OF RETURN

CASE I : DETOUR DISTANCE 150 KM
TRAFFIC INCREASE 4 %/ANN.
SAVINGS OF VOC 51.09 C/KM.VEHICLE

PROJECT LIFE	YEAR	TRAFFIC FORCAST	CONSTRUCTION COST (MILL C)	MAINTENANCE COST (MILL C)	TOTAL (MILL C)	BENEFIT SAVINGS ON VOC (MILL C)	RESULTS OF ECONOMIC ANALYSIS	
a)	1987	1,741					EIIR =	204.63 %
1	1990	1,958	1759.36		1,759.36	b)		
2	1991	2,036	439.84		439.84	2,944.90		
3	1992	2,118		5.00	5.00	5,924.52	NPV AT DISCOUNTED RATE OF	5 % 86,472.59 MILL C
4	1993	2,203		5.00	5.00	6,162.15		10 % 52,220.70 MILL C
5	1994	2,291		5.00	5.00	6,408.33		15 % 34,321.82 MILL C
6	1995	2,383		15.00	15.00	6,665.67		
7	1996	2,478		5.00	5.00	6,931.41		
8	1997	2,577		5.00	5.00	7,208.35	B/C AT DISCOUNTED RATE OF	5 % 40.84
9	1998	2,680		5.00	5.00	7,496.44		10 % 27.00
10	1999	2,787		5.00	5.00	7,795.75		15 % 19.13
11	2000	2,899		15.00	15.00	8,109.02		
12	2001	3,015		5.00	5.00	8,433.49		
13	2002	3,135		5.00	5.00	8,769.15		
14	2003	3,261		5.00	5.00	9,121.60		
15	2004	3,391		5.00	5.00	9,485.23		
16	2005	3,527		15.00	15.00	9,865.65		
17	2006	3,668		5.00	5.00	10,260.05		
18	2007	3,815		5.00	5.00	10,671.23		
19	2008	3,967		5.00	5.00	11,096.40		
20	2009	4,126		5.00	5.00	11,541.15		

NOTES : a) Base Year for Traffic Forecast (1987)

expected to accrue from the Project. The influence areas of the Project will cover widely 6 regions out of 10 in Ghana, and 8.7 million population thereof shall enjoy the benefits. In case of limiting the influenced area locally within 20 km from the project bridge, about 230,000 of the local people will benefit from the implementation of the Project.

The proposed project, therefore, will be one of the most appropriate project under Japanese grant aid programme, and is appraised to be realized as urgently as possible.

Table 7-3 COMPUTATION OF VEHICLE ECONOMIC OPERATING COST (1988)

(Unit: C/Km)

Item	CAR	LCV	BUS	MGV	HGV
Fuel	7.02	8.36	11.32	12.61	23.22
Tyres	0.34	0.79	1.22	3.00	9.09
Lube Oil	0.30	0.30	0.99	1.07	1.68
Maintenance & Rehabilitation	13.85	21.57	17.73	55.90	93.42
Accidents	1.08	1.68	1.79	5.64	9.43
Crew	0.88	1.39	1.78	4.10	3.80
Overheads	-	-	1.42	3.28	10.45
Total	23.47	34.09	36.25	85.49	151.09
Composition of vehicles	27%	42%	12%	4%	15%
VOC per Km for %	6.34	14.32	4.35	3.42	22.66
VOC per Km		51.09 (cedi/Km)			

Remarks: Car = Passenger Car, LCV = Light Commercial Vehicle
MGV = Medium Good Vehicle, HGV = Heavy Good Vehicle

Source : Draft F/S Report on Reconstruction of Route No. 8

CHAPTER 8

CONCLUSION AND RECOMMENDATION

CHAPTER 8

CONCLUSION AND RECOMMENDATION

8-1 Conclusion

The Project is to reconstruct the Beposo Bridge, which is "the one and only" means of crossing the Pra River on the National Route 1. National Route 1 connects principal cities and facilities on the coastal belt zone such as Sekondi/Takoradi industrial zone, Takoradi port (used as main export port for cocoa, timber and mining resources produced inside the "Golden Triangle" of Ghana), Cape Coast, Accra/Tema capital and industrial zone, and Tema port (used as main import port for industrial materials).

The existing suspension bridge has been in existence for more than 50 years and is generally superannuated due to the increase in volume of traffic and weight of vehicles using it. It is not exaggerated to state that the bridge may always be in danger of collapsing. The overall and thorough reinforcement or repair works for existing Beposo Bridge will be practically impossible without stopping the present traffic or divert them onto other means of crossing the river, because the existing bridge has only one traffic lane and there are no detour bridges nearby. Consequently, if the bridge becomes untrafficable, it will stop the passage of commodities and passengers on National Route 1, and create a serious obstacle in the economic activities of Ghana.

The implementation of the Project shall reduce immediately, the probable danger of the bridge collapsing and secure semi-permanently, the transport means and function across Pra River on National Route 1.

8-2 Recommendation

The implementation of the Project will be justified and it is recommended that the Project be executed as soon as possible under the Grant aid Programme of Japan.

The current alternate one-way traffic regulation and weight restriction on vehicles using the existing bridge shall be continued, for which GHA shall reinforce the current control organization. After the Project bridge is completed, GHA shall conduct routine and periodic maintenance for the project facilities including the approach roads.

A N N E X

ANNEX 1

ANNEX 1.1 MEMBER LIST OF STUDY TEAM

Name	Designation	Title
Masahiko MURAMOTO	Team Leader	Chief of Structural Engineer Structural Engineering Section, Nagoya Construction Bureau, Japan Highway Public Corporation
Kazuo KUROSAWA	Bridge Construction Planner	Senior Officer, Public Works Coordination, Planning Division, Kanto Regional Construction Bureau, Ministry of Construction
Shigeyuki SETO	Project Coordinator	Project Coordinator, Second Basic Design Study Division, Grand Aid Planning & Survey Department, JICA
Kimio CHIBA	Bridge Designer	Executive Vice-President, Construction Project Consultants, Inc.
Kazutoshi NISHINAKAMURA	Geological Surveyor	Executive Chief Engineer, Construction Project Consultants, Inc.
Yoichi HIGAKI	Construction Engineer	Executive Managing Director Construction Project Consultants, Inc.
Nobuyuki SUZUKI	Design Engineer	Assistant Manager Construction Project Consultants, Inc.
Yuichi KITAMURA	Land Surveyor	Senior Surveyor, Construction Project Consultants, Inc.

ANNEX 1.2 WORKING RECORD

FIRST FIELD SURVEY (24/9 - 23/10, 1988)

	Date		Place	Description
1	24/9	S	KI868	Geo-Surveyor and Land-Surveyor Leave for Ghana
2	25/9	S	(AMSTERDAM)	Arrive at Accra
3	26/9	M	KL585	
4	27/9	T	Accra	Visit to Embassy of Japan and JICA office
5	28/9	W	Accra	Preparation for Field Work in Accra
6	29/9	T	Accra	ditto
7	30/9	F	Accra/Beposo	Commencement of Land Survey
8	1/10	S	KL868	Team Leader and other three member leave Ghana Land survey
9	2/10	S	(AMSTERDAM)	Land survey
10	3/10	M	KL585	Arrive at Accra Land survey
11	4/10	T	Accra/Beposo	Internal Meeting of JICA Mission on the preparatory work progress Courtesy Call to Embassy of Japan Coutesy Call to Ministry of Finance & Economic Planning (MFEP) Courtesy Call to Ghana Highway Authority (GHA) Preliminary Meeting on Beposo Bridge with GHA (Record of Meeting "I") Land survey
12	5/10	W	Accra/Beposo	Site Investigation on Beposo Bridge Land survey
13	6/10	T	Accra/Beposo	Meeting on Technical Terms between JICA Mission and GHA at Takoradi (Record of Meeting "II") Land survey Commencement of Boring Survey on the site
14	7/10	F	Accra/Beposo	Internal Meeting of JICA Mission on Technical Terms Courtesy Call to Minister of Roads and Highways Detailed Discussion on the Implementation of the Project with GHA (Record of Meeting "III") Boring and land survey

	Date		Place	Description
15	8/10	S	Accra/Beposo	Internal Meeting of JICA Mission on General Matters Boring land survey
16	9/10	S	Accra/Beposo	Site Investigation on Route 1 (Accra-Lower Volta River Bridge), Route 2 (Tema-Akosombo Dam) & Port of Tema Internal Meeting of JICA Mission on Minutes of Discussion Boring and land survey
17	10/10	M	Accra/Beposo	Meeting with GHA on Minutes of Discussion (Record of Meeting"IV") Boring and land survey
18	11/10	T	Accra/Beposo	Signing of Minutes of Discussion at MFEP Report on Signing of Minutes to JICA and Embassy of Japan Boring and land survey
19	12/10	W	KL588 Beposo	Team Leader and other three members leave Accra for Tokyo Boring and land survey
20	13/10	T	(COPENHAGEN)	Boring and land survey
21	14/10	F	Beposo	ditto
22	15/10	S	SK989 Beposo	Arrive at Narita Boring and land survey
23	16/10	S	Accra	
24	17/10	M	Beposo	Traffic Survey, Boring and land survey
25	18/10	T	Beposo	Traffic survey and boring survey Completion of land survey
26	19/10	W	Beposo	Traffic Survey and boring survey
27	20/10	F	Accra/Beposo	Arranging collected data
28	21/10	S	BA7368	Geo-surveyor and Land-surveyor leave Ghana
29	22/10	S	(LONDON)	
30	23/10	S	BA007	Arrive at Narita

SECOND FIELD SURVEY (3/12 - 23/12, 1988)

	Date		Place	Description
1	3/12	S	BA006	Team leader and other three member leave for Ghana
2	4/12	S	(LONDON)	
3	5/12	M	BA079	Arrive at Accra
4	6/12	T	Accra	Visit to JICA office and embassy of Japan Coutesy call to Ministry of Finance & Economic Planning Coutesy call to Ghana Highway Authority (GHA) Preliminary meeting with GHA
5	7/12	W	Accra	Meeting with GHA
6	8/12	T	Accra	Meeting with GHA and signing of minutes of discusison
7	9/12	F	Accra	Report to embassy of Japan, Team leader leave Ghana
8	10/12	S	Takoradi	Site investigation
9	11/12	S	Takoradi	ditto
10	12/12	M	Accra	Data collection
11	13/12	T	Accra	
12	14/12	W	Accra	
13	15/12	T	Accra	Data collection and office work in Accra
14	16/12	F	Accra	
15	17/12	S	Accra	
16	18/12	S	Accra	
17	19/12	M	Accra	Report to embassy of Japan and JICA office
18	20/12	T	KL586	Remaining three member leave Ghana
19	21/12	W	(AMSTERDAM)	
20	22/12	T		
21	23/12	F	KL863	Arrive at Narita

ANNEX 1.3 LIST OF PERSONS INTERVIEWED

EMBASSY OF JAPAN

Mr. Shigemi ANDO	His Excellency, Ambassador to Ghana
Mr. Shigeru KUROSAWA	Minister Counsellor
Mr. Terufusa ARIGA	Minister Counsellor
Mr. Haruyuki TOGASHI	Second Secretary

JAPAN INTERNATIONAL COOPERATION AGENCY

Mr. Takashi NAGAKURA	Resident Representative, Ghana Office of JICA

MINISTRY OF ROAD AND HIGHWAYS (MRH)

Lt. Col. M. K. Gbedemah	His Excellency, PNDC Secretary for Roads and Highways
Mr. S. K. Nunoo	Chief Technical Director

GHANA HIGHWAY AUTHORITY (GHA)

Mr. H.A.O. Quaynor	Chief Executive
Mr. H.D. Pappoe	Deputy Chief Executive (Administration)
Mr. K. Abbey Sam	Deputy Chief Executive (Maintenance)
Mr. J.V. August	Deputy Chief Executive (Development)
Dr. K.A. Addai	Chief Engineer (Bridges)
Mr. M.G. Anafi	Chief Engineer (Planning)
Mr. A.K. Hammond	Chief Engineer (Contract)
Dr. F.A. Abedi	Chief Engineer (Material)
Mr. Kofi Yeboah	Principal Engineer (Bridges)
Mr. K. Ansah-Otoo	Material Engineer
Mr. Atta Afran	Principal Valuer

MINISTRY OF FINANCE AND ECONOMIC PLANNING (MFEP)

Miss Eleanor Quist	Acting Chief Director International Economic Relations Division
Mr. S.K. Kabo	Senior Economic Planning Officer
Mr. E.C. totimeh	Senior Economic Planning Officer
Mr. Badoor	Senior Economic Planning Officer
Mr. E.O. Prempeh	Asst. International Economic Relations Officer
Mr. K. Opoke	Asst. Economic Planning Officer