CHAPTER 7

CONSTRUCTION PLANNING

CHAPTER 7 CONSTRUCTION PLANNING

7.1 Outline of Construction Works

7.1.1 Summary of Construction Works

Improvement of West Floodway / Garang River including reconstruction of Simongang Weir are conducted for the stretch of 9.761 km from the river mouth to the confluence of Garang River and Kreo River. The main work items and work volumes are summarized as below.

Work Item	West Floodway Improvement	Garang River Improvement	Reconstruction of Simongan Weir	Total
Length of Objective Stretch	5,436 m	3,907 m	418 m	9,761 m
Coffering		160 m	120 m	280 m
Dredging and Excavation	857,400 m^3	395,100 m^3	61,200 m^3	1,313,700 m^3
Dike Embankment	57,200 m^3	10,400 m^3	14,200 m^3	81,800 m^3
Raising of Existing Floodwall	4,970 m	160 m		5,130 m
Revetment Works	4,000 m	2,500 m	490 m	6,990 m
Foundation Works PC Pile L=12.0 m PC Sheet Pile L=5.0 m			680 pcs 3,880 m	680 pcs 3,880 m
Concrete Works	5,800 m^3	6,300 m^3	11,700 m^3	23,800 m^3
Water Gate 18.5 m x 3.7 m 5.5 m x 4.35 m			3 gates 2 gates	3 gates 2 gates
Simongan Weir Intake Structure			2 places	2 places
Control Office			11 nos.	11 nos.
Maintenance Bridge			1 L.S	1 L.S
Raising of Existing Railway Bridge	1 L.S			
Ground Sill		2 places		2 places

7.1.2 Possible Spoil Bank Areas

The total volume of the excavated and demolished material from the improvement works of West Floodway / Garang River including relocation of Simongang Weir is estimated at 1,313,700 m^3.

The features of the proposed spoil bank areas are summarized as shown in the table below and the possible spoil bank is shown in Fig. 7.1.1.

Area No	Schedule of reclamation	Area (ha)	Volume of reclamation (m^3)
1	1999 ~ 2003	150	6,800,000
2	1997 ~ 2000	200	3,000,000
3	2003 ~ 2008	-	2,800,000
4	2001 ~	-	1,000,000
5	1999 ~	-	4,000,000
6	~ 2008	-	-
7	~ 2003	-	-
8	~ 2003	-	-
Total			17,600,000

Area No.1 is considered suitable spoil bank in terms of hauling distance and available schedule.

7.2 Construction Method of West Floodway/Garang River Improvement

7.2.1 Temporary construction road and bridge

As described in " **7.1.1 Summary of Construction Works"** the length of the objective stretch becomes about 10 km and the total volume of main earth works (dredging and excavation, dike embankment works) becomes about 1.4 million m^3. Considering this project conditions, temporary construction roads should be prepared with consideration of the balance of earth works in each construction area.

7.2.2 Channel Excavation and Dike Embankment Works

Some excavated material with required quality that meets the specification can be used for embankment material of earth dike and filling material of earth filling. Excavated material above water level will meet the specification and in principle, the qualified excavated material is transported directly to embankment and filling areas which are located at the same working place. Excavated material which cannot be used for dike embankment and filling will be hauled to spoil bank areas.

(1) Excavation above Water Level

Excavation and loading is done by backhoes and dump trucks are used for hauling excavated material to embankment area and a spoil bank. Giant breaker is applied to excavate of soft rock, which is predicted with low percentage at downstream side of the confluence with Kreo River.

(2) Excavation below Water Level and Dredging

(a) Excavation by backhoe

Even though an excavation area is below water level, if a backhoe could operate and move safely, excavation and loading are done by backhoe and dump trucks are used for hauling excavated material to a spoil bank. The capacity of the equipment are same as the excavation above water level.

(b) Excavation by dredger

In the stretch between the river mouth and North Ring Road, dredger is used for dredging river bed material and loading. Hauling of dredged material to a spoil bank is done by a combination of barge and tugboat.

Summary of the excavation, embankment and filling and material volume to be spoiled are shown in Table 7.2.1.

7.2.3 Earth Dike Embankment

Earth dike embankment works are executed for the areas at the river mouth and the confluence with Kreo River. If excavated material meet the specification for embankment material, the excavated material will be hauled to construction area directly. Spreading and compaction works are done by 21t-bulldozer. Bulldozer spreads transported material with the thickness of 30 cm and compacts with 4 times of pass keeping specified moisture content. After completion of embankment final slope shaping will be done by backhoe. Considering the work quantity, 15t-bulldozer is applied in the confluence with Kreo River.

7.2.4 Raising of Existing Floodwall

Raising works are done by connecting new reinforced concrete wall with the existing ones. Connecting surface of existing wall is chipped carefully, deformed bars are inserted in drilling holes with non-shrinkage mortar and concrete placing work will be carried out directly by agitator truck with chute and vibrator. The concrete should be vibrated to prevent honeycomb and to improve the appearance of the exposed surface.

Typical section of raising of existing floodwall is shown in Fig. 7.2.1.

7.2.5 Protection Works for Riverbank and Riverbed

(1) Coffering and Dewatering

Some types of coffering are employed for Revetment (refer to Fig. 4.2.22) and Groin (refer to Fig. 7.2.2).

A single steel sheet pile and earthfill type of coffering which has 100 m of unit length is applied. Standard section of coffering types are shown in Fig. 7.2.3.

(2) Bank Protection Works

After closing the construction area by coffering and completion of access road, excavation until bottom elevation of base concrete is carried out by backhoe and log pile driving is done by backhoe also.

Some types of revetment have concrete sheet piles, and these concrete sheet piles are driven by vibratary pile driver, base concrete, backfill gravel and wet stone masonry work is followed.

7.2.6 Ground Sill

(1) Construction of Ground Sill with Head (WF.124)

Ground Sill with Head is located about 1,050m upstream from Simongan Weir. After the access road to the site reached to the downstream side of the riverbed at the elevation about EL. 1.80 m, foundation excavation work will be commenced. After the foundation excavation and hauling excavated material to spoil bank areas, replacement work by selected material and concrete sheet pile driving work follows.

Base slab concrete of apron and sidewall concrete will be placed by concrete pump and backfill, backfill gravel and wet stone masonry works follows.

(2) Construction of Ground Sill without Head (WF.172+30)

Ground Sill without Head is located about 3,400 m upstream from Simongan Weir. After the access road to the site reached to the riverbed at the elevation of about EL. 5.30 m, foundation excavation work using by bulldozer, backhoe and if necessary giant breaker will be commenced.

Wet stone masonry works of the ground sill, backfill, gabion mattress, backfill gravel and wet stone masonry works of sidewall follows.

7.2.7 Raising of the Existing Railway Bridge

The railway bridge is located at the point of 3.6 km upstream from the river mouth and is to be raised about 70 cm to have a clearance of 1.0 m above the design high water level, because the present clearance of about 34 cm is too small.

Location of the new bridge shall be the same as the existing bridge but be shifted to the Cirebon side by 5.0 m in order to decrease the traffic jam at the Semarang side.

The raising of the existing railway bridge works consist of three main works, the raising and shifting of superstructures, reconstruction of the substructures and the raising of approach railway tracks.

Necessary time for raising up works of the existing superstructure of the truss bridge on the existing substructures which foundation condition is not grasped, should be shortened. Considering these matters, procedure of main works and construction time schedule is prepared and shown in Table 7.2.2 and Fig. 7.2.4.

(1) Abutment

Since the abutment of the Cirebon side is reconstructed within the existing public road, a retaining wall should be installed before the commencement of the excavation and structure construction works. On the other hand, the one of the Semarang side is reconstructed in the flood plain, so there is no need a retaining wall. Concrete placing works are continued until the same elevation of the existing one, and the remaining height (a part of wall concrete and parapet) is continued after completion of the raising work of the superstructure.

(2) Pier

After completion of the coffering, piling and retaining wall work , excavation and concrete work for pier will be carried out. But concrete placing works for beam portion are executed after completion of the raising of the existing superstructure in order not to avoid the existing rail elevation. Coffering is needed again at the time for the removal of the existing piers after the completion of bridge shifting works.

(3) Bridge and approach track

After completion of the concrete placing of piers and abutments until the same elevation of the existing substructures, raising works of the bridge and the approach tracks are carried out step by step. Considering the total raising height of 60 cm and the existing railway track conditions, 15 cm raising in one time is applied as the stepped raising height in this project.

Raising of tracks are carried out during the free time of train at first and after completion of the one step of the raising of tracks, raising works of superstructure is followed using the no operation time of day.

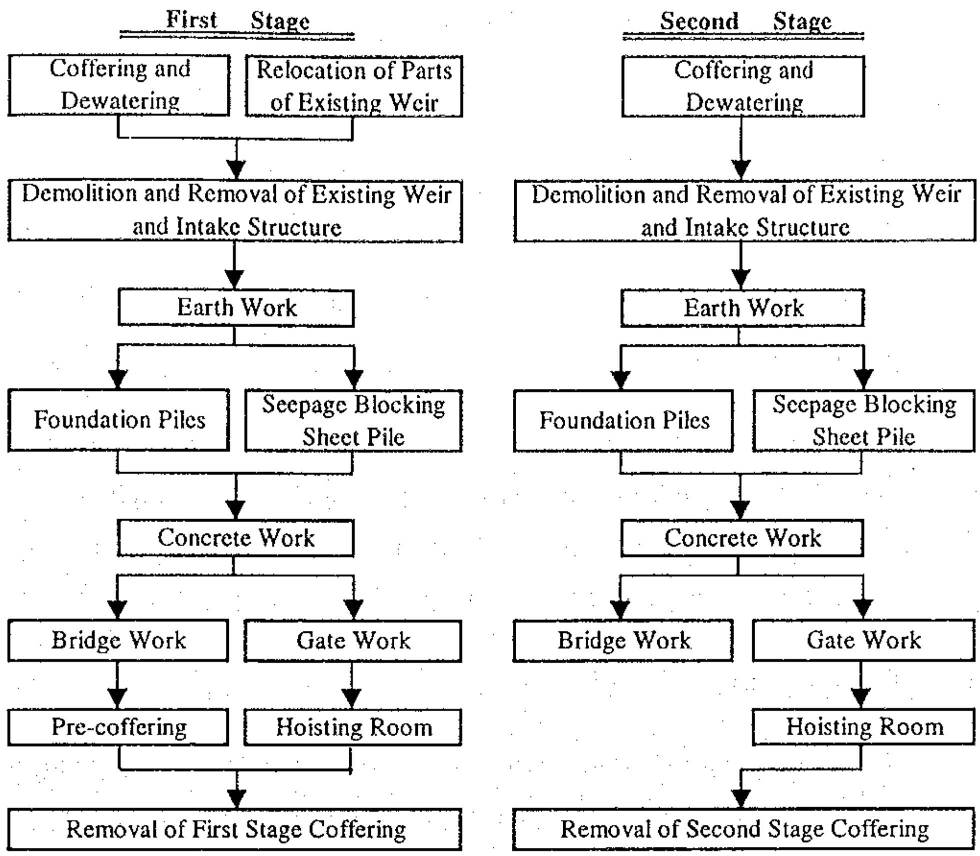
A shifting works of 3-spaned bridge are carried out at one time during no operation time after preparation of the temporary girders at both abutments. Demolition of existing piers and abutments, removal works of temporary girders and other supporting facilities are followed and arrangement of the rail alignment within the project area is carried out finally.

7.3 Construction Method of Reconstruction of Simongan Weir

7.3.1 Staged Construction

Whole construction time schedule of reconstruction of Simongan Weir takes several years, so diversion method of streamflow during rainy season becomes very important. River diversion method is not reasonable because a new bypass structure of full closing of the river has to have same capacity as the existing river.

Therefore, the staged construction method, which the half of the river is closed by coffering and after completion of construction of structures within the coffering area the coffering is removed in order to keep enough capacity for the rainy season's streamflow, is applied for the river diversion of Simongan Weir reconstruction works. Procedure of the two-stage construction is shown below.



7.3.2 Temporary Cofferdam

(1) First Stage Coffering and Dewatering

The first stage works are carried out at the left bank side, and first stage working area is closed by using a few types of coffering. After completion of the first stage works, the first stage coffering will be removed before rainy season remaining pre-constructed double steel sheet pile for a part of the second stage coffering. Procedure of the first stage coffering is shown in Fig. 7.3.1.

(2) Second Stage Coffering and Dewatering

The second stage works are carried out at the right bank side. The driving work of double steel sheet pile (upstream coffering) will be commenced from the pre-construction portion to the bank side. In order to execute this driving direction, earthfill coffering is necessary for working place of crawler crane, and after finishing sheet pile driving, this earthfill coffering is used as access road to the riverbed. Procedure of the second stage coffering is shown in Fig. 7.3.2.

7.3.3 Channel Diversion and Water Supply

(1) For Semarang River

Required discharge to Semarang River is 0.50 m^3/s during the construction period. It is too big amount to supply by temporary pumps. Many numbers of pumps and big size of an intake structure is required (for example ϕ 180 mm submergible pump : 2.5 m^3/min/unit x 16 units).

Since a new intake structure is to be constructed at almost same location as the existing one, it is difficult to install open channel type temporary water supply facilities in this area. Therefore, corrugated pipe with gravity flow type is applied to supply water of 0.50 m^3/s to Semarang River. (refer to Fig. 7.3.3)

(2) For Left Irrigation Channel

Rquired discharge to Left Irrigation Channel is 0.15 m^3/s during construction period. It is possible amount to supply by pumps, so submersible pumps set in a sump pit will be prepared at the upstream side of the coffering. Water is pumped up to a temporary water tank which is installed on the left bank crest and flows down to the existing Channel Water Gate through open ditch by gravity flow.

7.3.4 Demolition and Removal of Existing Weir and Intake Structures

After completion of coffering works and construction of temporary access road, demolition and removal works of the existing Weir are commenced and the construction works of the Intake Structures will be followed. Giant breaker and backhoe are used for these works and demolished material is hauled to a spoil bank through access road on both sides.

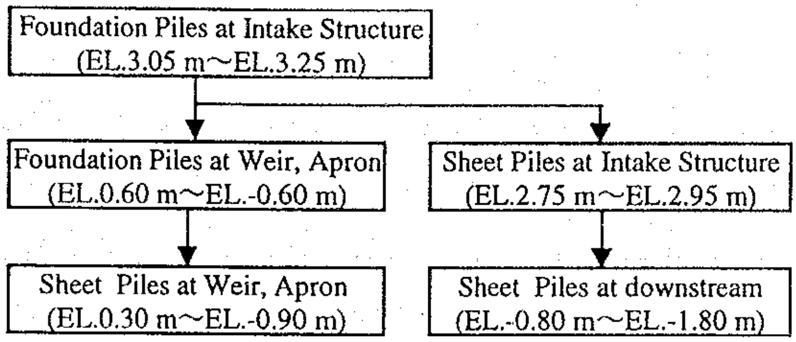
7.3.5 Earth Work

In principle, earth work area will be closed by coffering and dried up by pumps, so that excavation work can be carried out by backhoe and bulldozer under dry condition. Careful excavation work by backhoe and manpower shall be carried out near the existing structures under the protection of temporary retaining wall.

The excavated material and the demolished material of the existing structure are to be hauled to a spoil bank located 7.0 km away from the site by dump trucks through the public roads along the river and North Ring Road.

7.3.6 Foundation Piles and Seepage Blocking Sheet Piles

Top elevation of both the foundation piles and the sheet piles of Intake Structures is 2.50 m higher than the one of the Weir and the apron, pile driving work for Intake Structure should be done first before excavation of the Weir foundation. Procedure of these two works is shown below.



7.3.7 Concrete Work

(1) Foundation Slab Concrete

Maximum concrete volume among the blocks is about 460 m^3 and block's height is 2.20 m at the upstream and 1.60 m at the downstream. Construction joint is to be made at the height of 1.60 m of slab and separated two lifts, then the maximum concrete volume of the block becomes about 390 m^3.

Ready mixed concrete is transported from a concrete plant in Semarang City or the one established by a contractor to the sites and concrete will be placed by concrete pump, concrete bucket and chute.

(2) Pier Concrete

Since pier concrete volume is not so big as slab, 1.80 m lift height with maximum volume of 72 m^3 is available for standard lift height for Simongan Weir.

25-ton truck crane is used for loading and unloading of form material and reinforcing bar at the work site and prefabricated independent scaffold or single-pole scaffold is used according to the working conditions.

7.3.8 Gate Installation Work

After completion of concrete work, gate guide frame and gate installation works will be commenced. These installation works will be done by truck/crawler crane setting on EL.1.500 m of apron slab and concrete block.

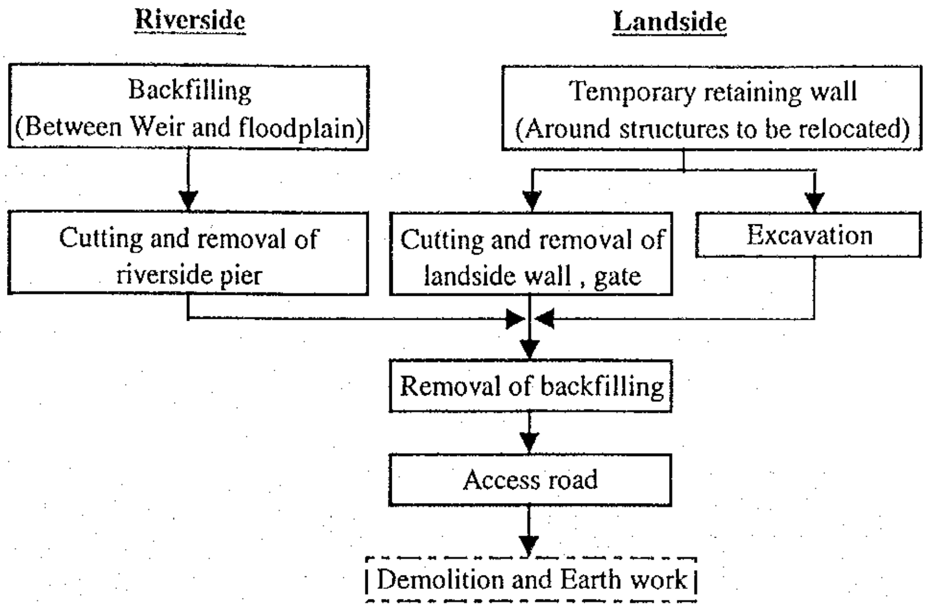
Flood discharge gates and sediment flush gates will be transported from a factory to the site by separated several pieces. These gate pieces are assembled on the support facilities setting on EL.1.500 m of slab at the exact location of the gates by 50-ton crawler crane with assistance by 25-ton truck crane and welding work follows. While intake gates will be transported from a factory to the site by one unit and installed by 20-ton truck crane.

Hoist apparatus for flood discharge and sediment flush gates, which are separated into 3 blocks, will be installed on the winch deck by 50-ton crawler crane. The plan of the gate installation works is shown in Fig. 7.3.4 and 7.3.5.

7.3.9 Relocation of Parts of Existing Weir

The existing Intake Structures on the left bank and a part of Simongan Weir is relocated to a area where a part of the existing structures are exhibited publicly as historical monument. Therefore, relocation works should be carried out before commencement of the demolition and removal of the existing Weir.

In order to keep schedule cutting works of the structure relocation works will be commenced from the both the riverside and landside in parallel. On the riverside, before start of coffering of upstream side, water area that exists between the Weir and floodplain will be backfilled and used for working area and access road. On the landside, single steel sheet pile for the temporary retaining wall will be driven around the relocation parts and excavation work will be carried out step by step until reasonable depth for cutting work. Working procedure is shown below.



The wire sawing and the wall sawing method are available for cutting work of structures. Considering the present conditions, it is better to use the wire sawing for structures with thickness of more than 1.0 m and the wall sawing for structures with thickness less than 1.0 m. According to the working efficiency, safety and capacity of transportation condition, the maximum cutting block's weight shall be less than 5.0 t.

7.4 Construction Time Schedule

7.4.1 Planning Condition

To establish construction plan, estimation of the workable days is most important factor for construction schedule.

(1) Workable Days

(a) Dry and Rainy Seasons

- Dry Season : April to November (8 months)
- Rainy Season : December to March (4 months)

(b) Construction Mode

Construction works, which are possible to be done even in rainy season by applying dewatering facilities, will be executed through a year. While construction works which are difficult to be done in rainy seasons will be executed in dry seasons.

(c) Seasonal Workable Days

Since construction works along/within the river course are much influenced by rainfall and flooding, the construction period and workable days are estimated based on the rainfall data at the Semarang station for 10 years starting from 1987. In addition, national holidays and religious events are considered. The summary of the workable days by season is tabulated below.

Work Items	Dry Season (Apr. – Nov.)	Rainy Season (Dec. – Mar.)	Through a Year
Earth Works and Foundation Works	176 days/8 mths = 22 days/mth	49 days/4 mths = 12 days/mth	225 days/year = 18 days/mth
Concrete Works and Installation of Gate	184 days/8 mths = 23 days/mth	68 days/4 mths = 17 days/mth	252 days/year = 21 days/mth

(2) Daily Workable Hours

All construction works are planned to be carried out under the single shift working system of 9-hour labour per day including 2 hours of overtime work.

7.4.2 Construction Time Schedule

The balance of construction volumes including numbers of construction equipment and facilities is very important for economic construction. The principal conception of the Construction Time Schedule for each package is described below.

(1) West Floodway and Garang River Improvement

It is possible to start up at the same time both West Floodway and Garang River Improvement works, but it causes the concentration of equipment, facilities, manpower and materials from the beginning of the project. To avoid the concentration of works at the first year, commencement of Garang River Improvement works is brought to the second year.

Construction time schedule of West Floodway and Garang River Improvement is shown in Table 7.4.1.

(2) Reconstruction of Simongan Weir

The principal condition with regard to the upstream water level will affect to the construction time schedule. Especially at the first stage, all main works are on the critical path and the critical path continues from the relocation works of the existing structures to gate installation work.

Construction time schedule of Simongan Weir is shown in Table 7.4.2.

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Table 7.2.1 WORK VOLUME OF CHANNEL EXCAVATION AND DIKE EMBANKMENT (WEST FLOODWAY/GARANG RIVER IMPROVEMENT)

LOCATION / WORK ITEM, EQUIPMENT	River Mouth - NRR Bridge (WF.-9 - WF.15)	NRR Bridge - Simongan Weir (WF.15 - WF.96)	Simongan Weir - Kreo Junction (WF.101 - WF.184)	TOTAL
RIGHT BANK	(m^3)	(m^3)	(m^3)	(m^3)
Excavation above W.L.	27,671	147,015	176,616	351,303
Excavation below W.L.	120,462	247,399	71,153	439,013
Embankment	8,701	4,654	4,793	18,148
Earthfilling	11,130	14,598	4,779	30,507
LEFT BANK	(m^3)	(m^3)	(m^3)	(m^3)
Excavation above W.L.	934	83,581	81,552	166,067
Excavation below W.L.	99,396	130,969	65,795	296,159
Embankment	510	7,028	995	8,533
Earthfilling	464	10,097	1,024	11,585
TOTAL (RIGHT B. + LEFT B.)	(m^3)	(m^3)	(m^3)	(m^3)
Excavation	248,463	608,963	395,115	1,252,541
Embankment and Earthfilling	20,805	36,377	11,591	68,773
Material to be spoiled	227,658	572,587	383,524	1,183,769
NUMBER OF EQUIPMENT	unit	unit	unit	unit
Bulldozer 15 t	2	2	2	6
Backhoe 0.35 m^3	6	10	6	22
Backhoe 0.60 m^3			2	2
Giant Breaker 600/800kg			2	2
Dump Truck 10 t	18	50	46	114
Clamshell Grabbing 1.0 m^3	2			2
Pontoon 200 t	2			2
Barge 100 m^3	4			4
Tug Boat 15 t	2			2

Table 7.2.2 CONSTRUCTION TIME SCHEDULE OF RAISING OF THE EXISTING RAILWAY BRIDGE

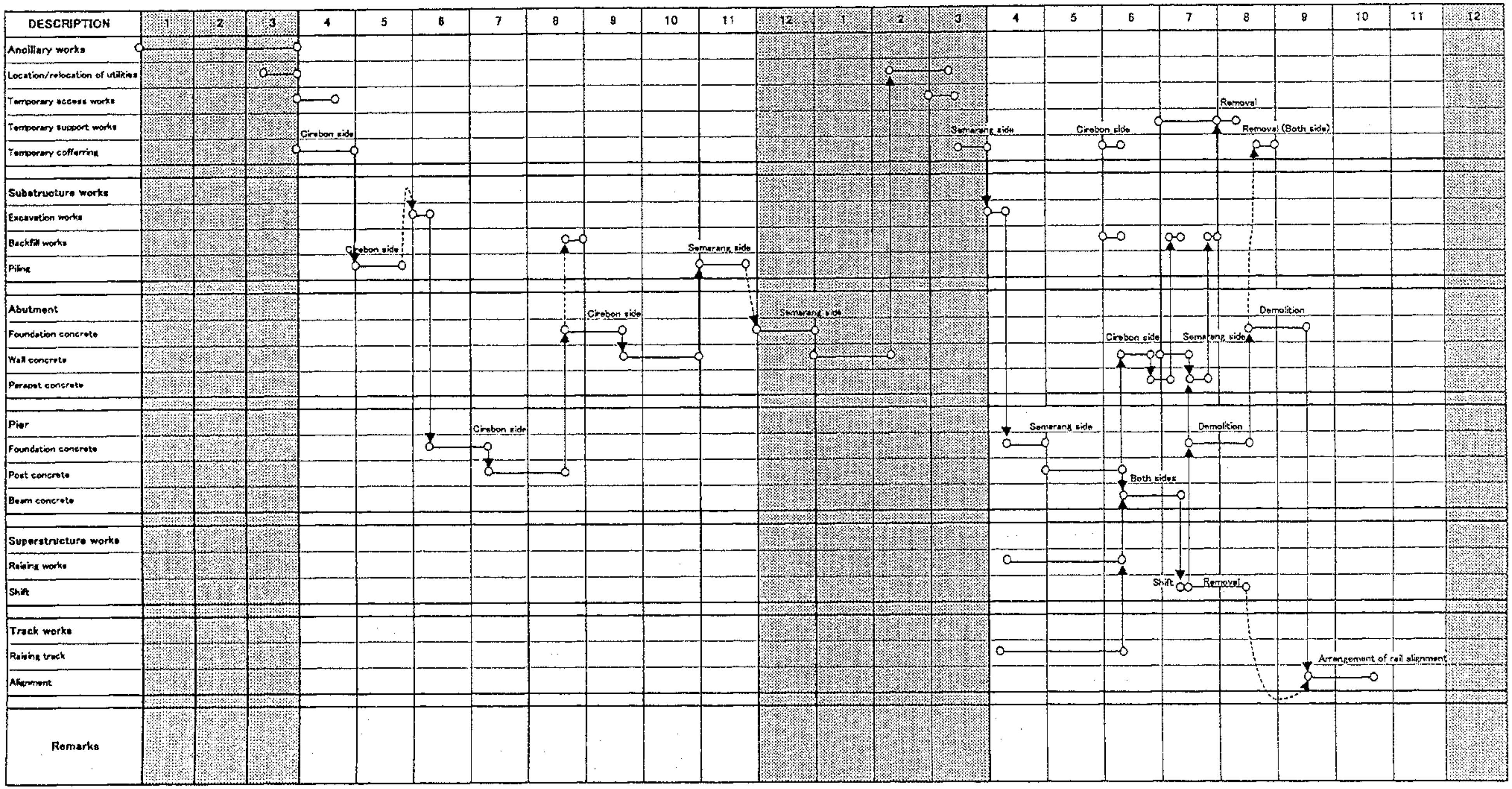


Table 7.4.1 CONSTRUCTION TIME SCHEDULE OF WEST FLOODWAY/ GARANG RIVER IMPROVEMENT

Work Item	Unit	Quantity
1. West Floodway Improvemen		
Clearing and Grubbing	m^2	105,900
Dredging	m^3	163,000
Excavation	m^3	694,000
Filling on Floodplain	m^3	36,300
Earth Dike Embankment	m^3	20,900
Raising of Existing Floodwall	m	4,970
Revetment	m	4,000
Waterfront Facilities	L.S	1
Drainage Outlet	L.S	1
Protection Works for Bridge Pier	L.S	1
2. Garang River Improvement		
Clearing and Grubbing	m^2	17,100
Excavation	m^3	395,000
Filling of Channel and Floodplain	m^3	5,800
Earth Dike Embankment	m^3	5,800
Floodwall	m	160
Revetment	m	2,500
Ground Sill (WF 124)	L.S	1
Ground Sill (WF 176)	L.S	1
Waterfront Facilities	L.S	1
Sluiceway	L.S	1
Drainage Outlet	L.S	1
Protection Works for Bridge Pier	L.S	1

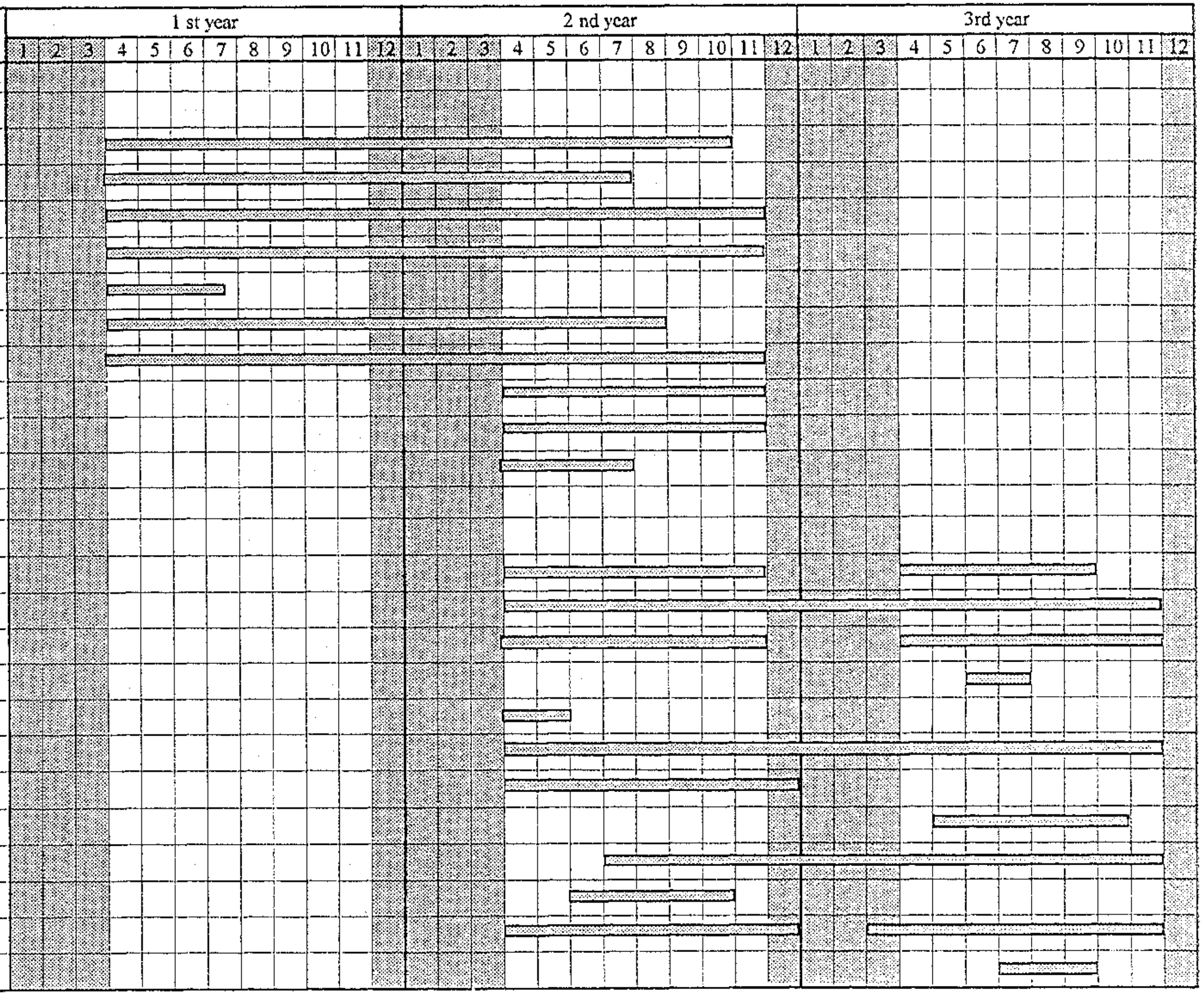
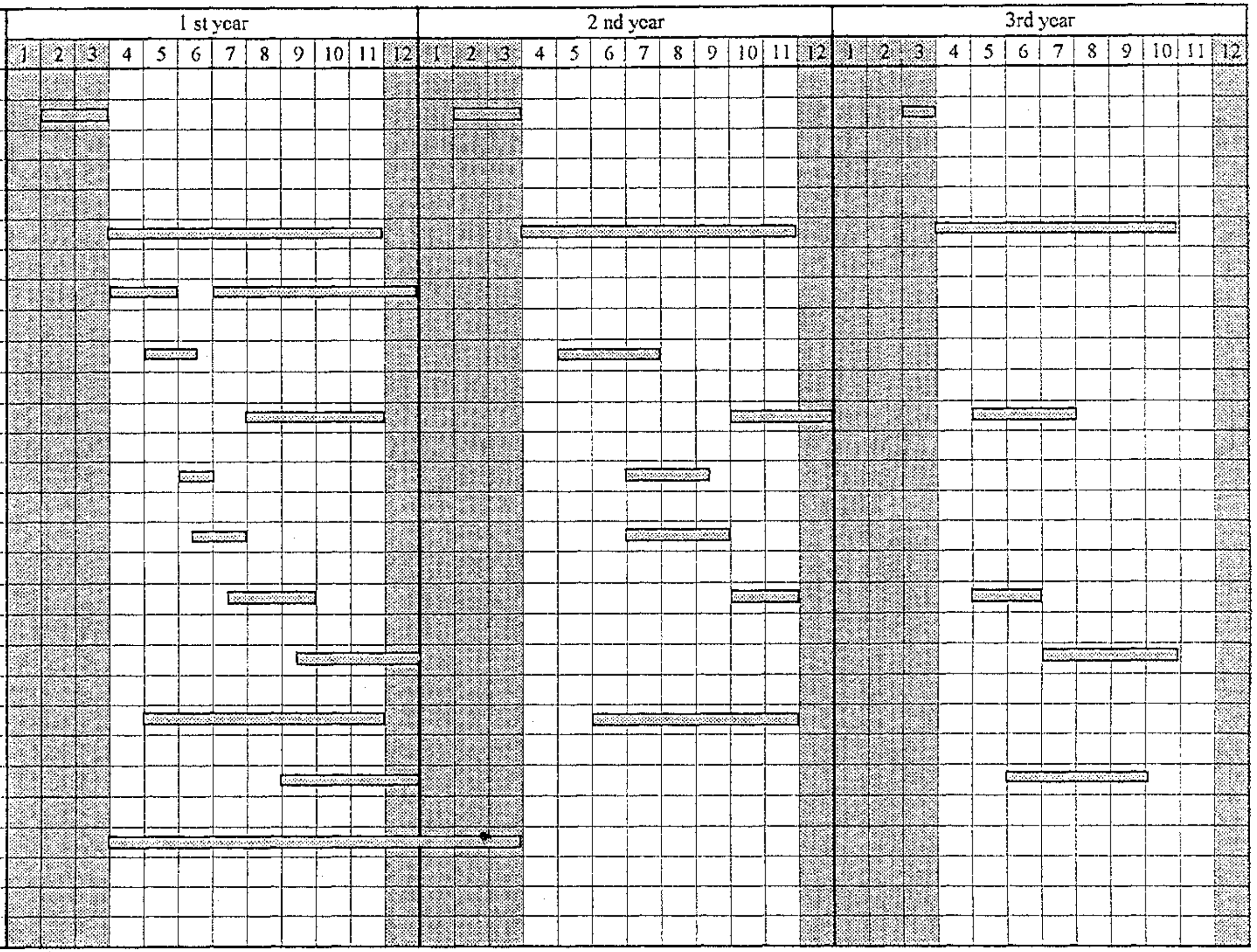


Table 7.4.2 **CONSTRUCTION TIME SCHEDULE OF RECONSTRUCTION OF SIMONGAN WEIR**

Work Item	Unit	Quantity
1. Preparation Works	L.S	1
2. Simongang Weir		
Coffering and Dewatering	L.S	1
Relocation of Parts of Existing Weir	L.S	1
Demolition and Excavation	m^3	66,400
Filling and Embankment	m^3	14,200
Foundation P.C.Pile, L=12m	pcs	680
Steel Sheet Pile anc P.C. Sheet Pile	m	8,100
Concrete	m^3	11,700
Gate Works	L.S	1
Retaining Wall and Revetment	L.S	1
Bridge	L.S	1
Control House	L.S	1



FIGURES

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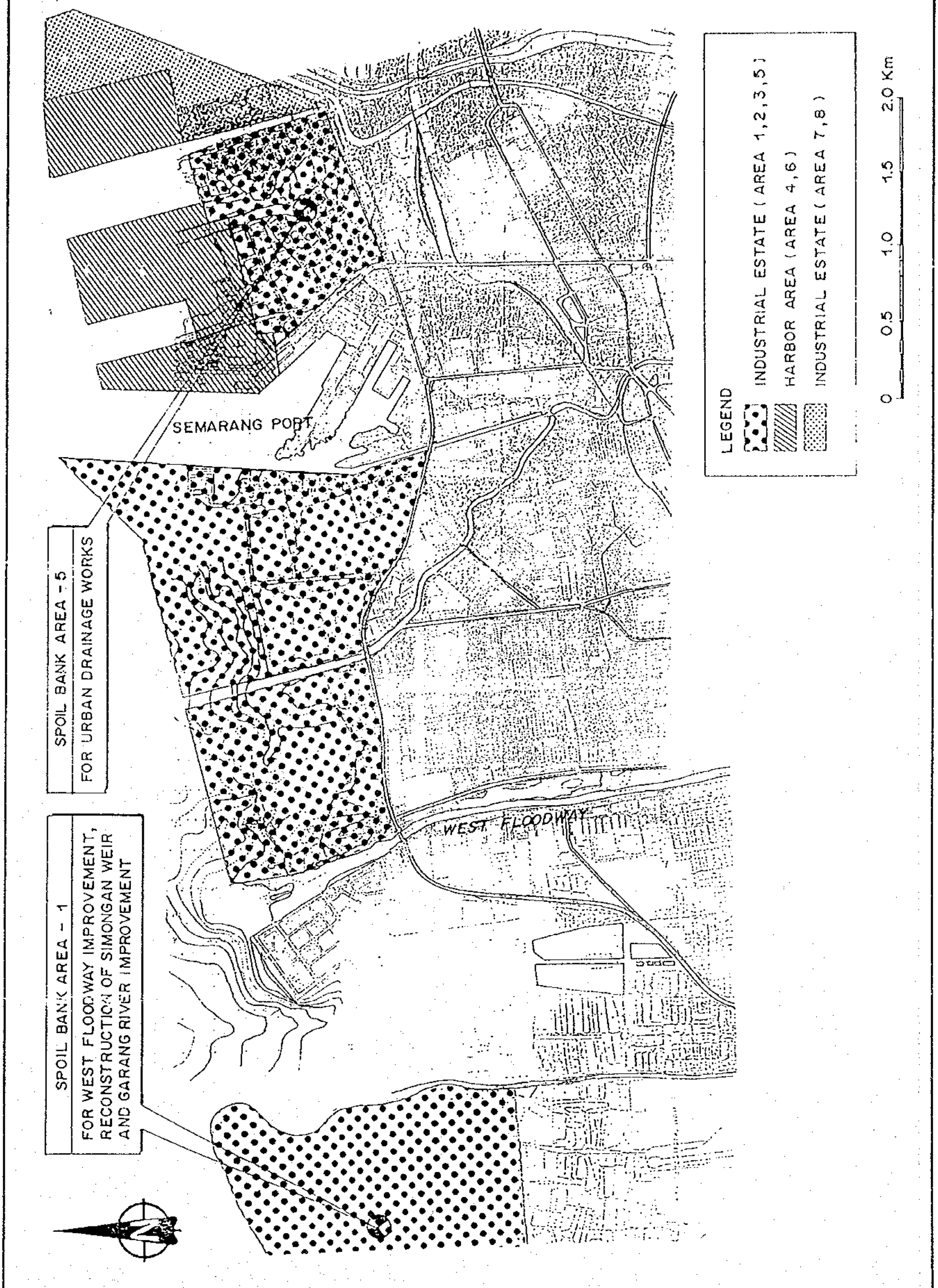
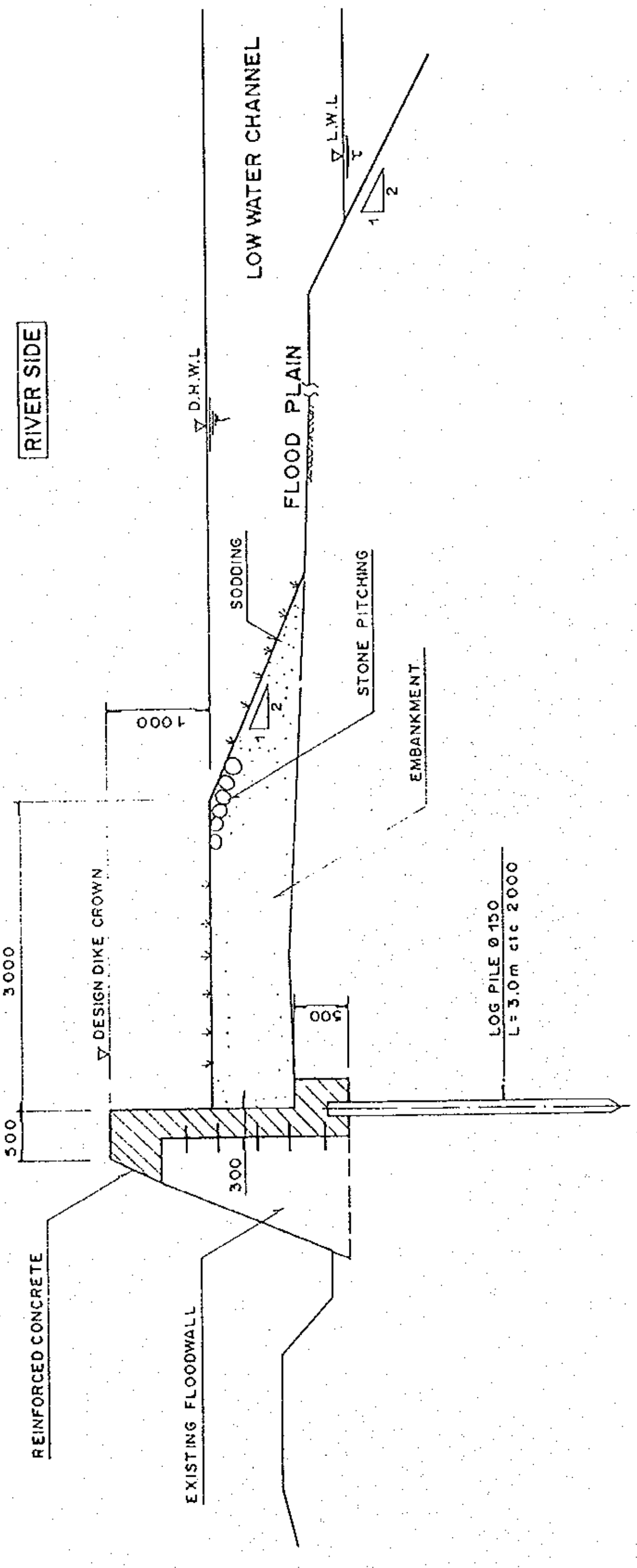
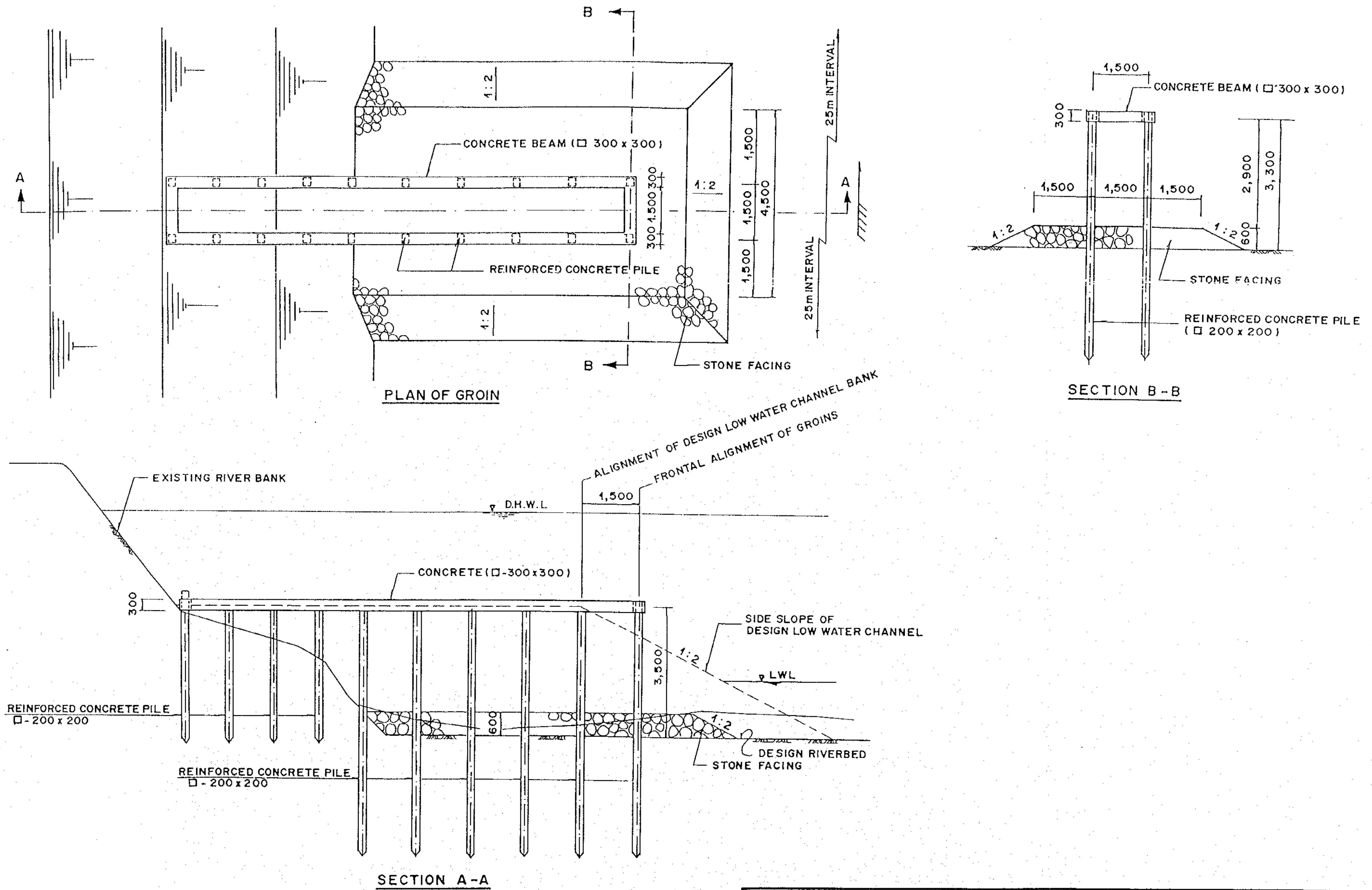


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 7.1.1 POSSIBLE SPOIL BANK AREAS
JAPAN INTERNATIONAL COOPERATION AGENCY	



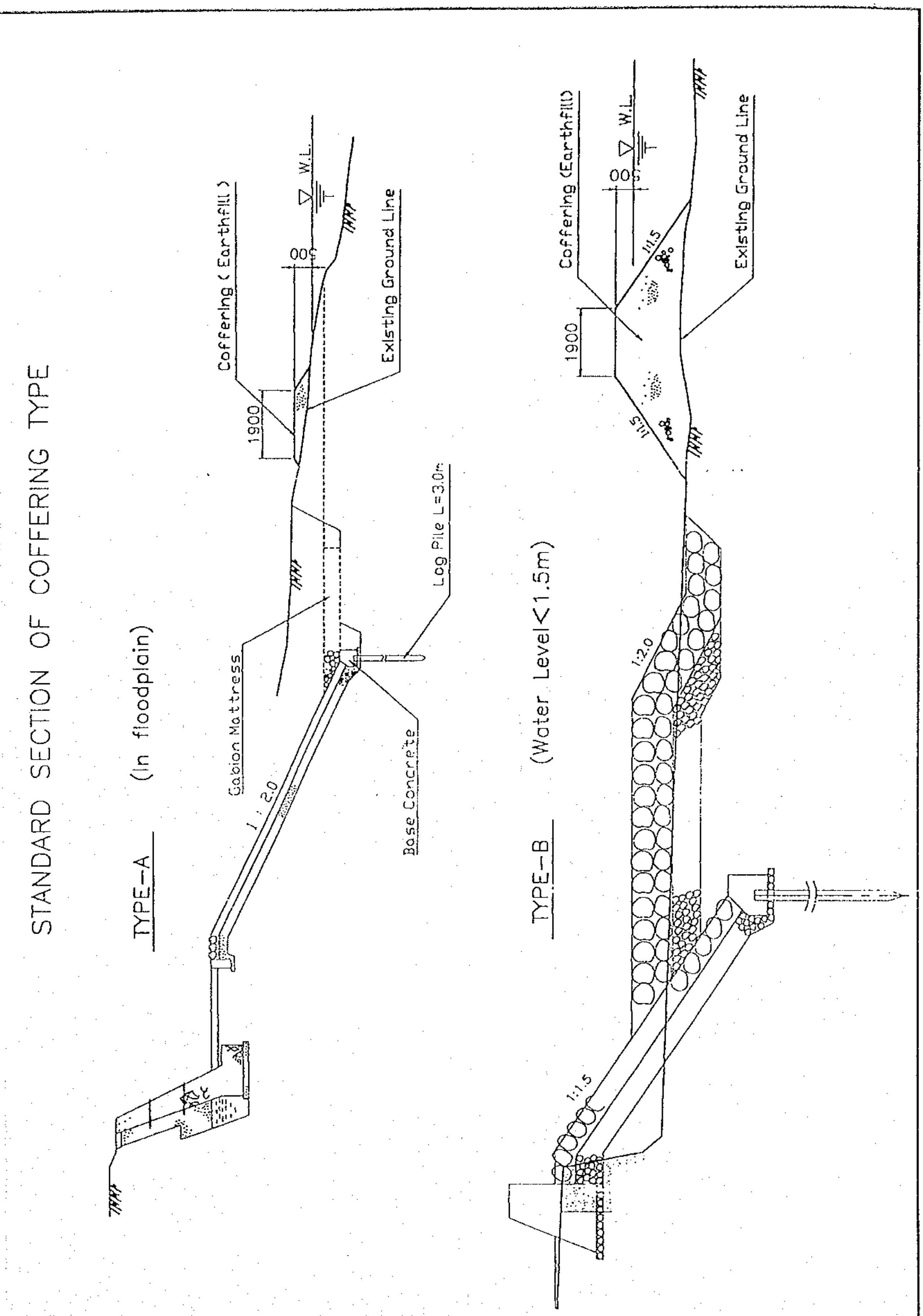
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 7.2.1 RAISING OF EXISTING FLOODWALL
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

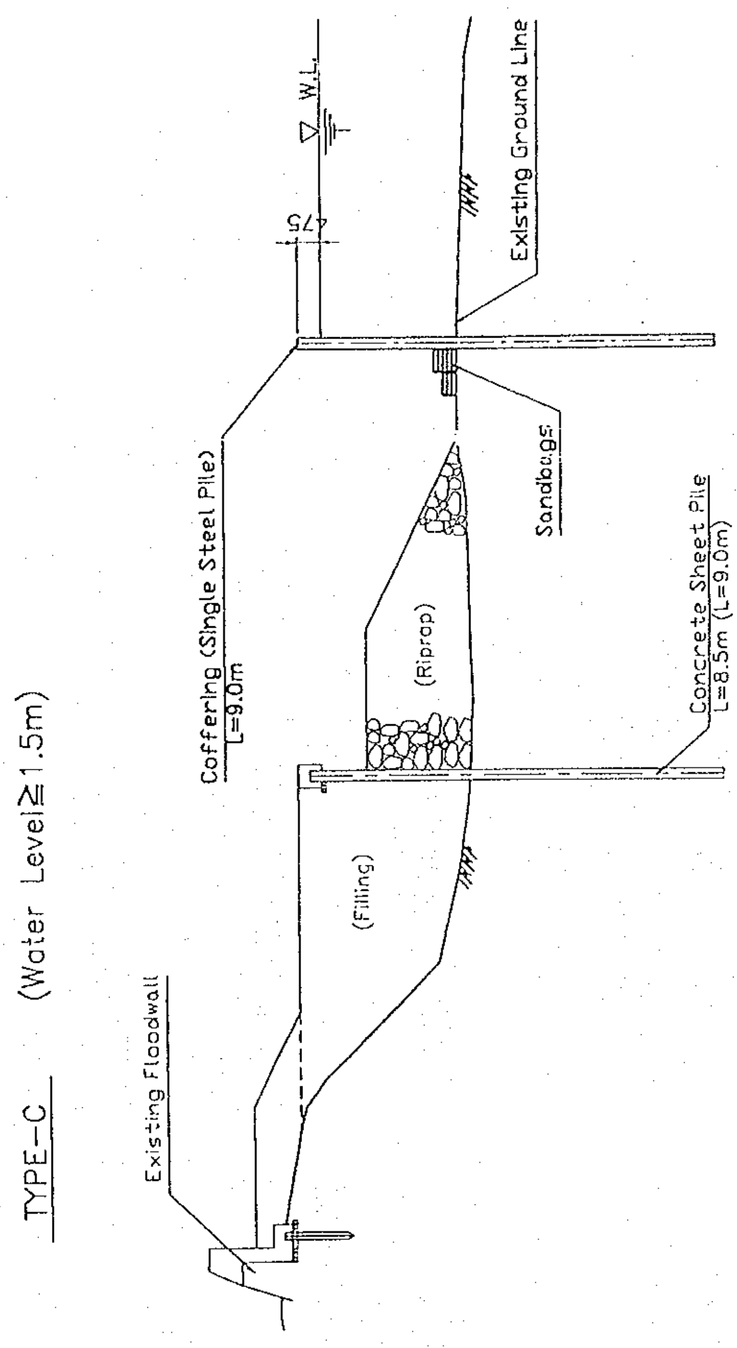
Fig. 7.2.2
GENERAL FEATURE OF GROIN



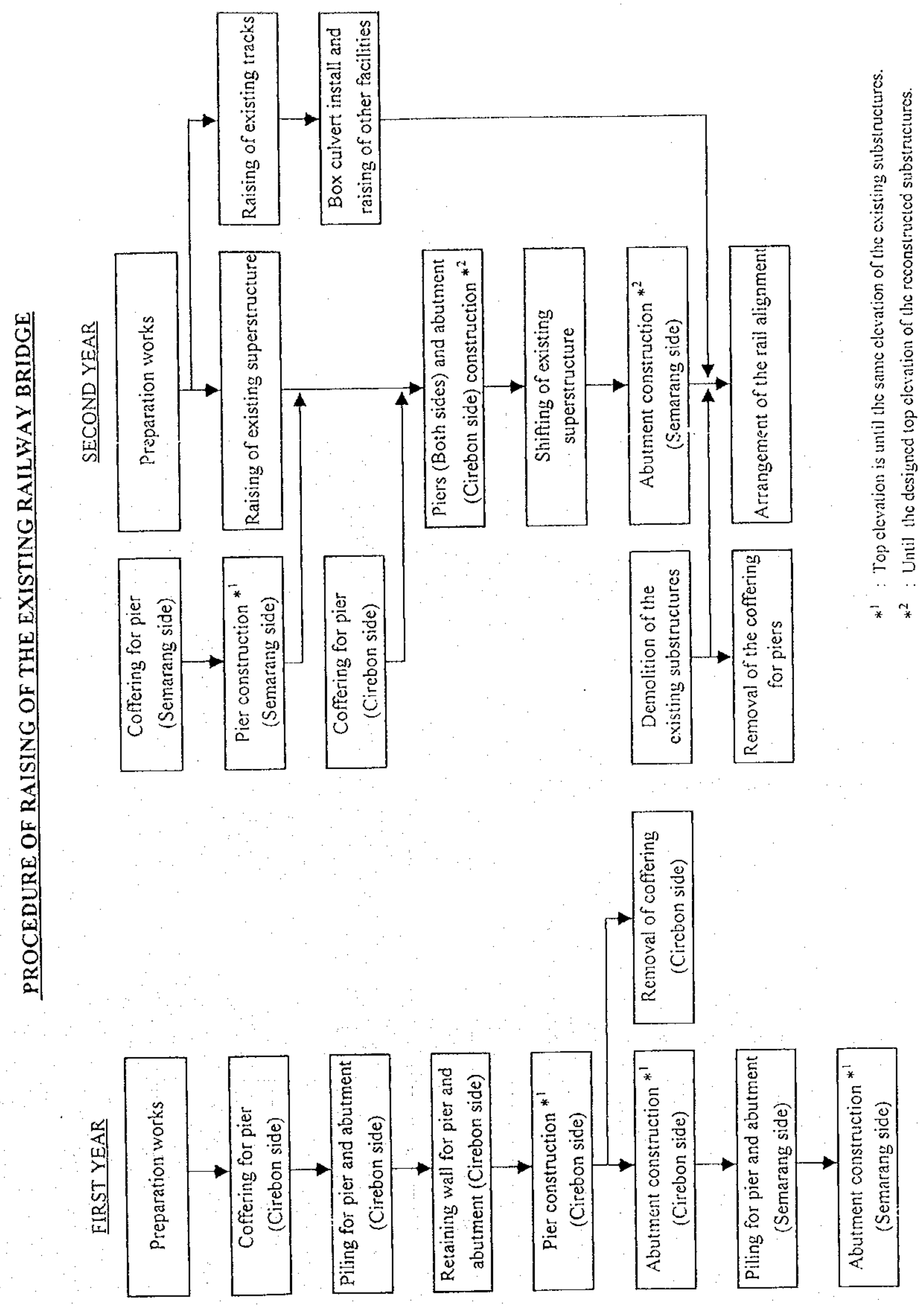
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 7.2.3 (1/2)
STANDARD SECTION OF COFFERING TYPES



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 7.2.3 (2/2) STANDARD SECTION OF COFFERING TYPES
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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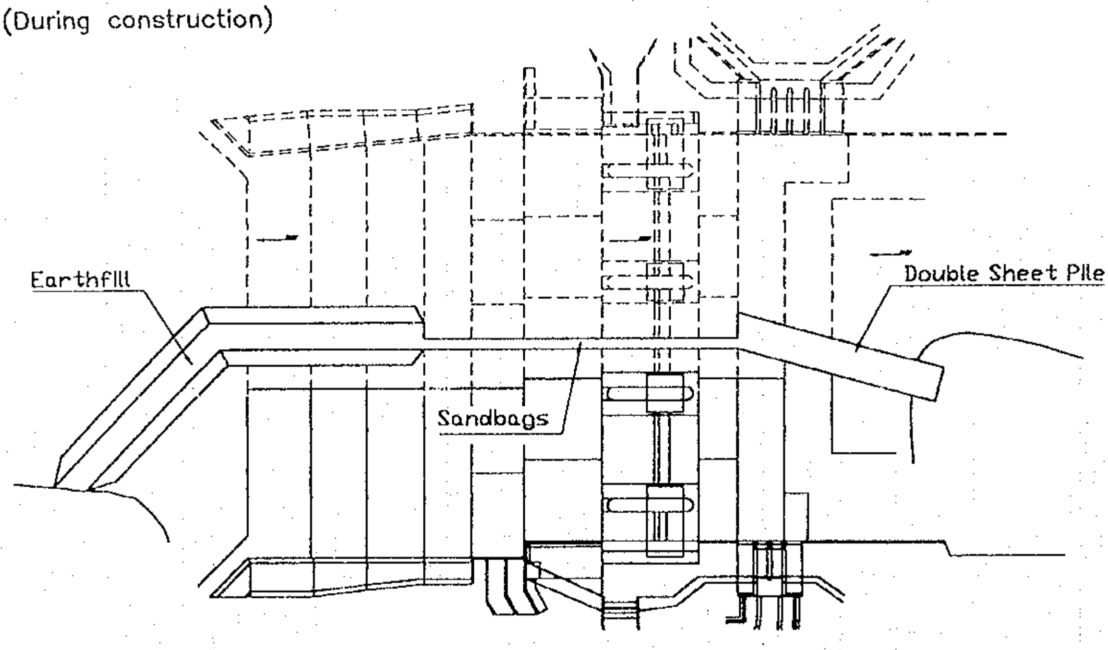
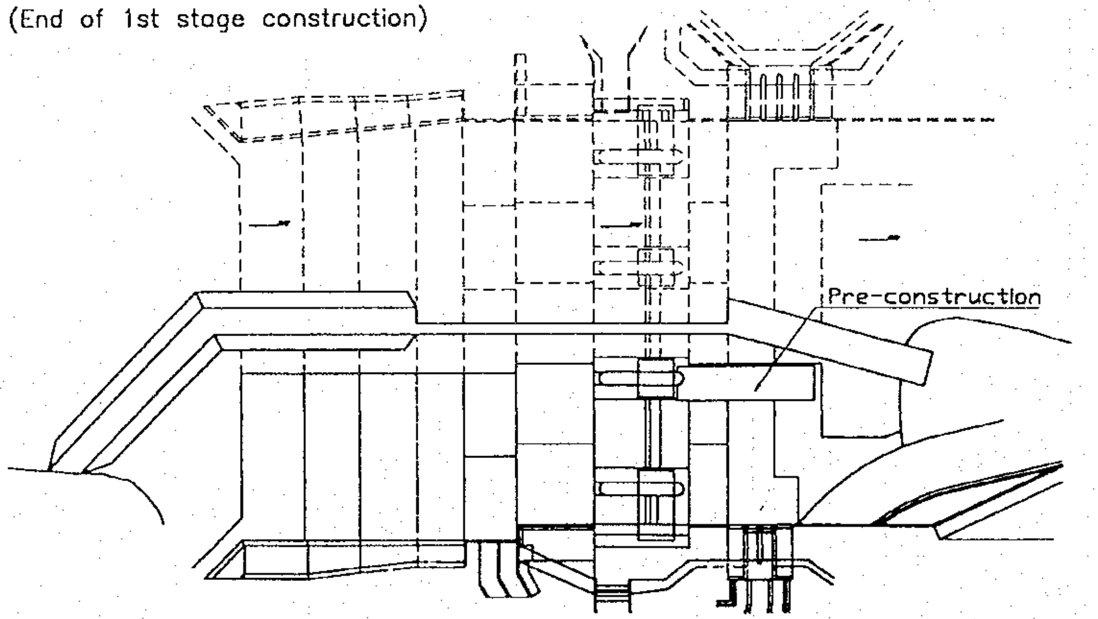
Fig. 7.2.4
PROCEDURE OF RISING OF THE EXISTING RAILWAY BRIDGE

FIRST STAGE

(1/3)
(During construction)



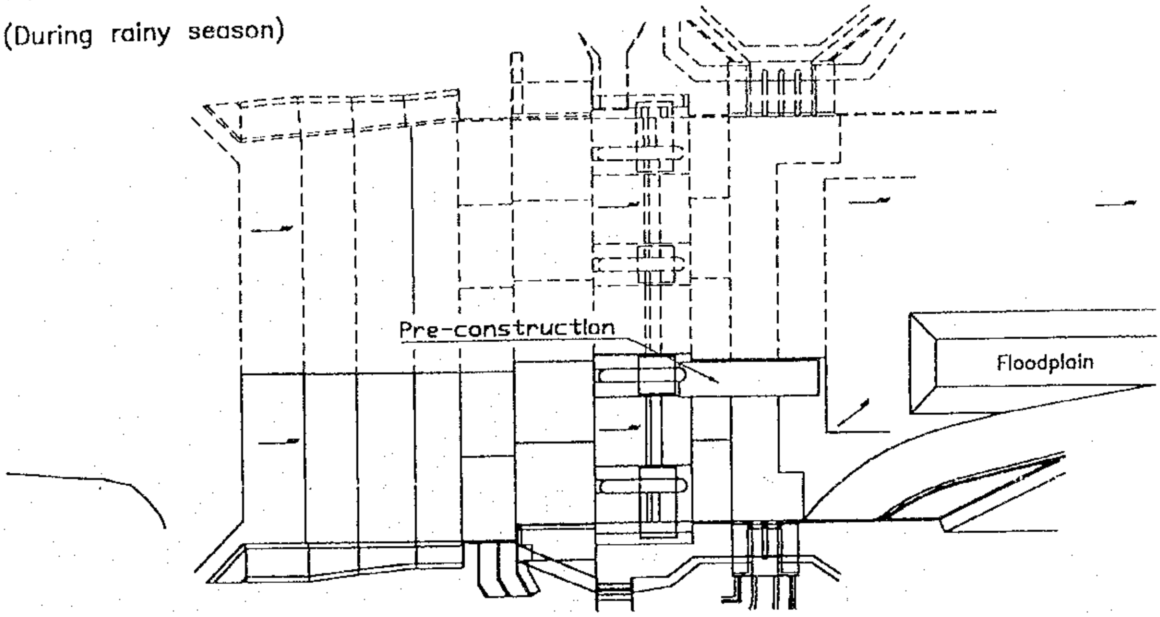
(2/3)
(End of 1st stage construction)



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 7.3.1 (1/2) PROCEDURE OF THE FIRST STAGE COFFERING
JAPAN INTERNATIONAL COOPERATION AGENCY	

(3/3)

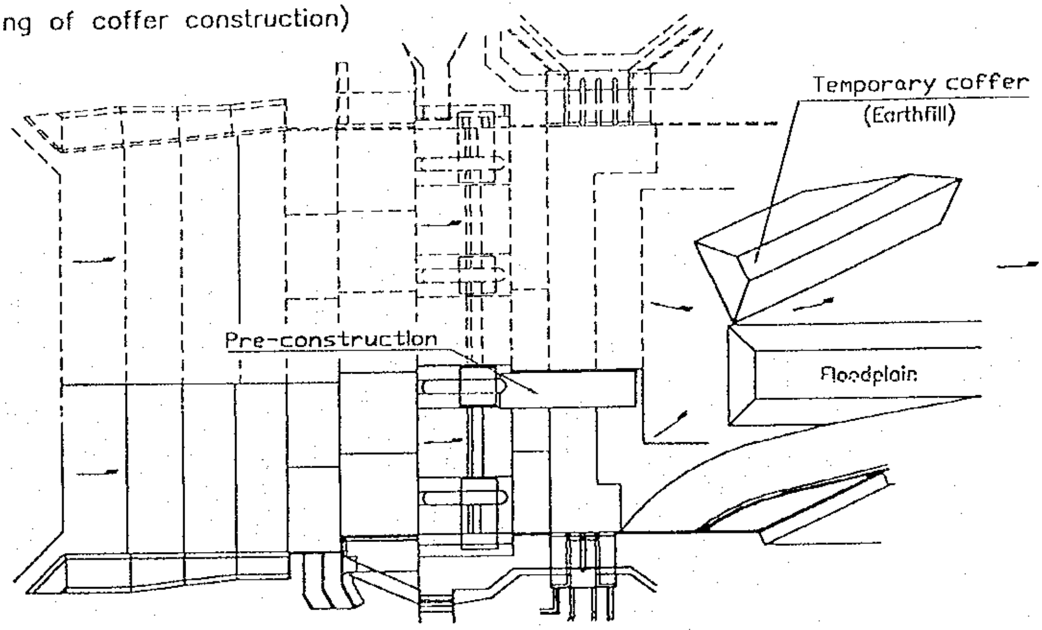
(During rainy season)



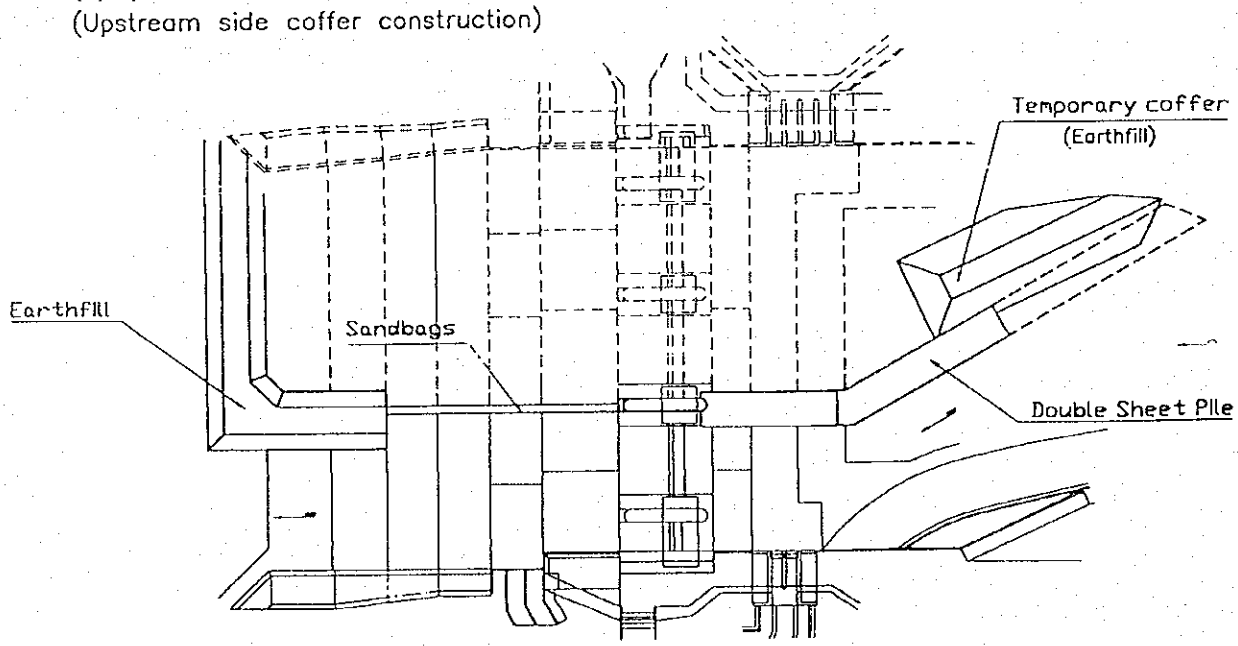
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 7.3.1 (2/2) PROCEDURE OF THE FIRST STAGE COFFERING
JAPAN INTERNATIONAL COOPERATION AGENCY	

SECOND STAGE

(1/5)
(Biginning of coffer construction)



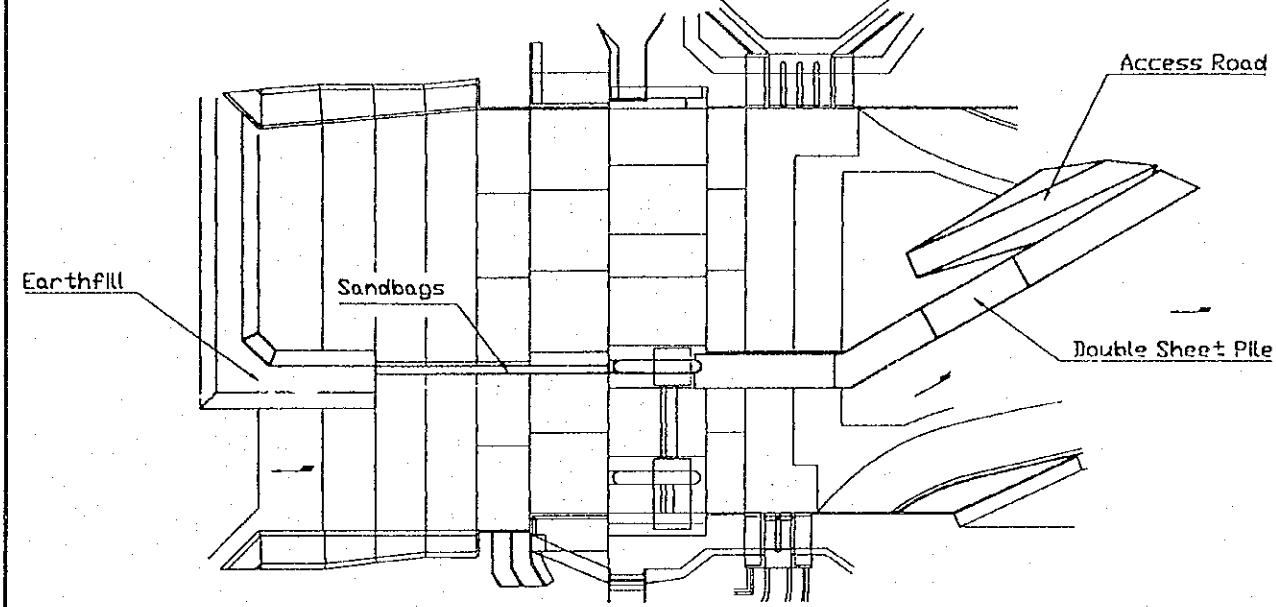
(2/5)
(Upstream side coffer construction)



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 7.3.2 (1/3) PROCEDURE OF THE SECOND STAGE COFFERING
JAPAN INTERNATIONAL COOPERATION AGENCY	

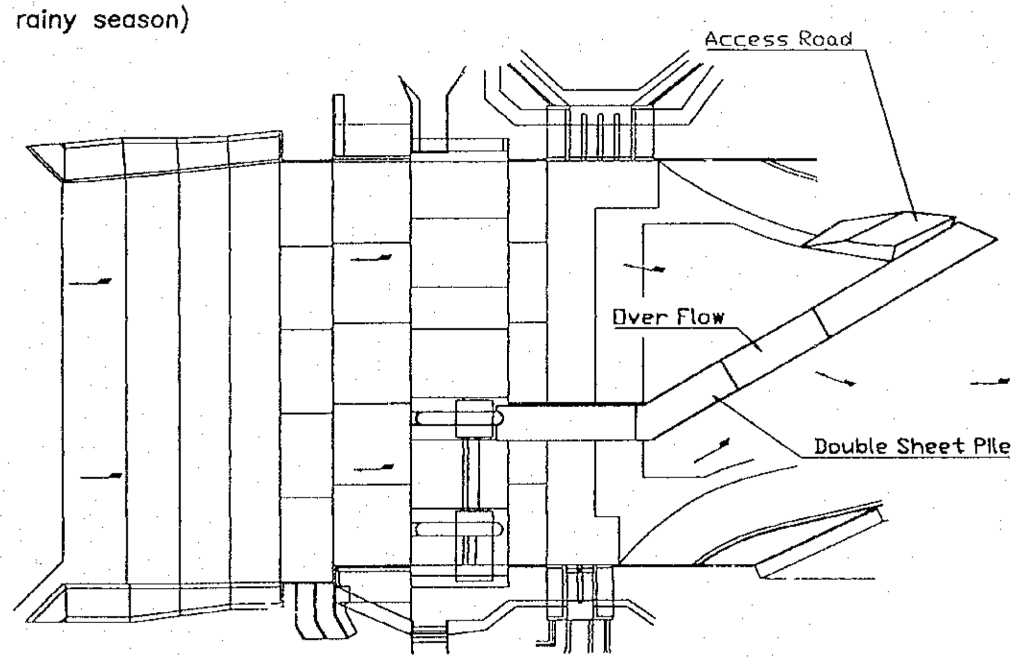
(3/5)

(During construction)



(4/5)

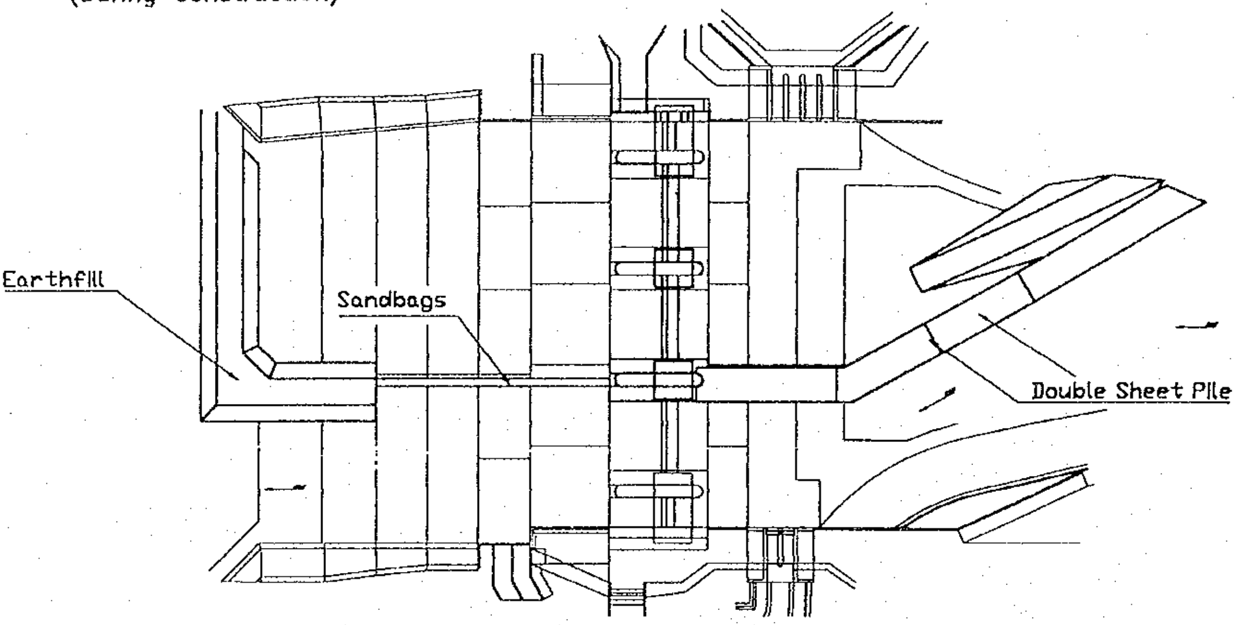
(During rainy season)



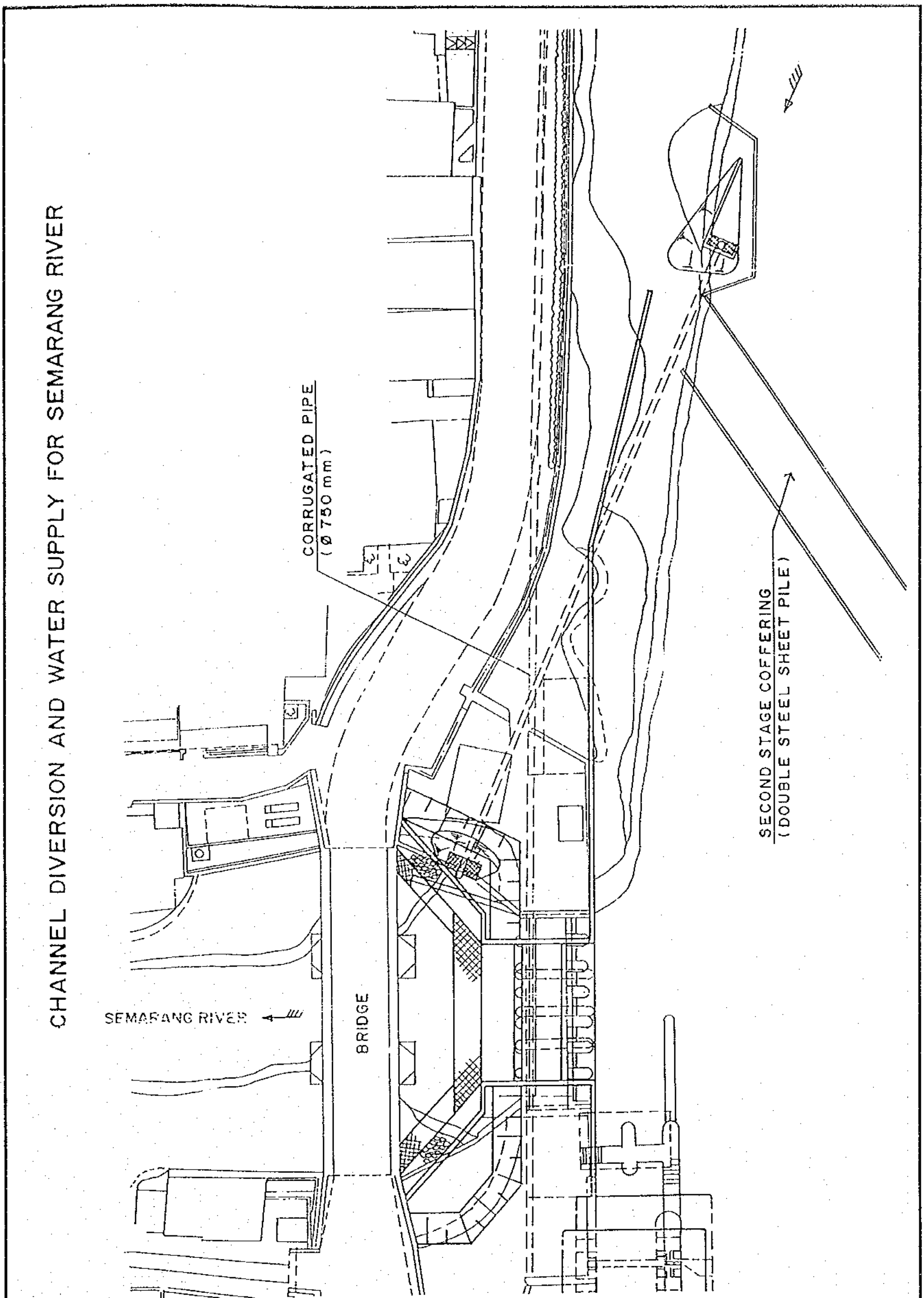
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 7.3.2 (2/3) PROCEDURE OF THE SECOND STAGE COFFERING
JAPAN INTERNATIONAL COOPERATION AGENCY	

(5/5)

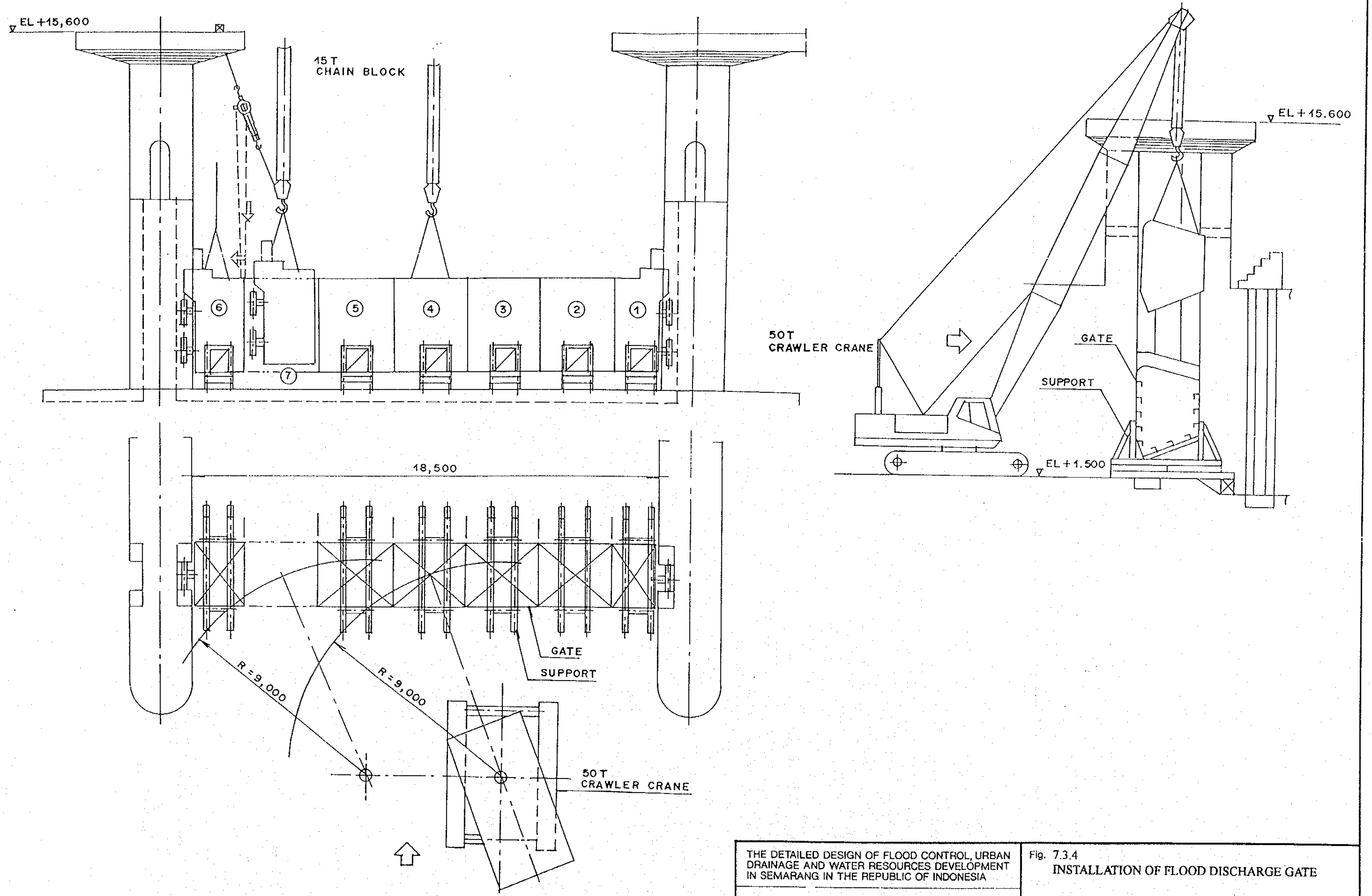
(During construction)



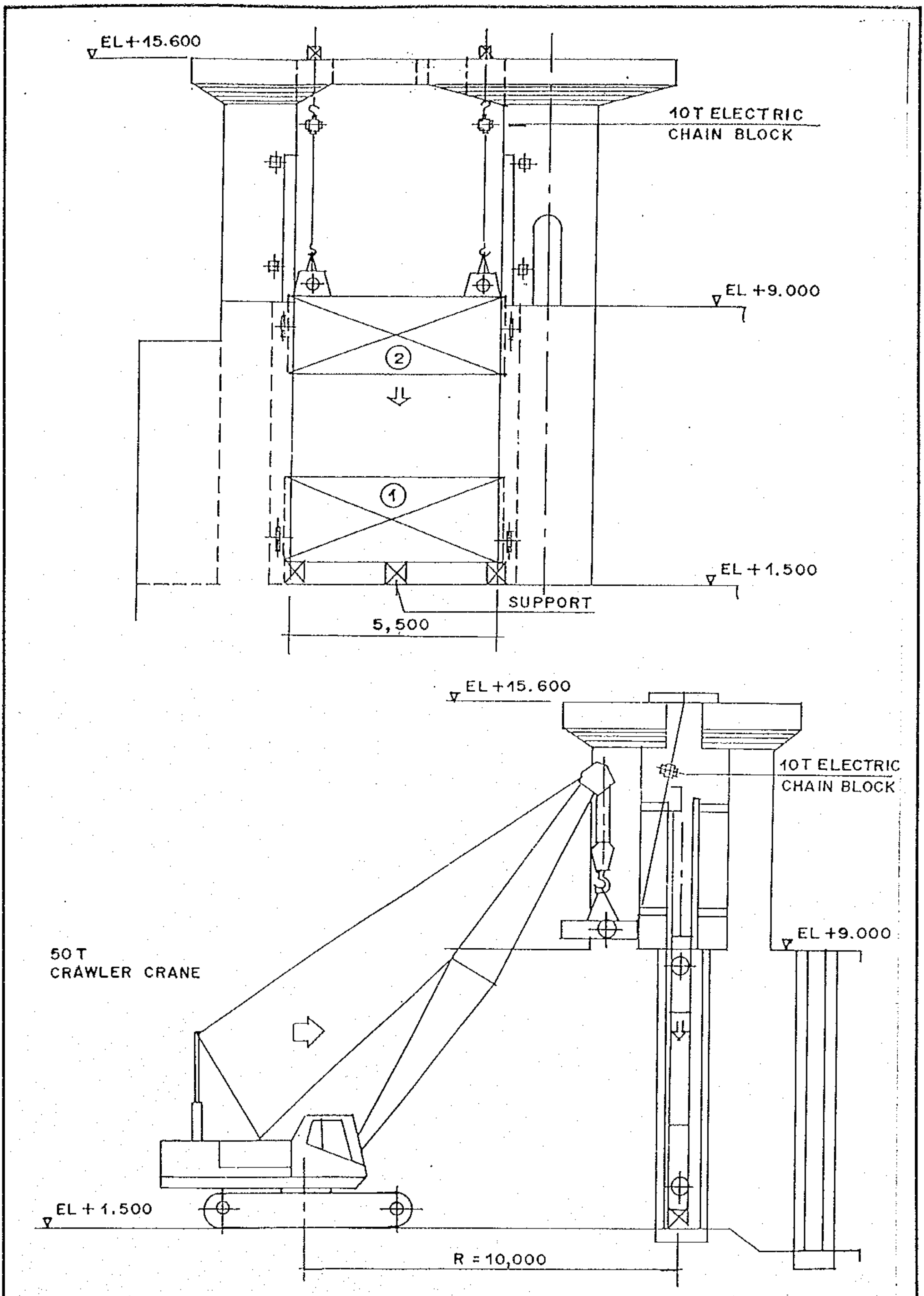
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 7.3.2 (3/3) PROCEDURE OF THE SECOND STAGE COFFERING
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 7.3.3 CHANNEL DIVERSION AND WATER SUPPLY FOR SEMARANG RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 7.3.4 INSTALLATION OF FLOOD DISCHARGE GATE
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 7.3.5
INSTALLATION OF SEDIMENT FLUSH GATE

CHAPTER 8

COST ESTIMATE

CHAPTER 8 COST ESTIMATE

8.1 Introduction

This chapter is prepared for the estimate of the project cost for the West Floodway/Garang River Improvement, which consists of the West Floodway and Garang River Improvement (hereinafter referred to as the Package-1), Simongan Weir Reconstruction (the Package-2) and Raising Existing Railway Bridge (the Package-3).

8.2 Constitution of Project Cost and Conditions of Cost Estimate

8.2.1 Constitution of Project Cost

Project cost is composed of such costs as construction base cost, engineering service cost, compensation cost, administration cost, physical contingency, price contingency and tax. In addition, construction base cost is divided into many cost items as illustrated in Fig. 8.2.1.

The explanation of each project cost item is described below. Administration cost, physical contingency, price contingency and tax are calculated by ratios which are expressed in percentage to other cost items (refer to Table 8.2.1):

Construction Base Cost : Construction base cost is composed of direct cost estimated based on the work quantities and indirect cost which is estimated in percentage (refer to Sub-Section 8.2.2 Composition of Construction Base Cost).

Engineering Service Cost :Engineering service cost is mainly expended for the construction supervision services of consultants. It is estimated based on the number of consultant engineers and other expenses, necessary for the supervision service. The engineering service cost is estimated based on the data collected from the previous and current similar projects.

Compensation Cost :Compensation cost consists of the land acquisition and house evacuation costs.

Administration Cost :This cost is Project Owner's expenditures for the proper project management to execute the project implementation smoothly.

Seven (7) % of the sum of the construction base cost and the compensation cost is adopted.

Physical Contingency :**Six** (6) % of the sum of the construction base cost, the engineering service cost and the compensation cost is considered for contingent expenses for the incidental construction tasks.

Price Contingency :This contingency is the cost for the price escalation. From the economical point of view, it is assumed and adopted that **three** (3) % of all costs, in which construction base cost, engineering service cost, compensation service cost, administration service cost and physical contingency are included, in foreign currency portion and **eight** (8) % of all costs in local currency portion is the ratios of price escalation for one (1) year. (Refer to Tables 8.2.2 and 8.2.3)

Value Added Tax :**Ten** (10) % of the construction base cost, the engineering service cost and contingencies shall be considered.

8.2.2 Composition of Construction Base Cost

The construction base cost is calculated in the following manner.

Construction Base Cost = Σ (Unit Cost for a Payment Item x Work Quantity for a Payment Item).

The unit costs for payment items are estimated as the sum of the direct cost and the indirect cost.

(1) Direct cost

The estimate for direct costs is performed based on the quantities of all construction tasks shown on drawing and described in project requirements. The direct cost includes all of countable element due to the type, size, design, construction procedures and quality of the intended structure, which are taken into account when deriving the cost for each work item. Direct costs are broken down into the following costs and rates.

(a) Basic Cost

Basic costs are determined at first for the estimate of the project cost. Basic costs consist of labor wage, prices of materials and operation costs of equipment. Details of each basic cost are explained in Section 8.3.

(b) Unit Rate

Using the basic costs, unit rates are estimated for basic work items such as unit rate of excavation by backhoe, rate of concrete works per 1.0 m^3, etc. Basic costs and unit rates were used directly to compute unit costs of payment items, which correspond to items of bill of quantities. Unit rates are explained in Section 8.4.

(2) Indirect Cost

The indirect cost on the project is an integral part for estimate. "Site expense", "Overhead and profit" and parts of "Preparatory and Temporary works" ("General" in items of bill of quantities and payment) are considered as the indirect cost.

"Site expense" includes the cost items such as staffing, site office expenses, consumables, small tools and insurance for laborers at a site. **Fifteen (15) %** of direct costs of each payment item are adopted.

"Overhead and Profit" includes the cost items such as home office support, profit and insurance at head office. **Ten (10) %** of the sum of the direct costs of each payment item and site expense is adopted.

"Site expense" and "Overhead and Profit" are added in unit costs of payment items.

"Preparatory and Temporary works" includes countable and uncountable items, direct cost and indirect cost, such as temporary buildings, electrical facilities, water supply system, construction and maintenance for access road, investigation and temporary utilities. These costs for each payment item are added up as countable cost or appropriated as percentage. Lump sum for each facilities, system and maintenance is adopted referring to similar and recent projects or quotation by private firms through formal inquiry letters.

8.2.3 Conditions of Project Cost Estimate

(1) Price Level and Foreign Exchange Rate

The cost estimate is made on the price level as of **the end of July 1999**, since the cost data of materials, laborers, equipment and other necessary items for the cost estimate are collected in this period. The foreign exchange rate applied to the cost estimate is **US$ 1.0 = Rp. 6,885** and **¥1.0 = Rp. 60.39** of the International Banking Rate at that time.

(2) Currency Component

The project cost is divided into the foreign currency components representing the and indirect foreign currencies and local currency component. The local currency for cost estimate is expressed in Rupiah currency. Moreover, the pure foreign and the indirect foreign currencies and total cost are expressed in Rupiah after exchanging from Yen, US$ or Other Currencies to Rupiah. The pure foreign currency, indirect foreign currency and local currency comprise the following items respectively:

Pure Foreign Currency (Rp.) : Cost of wage for foreign engineer and foreman,

(1) Base cost of all components for construction plants and heavy equipment except local mechanic, maintenance, repairing, fuel and laborer costs,

(2) Cost of imported materials and Cost of materials that are produced in Indonesia by Foreign-Indonesian joint enterprise with the capital of the foreign firm which occupy more then 10% of the share.

Indirect Foreign Currency (Rp.) : Cost of foreign portion of local materials and Cost of foreign portion of equipment produced in Indonesia.

Local Currency (Rp.) : Cost of per diem portion for foreign personnel,
Cost of local laborers,
Cost of local portion of local materials,

Cost of local portion of equipment produced in Indonesia, and
Inland transportation cost exclusive of foreign portions

Refer to Section 8.3 for further details.

8.3 Basic Cost

The basic costs are estimated as unit rates for basic laborer, material and equipment costs.

8.3.1 Condition of Currency Component

The basic costs are estimated in terms of pure and indirect foreign currencies and local currency. The constitution of currency component is explained below.

(1) Laborer Cost

The laborer cost is computed as local currency portion in the cost estimate. The foreign laborer wage is computed as pure foreign and local currencies taking into account the annual income, airfare and living allowance, etc.

(2) Material Cost

Materials are counted as local currency portion and indirect or pure foreign currency portion taking account into their usage of imported raw or processed materials, costs of production facilities and amount imported as a pure or indirect foreign currency. The price ratios of some material groups divided into every portion are listed in Table 8.3.1.

(3) Equipment Cost

The currency component of the operation cost of the equipment is taking account into the following currency portion.

Pure Foreign Currency (Rp.) : Hourly depreciation costs,
Spare parts and foreign mechanic costs for repairing, and
Parts of annual management costs

Indirect Foreign Currency (Rp.) : Foreign portion of local material such as

		tire, fuel, etc.
Pure Local Currency (Rp.)	:	Local mechanic cost for repairing, Local laborer for repairing, and Parts of annual management costs.

8.3.2 Basic Cost of Laborer

The List of Construction Material Unit Cost in Semarang by DPU, April-May 1999/2000 (hereinafter referred to as "DPU Cost Table") ("Daftar Harga Satuan Bahan Bangunan), as well as survey in the Semarang City, are referred for the basic costs of laborer. The costs of laborer wages are shown in Table 8.3.2 including the laborer's all fringe benefits, such as vacation and sick leave, charge of insurance, living allowance and others according to the Labor Law in Indonesia.

8.3.3 Basic Cost of Material

Prices of materials required for the construction works are canvassed from DPU Cost Table, some cost reports published periodically and domestic market price survey as well as Japanese market price (refer to Chapter 6 Reference Material).

Table 8.3.3 shows basic costs of materials divided into each currency portion.

8.3.4 Basic Cost of Equipment

The costs of equipment are reached by the calculation measure of Japanese Construction Equipment Society as well as the measure of Technical Guide of Cost Analysis & Unit Price of Work in Semarang, Bina Marga 1995. The equipment cost for the work consists of the hourly depreciation cost, repairing cost, annual management cost and operator wage for operating, which are calculated by using a rate of delivered cost, proper economical life and repairing rate in Indonesia.

Hourly driving equipment cost calculated is shown in Table 8.3.4.

8.3.5 Reference Book

The following reference books are referred for the estimate of the basic costs:

No.	Data in Indonesia		Data in Japan
	Indonesian Word	English Word	
1	Daftar Harga Satuan Bahan Bangunan, DPU	The list of Construction Material Unit Price, DPU	
2	Jurnal Bahan Bangunan, Konstruksi dan Interior	Journal of Building & Iterior	
3	Petunjuk Teknik Analisa Biaya dan Harga Stuan Pekerjaan Kabupaten, Bina Marga 1995	Technical Guide of Cost Analysis & Unit Price of Work in Semarang, Bina Marga 1995	
4			Construction Equipment/Machine Catalogue in Japan
5			Depreciation Calculation Table by Japanese Construction Equipment Society
6			Journal of Cost Estimate, July 1999

8.4 Unit Rates for Work Items and Unit Costs for Payment Items

Based on the basic costs mentioned in the preceding chapter, unit rates for work items and unit costs for payment items will be calculated in the manner mentioned hereinafter.

8.4.1 Unit Rate

It is important for estimate of unit rates, such as excavation by an excavator, or concreting works by m^3, etc. to decide production rates. Most of production rates are quoted from Japanese and Indonesian Standard. Japanese standard rates are utilized in case of construction works by using equipment for weir, bridge, dredging, earth works and so on. On the other hand, Indonesian Standard rates are utilized in case of construction by manpower mainly, such as building, masonry works and etc. The summary of unit rates is enumerated in Table 8.4.1.

8.4.2 Unit Cost for Payment Item

(1) General

As described in Fig. 8.2.1, an unit cost for a payment item consists of basic costs, unit rates and their production rates.

The other conditions for the estimates of unit costs are as follows:

(a) Quotation

Quotations of electrical and mechanical facilities for pumping facilities and gates are asked to private firms for certainty.

(b) Mobilization and Demobilization

Based on the construction schedule established in "Volume VI Construction Planning", numbers of mobilization and demobilization of equipment for cost estimates are counted. The results, which are adopted to the unit costs for payment items, of the number of trailer, track and vessel for mobilization and demobilization are summarized in Tables 8.4.2 and 8.4.3.

(2) Amount of Unit Costs for Payment Items

The unit costs for payment items, which are tabulated in the Volume IV, Work Quantity Calculation, in three (3) packages are broken dawn into basic costs and unit rates with construction base costs in Tables 8.5.1 to 8.5.3.

8.4.3 Reference Book

In addition to the reference book enumerated in Sub-section 8.3.5, the following books/materials are referred to for computation of unit rates and costs.

No.	Data in Indonesia		Data in Japan
	Indonesian Word	English Word	
1	Dasar Penyusunan Anggaran Biaya Bangunan	Standard of Building Cost Estimate	
2			Standards Outline of Production Rate for Construction (1998)
3			Manual for Cost Estimate Standard for Civil Work by Ministry of Construction (1999)
4			Construction Equipment/Machine Catalogue in Japan
5			Standard of Cost Estimate for Civil Work by Ministry of Construction (1999)

8.5 Project Cost

8.5.1 Construction Schedule

To estimate the project cost, construction schedule is most important factor in terms of price escalation, depreciation cost of equipment and/or temporary facilities, running cost of site office and so on. Therefore the construction schedules of three (3) packages which were established in Volume VI Construction Planning, are confirmed hereafter. The schedule are prepared under the assumption that the project implementation starts at the beginning of 2001 with arrangement such as tendering, contract and etc. in 2000. The project is completed until the end of 2003. The schedules of main items are assumed as follows (refer to Volume VI Construction Planning);

<u>Package-1 (the West Floodway/Garang River Improvement)</u>

1. West Floodway : Feb. 2001 – Mar. 2001
2. Garang River : Apr. 2001 – Oct. 2003

Package-2 (Simongan Weir Reconstruction)

1. Preparation Works : Feb. 2001 – Mar. 2001
2. Construction : Apr. 2001 – Oct. 2003
3. Relocation of Existing Weir : Apr. 2001 – Nov. 2001

Package-3 (Raising Existing Railway Bridge)

1. Raising of Main Bridge : Apr. 2002 – Jun. 2002
2. Truck Work : Apr. 2002 – Oct. 2002
3. Other Facilities : Apr. 2001 – Sep. 2002

8.5.2 Project Cost

(1) Construction Base Cost

Based on the unit costs for each payment item, construction base costs of three (3) packages are computed respectively as follows:

(a) Package-1: Improvement of West Floodway and Garang River

Payment items and the work quantities for Package-1 are indicated in Table 8.5.1. Soil and masonry works account for main item in this package. Specially speaking, dredging works are implemented in payment item "Excavation below Water Level" (B.2.1).

(b) Package-2: Reconstruction of Simongan Weir

Payment items and the work quantities for Package-2 are indicated in Table 8.5.2. The main purpose of this package is reconstruction of the Simongan Weir. Therefore, the major items are concrete and gate works including furnishing and installation. In addition to concrete and gate, another main works are to dismantle existing weir for preservation of historical structure. Specially, when the existing structure is cut into some hundred blocks for transportation, new technology named "Wire Saw Method" is utilized for smooth cutting. It is necessary for implementation of the work to use special equipment and engineers.

(c) Package-3: Raising of Railway Bridge

Payment items and the quantities for Package-3 are indicated in Table 8.5.3. There are also particular works undertaken with maintaining regular operation of train. Therefore, the one of the most important work is the temporary work as well as Bridge Work from the cost's points of view.

(1) Total Construction Base Cost

The results of calculation of the construction base cost are summarized in the following table.

Name of Package	Currency	Construction Base Cost			
		Pure Foreign Portion	Indirect Foreign Portion	Pure Local Portion	Total
Package-1 (the West Floodway/Garang River Improvement)	Rp x 10^6	52,579	3,343	47,600	103,521
Package-2 (Simongan Weir Reconstruction)	Rp x 10^6	61,201	3,632	24,128	88,960
Package-3 (Raising Existing Railway Bridge)	Rp x 10^6	5,804	838	9,871	16,514
Total	Rp x 10^6	119,583	7,813	81,599	208,995
	Yen x 10^6	1,980	129	1,351	3,461
	US$ x 10^3	17,369	1,135	11,852	30,355

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

(2) Engineering Service Cost

The total man-month of foreign engineer has been assumed at 79 man-months for 1 year of preliminary term and 3 years for construction works in which package-1, 2 and 3 are undertaken. In addition, local engineer remuneration, international and local transportation fee, salary for office staff and establishment and etc. are summed up. The summary of the engineering service cost are tabulated below (refer to Tables 8.5.4) :

Name of Package	Currency	Engineering Service Cost			
		Pure Foreign Portion	Indirect Foreign Portion	Pure Local Portion	Total
Three (3) packages in Total	Rp x 10^6	11,950	0	6,220	18,170
	Yen x 10^6	198	0	103	301
	US$ x 10^3	1,736	0	903	2,639

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

(3) Compensation Cost

Some hectare of land areas and three (3) houses/buildings should be expropriated for construction. Unit compensation costs were decided as below under the results of consultation between the Jratunseluna and the Study Team;

Land : 25,000 Rp/m^2

Building : 30,000,000 Rp/house

5.0 ha of land acquisition and 3 units of house evacuation are necessary to be compensated in the three (3) packages.

The total compensation cost is shown in the following table (refer to Table 8.5.5);

Name of Package	Currency	Compensation Service Cost (million rupiah/yen)			
		Pure Foreign Portion	Indirect Foreign Portion	Pure Local Portion	Total
Three (3) packages in Total	Rp x 10^6	0	0	710	710
	Yen x 10^6	0	0	12	12
	US$ x 10^3	0	0	103	103

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

(4) Administration Cost

As described in Sub-Section 8.2.1 Basic Composition of Project Cost, the administration cost for owner's expenditures is estimated as local portion at seven (7) % of the sum of construction base cost and the compensation cost. The amount of administration cost is as follows;

Name of Package	Currency	Administration Cost (million rupiah)			
		Pure Foreign Portion	Indirect Foreign Portion	Pure Local Portion	Total
Three (3) packages in Total	Rp x 10^6	0	0	14,679	14,679
	Yen x 10^6	0	0	243	243
	US$ x 10^3	0	0	2,132	2,132

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

(5) Physical Contingency

Physical contingency is considered as local portion at six (6) % of the sum of the construction base cost, engineering service cost and the compensation cost.

Name of Package	Currency	Physical Contingency (million rupiah)			
		Pure Foreign Portion	Indirect Foreign Portion	Pure Local Portion	Total
Three (3) packages in Total	Rp x 10^6	7,892	469	5,312	13,673
	Yen x 10^6	131	8	88	226
	US$ x 10^3	1,146	68	771	1,986

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

(6) Price Contingency

Based on the construction period and construction schedule described in Section 5.1 Construction Schedule, price contingency are computed at three (3) % of the foreign currecy portion and eight (8) % of the local portion respectively. Table 8.5.6 shows summary of price contingency between years 2000 and 2003.

Name of Package	Currency	Price Contingency (million rupiah)			
		Pure Foreign Portion	Indirect Foreign Portion	Pure Local Portion	Total
Three (3) packages in Total	Rp x 10^6	11,867	735	24,886	37,489
	Yen x 10^6	197	12	412	621
	US$ x 10^3	1,724	107	3,615	5,445

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

(7) Value Added Tax

Value added tax is considered as local portion at ten (10) % of the sum of the construction base cost and engineering service cost including physical and price contingencies. The amount of value added tax is shown in the following table.

Name of Package	Currency	Value Added Tax (million rupiah)			
		Pure Foreign Portion	Indirect Foreign Portion	Pure Local Portion	Total
Three (3) packages in Total	Rp x 10^6	0	0	27,554	27,554
	Yen x 10^6	0	0	456	456
	US$ x 10^3	0	0	4,002	4,002

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

8.5.3 Total Project Cost

Total project cost, which is summed up aforementioned items, is as follows;

Project Cost of Package-1

Name of Package	Currency	Project Cost (million rupiah)			
		Pure Foreign Portion	Indirect Foreign Portion	Local Portion	Total
Construction Base Cost	Rp x 10^6	52,579	3,343	47,600	103,521
Engineering Service Cost	Rp x 10^6	5,253	0	3,627	8,880
Compensation Cost	Rp x 10^6	0	0	710	710
Administration Cost	Rp x 10^6	0	0	7,373	7,373
Physical Contingency	Rp x 10^6	3,470	201	3,116	6,787
Price Contingency	Rp x 10^6	5,201	311	14,506	20,017
Value Added Tax	Rp x 10^6	0	0	13,756	13,756
Total	Rp x 10^6	66,502	3,854	90,688	161,044
	Yen x 10^6	1,101	64	1,502	2,667
	US\$x10^3	9,659	560	13,172	23,391

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

Project Cost of Package-2

Name of Package	Currency	Project Cost (million rupiah)			
		Pure Foreign Portion	Indirect Foreign Portion	Local Portion	Total
Construction Base Cost	Rp x 10^6	61,201	3,632	24,128	88,960
Engineering Service Cost	Rp x 10^6	6,117	0	1,838	7,955
Compensation Cost	Rp x 10^6	0	0	0	0
Administration Cost	Rp x 10^6	0	0	6,116	6,116
Physical Contingency	Rp x 10^6	4,039	218	1,558	5,815
Price Contingency	Rp x 10^6	6,089	344	7,469	13,901
Value Added Tax	Rp x 10^6	0	0	11,566	11,566
Total	Rp x 10^6	77,445	4,193	52,675	134,313
	Yen x 10^6	1,282	69	872	2,224
	USx10^3$	11,248	609	7,651	19,508

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

Project Cost of Package-3

Name of Package	Currency	Project Cost (million rupiah)			
		Pure Foreign Portion	Indirect Foreign Portion	Local Portion	Total
Construction Base Cost	Rp x 10^6	5,804	838	9,871	16,514
Engineering Service Cost	Rp x 10^6	580	0	755	1,335
Compensation Cost	Rp x 10^6	0	0	0	0
Administration Cost	Rp x 10^6	0	0	1,190	1,190
Physical Contingency	Rp x 10^6	383	50	638	1,071
Price Contingency	Rp x 10^6	578	81	2,912	3,570
Value Added Tax	Rp x 10^6	0	0	2,231	2,231
Total	Rp x 10^6	7,345	969	17,597	25,912
	Yen x 10^6	122	16	291	429
	USx10^3$	1,067	141	2,556	3,764

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

Total Project Cost of Three Packages

Name of Package	Currency	Project Cost (million rupiah)			
		Pure Foreign Portion	Indirect Foreign Portion	Local Portion	Total
Construction Base Cost	Rp x 10^6	119,583	7,813	81,599	208,995
Engineering Service Cost	Rp x 10^6	11,950	0	6,220	18,170
Compensation Cost	Rp x 10^6	0	0	710	710
Administration Cost	Rp x 10^6	0	0	14,679	14,679
Physical Contingency	Rp x 10^6	7,892	469	5,312	13,673
Price Contingency	Rp x 10^6	11,867	735	24,886	37,489
Value Added Tax	Rp x 10^6	0	0	27,554	27,554
Total	Rp x 10^6	151,292	9,017	160,961	321,270
	Yen x 10^6	2,505	149	2,665	5,320
	USx10^3$	21,974	1,310	23,379	46,662

Note ; Conversion Rate : US$ 1.0 = Rp. 6,885, ¥ 1.0 = Rp. 60.39

8.5.4 Disbursement Schedule

Based on the Project Cost estimates, disbursement schedule of total project costs is indicated as Table 8.5.7.