during flood is anticipated, motor driving by commercial power source is generally adopted. In case of short annual running hours expected in a remote place where commercial electric power is not available, diesel engine drive is usually selected. In this project, even though reliable electric power source is available, motor driving by commercial power source and diesel engine generator is adopted considering the reliability of power supply at the time of storm and the importance of the area to be protected.

Approximate output for main motor and diesel engine generator are as follows:

PUMPING STATION	PUMP UNIT CAPACITY (m3/s)	PUMP TOTAL HEAD (m)	MOTOR OUTPUT (kW)	OUTPUT OF DIESEL GENERATOR (kVA)
P1	0.4	3.4	22	150
P2	2.85	4.4	200	700
P3	1.0	4.4	75	400

Other Major Equipment

The other major equipment required for the installation, operation and maintenance works of the pumps are summarized as follows:

(a) Additional pump for daily small discharge

(b) Traveling overhead crane (manual trolley type)

(c) High/low tension electric panel

(d) Bar screen (manual raking type)

(e) Butterfly/flap valve

(2) Civil Works

The pumping station mainly consists of pump house, sand basin, and outlet structure. The typical design of proposed pumping stations are shown in Figs. X.3.5 to X.3.7.

Pump House

The pump house is basically divided into substructure and superstructure. Substructure, which consists mainly of pump pit, cooling water tank and fuel tank, is constructed with reinforced concrete and supported by prestressed concrete (PC) pile foundation. Superstructure, constructed of reinforced concrete, is designed to have enough space and functions for pump/motor room, electrical/control room, workshop and so on.

Sand Basin

The sand basin, constructed of reinforced concrete, is proposed in front of pump pit to promote the sedimentation of bed load and suspended load in the flowing water. The length of the basin is set at 10 m and width is set to keep the width of pump pit.

Outlet Structure

The outlet structure is designed as reinforced concrete structure with top elevation higher than the earth dike. The bottom elevation is designed to be able to install the outlet pipe with a flap valve below LWL of the river side.

To ensure stability, PC pile foundation is employed.

Gate Structure

The gate structures proposed in Bandarharjo East, Bandarharjo West and Asin River Basin are designed to control the discharge of the secondary drainage channel. Reconstruction of the existing gate structure located in Baru River is proposed to regulate the inflow volume from Semarang River at 6.0 m^3/s.

The slide gate type is employed for these gate structures in due consideration of easy operation, and prompt and precise water stop. The basic structure which should be designed with reinforced concrete is composed of floor slab supported with PC pile foundation, piers and operation deck. To cope with the scouring of riverbed, gabion mattress is provided in front of the gate structures. The typical design of gate structures are presented in Figs. X.3.8 to X.3.11.

Regarding the gate structure proposed in Bandarharjo West Area, a sluiceway is proposed at the downstream side of gate structure to conduct the drainage water to Semarang River through the earth dike. The typical section of the sluiceway is shown in Fig. X.3.12.

Retarding Basin

The retarding basins are provided beside the pumping station to reduce the pump capacity. The major structures in the retarding basin are revetment or retaining wall, overflow section and drain ditch.

The overflow section composed of bar screen, operation bridge and inlet slope is placed at the boundary of drainage channel and retarding basin to control the inflow water from drainage channel. To protect the retarding basin bed from the scouring by inflow water, gabion mattress and/or apron concrete is provided. The typical sections of overflow section are shown in Fig. X.3.13.

The drain ditch is spread in bed to take in the seepage water from surroundings and lead it to the pumping station. This is designed to be a trapezoidal shape with 1:0.33 slope lined with stone masonry. The typical section of drain ditch is shown in Fig. X.3.14.

Regarding the retarding basins proposed in Bandarharjo West and Asin River Basin, the revetment (Type F) is employed on the slope for retaining, erosion control and seepage flow stop. On the other hand, gravity type and inverted T-shaped retaining wall is adopted for the retarding basin proposed in Bandarharjo East. The typical section of gravity type retaining wall is presented in Fig. X.3.14.

Open Channel

In due consideration of structural and economical aspects and easiness of land acquisition and house evacuation, the following four (4) types of open channel are proposed:

(1) Type A

This trapezoidal shape open channel is applied from the mouth of Semarang River upto Layur Bridge (2.35 km from the mouth). The crown width and freeboard of the dike are designed as

5.0 m and 0.6 m, respectively. The side slope gradient on both landside and riverside is set in 1:2 (1.0 vertical to 2.0 horizontal).

(2) Type D

This rectangular shape open channel is employed at all secondary drainage channels and a part of Semarang River (from Layur Bridge up to Railway Bridge). Retaining wall with vertical inner slope is provided at inner sides of channel. This wall is designed as gravity type stone masonry structure supported by log pile foundation. To cope with the scouring, the bottom of wall should be embedded 1.0 m from the channel bed.

(3) Type F

This type is applied from Railway Bridge (2.85 km from the mouth of Semarang River) up to Pandanaran Culvert (6.88 km from the mouth) where the rectangular shape channel (Type D) is existing and excavation of channel bed is required to keep sufficient flow sectional area. Proposed channel bed elevation is calculated from 5-year return period. Considering the bottom elevation of existing retaining wall, the foot protection, which was proposed in Master Plan for 10-year return period, is not applied at this stage.

(4) Type G

Type G is rectangular shape open channel and proposed at Baru River along the proposed retarding basin of Bandarharjo East.

This channel mainly consist of gravity type retaining wall at the left bank and inverted T-shaped retaining wall at the right bank. The gravity type retaining wall is constructed of stone masonry and supported with log pile foundation. The inverted T-shaped retaining wall is designed as reinforced concrete structure with concrete sheet pile and log pile foundation. The major purpose of this concrete wall is to partition Baru River efficiently, and to stop seepage.

The typical sections of proposed open channels are shown in Fig. X.3.15.

Related Structures

(1) Revetment

To prevent scouring and seepage, the following three (3) types of revetment shown in Fig. X.3.16 are proposed.

Type D consists of cobblestone pitching, backfill gravel and base concrete supported with log piles. This type is designed for sections where there is a great impact of running water along the open channel (Type A). The revetment is applied up to high water level and slope gradient is set at 1:2 (1.0 vertical to 2.0 horizontal).

Type E is employed at slope of open channel (Type A) where the retarding basin is adjacent across the inspection road. The structural composition of Type E is the same as Type D except the base concrete which is supported with concrete sheet pile instead of log pile.

Type E is also applied up to high water level and the slope gradient is set at 1:2.

Type F is applied to peripheral slope of retarding basin. Although the slope gradient is set at 1:1, the structural composition is basically the same as Type E. This revetment should cover the slope up to the ground elevation.

(2) Bridge

Considering the existing condition and proposed channel improvement plan, reconstruction of road bridge in Asin River is proposed. From economical and structural aspects, PC made simple girder type is recommended for superstructure. Abutments are designed as reinforced concrete structure with PC pile foundation to ensure the stability of the substructure.

The typical design of proposed bridge is shown in Fig. X.3.17.

CHAPTER 4 URGENT PROJECT

4.1 General

The urgent project study was carried on West Floodway/Garang River, and basic planning for flood control was proposed in due consideration of existing flood conditions (refer to SECTOR V, FLOOD CONTROL PLAN).

In line with the above planning, the preliminary design was conducted on objective structures identified as urgent project. Proposed works are summarized in Table X.4.1 and X.4.2.

4.2 Flood Control Plan

4.2.1 Basic Design Concept

The following basic design concepts, criteria and standards are applied to all the related structures in the Urgent Project.

(1) Proposed structures are designed based on a structural plan of 25-year return period.

(2) The Design Criteria for Irrigation Structures prepared by Directorate General of Water Resources Development, Ministry of Public Works, Government of Indonesia is applied.

(3) The Technical Standard for River and Sabo Facilities prepared by the Ministry of Construction, Government of Japan is applied.

(4) In designing structures, locally based structural materials are used as much as possible.

(5) Structures are designed in consideration of previous and ongoing flood control plans.

(6) Review and re-evaluation of existing main riparian structures are done.

4.2.2 Preliminary Design for Optimum Plan

Structural design is carried out for the following flood control structures for the optimum plan.

(1) Earth dike

Earth dike is applied for sections where enough right-of-way or easy land acquisition is expected. The crown width of the dike and the slope gradient are designed to keep sufficient section for stability and assurance against seepage. To assure the safety of the dike against flood flow, freeboard of 1.0 m against a 25-year return period flood is provided. The riverside slope of earth dike is to be partly covered with revetment or sodding for erosion control.

The standard design of earth dike is shown in Fig. X.4.1.

(2) Revetment

To prevent scouring of dike slope, three (3) types of revetment shown in Fig. X.4.1 are proposed, namely:

(a) Type A

This is for high water channel revetment and should cover the slope of earth dike from foot up to high water level. The revetment consist of concrete block with joint mortal and backfill gravel, supported by base concrete. Base concrete should be embedded deep enough to cope with the scouring.

(b) Type B

This is for low water channel revetment and employed at zones where there is a great impact of running water. Structural composition of revetment is the same as Type A. To prevent scouring of riverbed and high water channel terrace, gabion mattress is provided at the foot and top of revetment.

(c) Type C

This revetment is to be provided at the downstream of Simongan Weir to protect the steep slope. The revetment consists of concrete block, backfill concrete and backfill gravel, supported by base concrete. The base concrete should be embedded deep enough to cope with the scouring.

(3) Retaining wall

Five (5) types of retaining wall shown in Fig. X.4.2 are proposed, namely:

(a) Type A

This is a concrete gravity wall with log foundation piles, and will be constructed to replace the existing retaining wall which does not have any foundation and enough embedment depth. To assure the safety of the wall against flood flow, freeboard of 1.0 m against a 25-year return period flood is adopted.

(b) Type B

This wall is of reinforced concrete and attached to the existing concrete gravity wall which have log foundation piles. Freeboard of 1.0 against a 25-year return period flood is adopted.

(c) Type C and Type D

These are L-shaped retaining walls with PC pile foundation 0.4 m in diameter. These walls are provided for the new Simongan Weir and the intake structures which require large scale retaining wall, approximately 6 to 10 m high above the riverbed.

(d) Type E

This wall consists of concrete sheet piles and PC piles driven in parallel and connected with each other by tie-rod beams. In consideration of the present scouring of riverbed, gabion mattress is to be provided at the front of the sheet pile. This type of wall is to be applied

at the upstream and downstream sides of the intake facilities of PDAM.

(4) Groundsill

There are two (2) types of groundsill, namely, with head and without head. Groundsill with head is proposed to moderate the bed slope for stabilization of the riverbed. This type is composed of a main body of reinforced concrete and apron made of gabion mattress to cope with scouring. In addition, concrete sheet piles are provided underneath of the main body to block seepage flow and scouring.

Groundsills without head are proposed at the downstream side of the Toll Road Bridge in Garang River and the points where tributaries join Garang River to maintain the existing riverbed elevation. This type consist of a main body of reinforced concrete and gabion mattress.

Standard designs of groundsills are shown in Fig. X.4.3.

(5) Simongan Weir

Reconstruction of the existing fixed type Simongan Weir to a movable weir with gates is proposed from the evaluation of the existing weir. A general view of the existing Simongan Weir is shown in Fig. X.4.7.

(a) Comparative Study on Gate Type

To select the most suitable gate type for the reconstruction of Simongan Weir, the

following four (4) alternatives are proposed:

Alternative 1: Roller Gate
Alternative 2: Radial Gate
Alternative 3: Rubber Gate
Alternative 4: Tilting Gate

The standard design of each alternative is illustrated in Fig. X.4.4.

Comparative study is made from various viewpoints as shown in Table X.4.3. Through the above study, roller gate is selected as the optimum type.

(b) Structural Design of New Simongan Weir

In consideration of the required upstream water level to be maintained, the proposed river section and the technical aspects, three (3) main gates 19.2 m in span length and 4.1 m in gate height, and two (2) flushing gates 6.6 m in span length and 4.1 m in gate height are adopted.

PC piles are adopted for the foundation at the footing slab of pier to transmit the weight of upper structures to the supporting layer.

Concrete sheet piles are also provided for the purpose of seepage and scouring control. At the upstream and downstream sides of piers, reinforced concrete apron with reinforced concrete (RC) piles, concrete apron blocks and gabion mattress are provided to prevent riverbed scouring.

A bridge is provided for both purposes of inspection and maintenance of gates and for the public. PC composite girder type is employed for the bridge.

(6) Intake structures

The intake structures at the right bank of Semarang River and the left bank of the irrigation channel are also designed for reconstruction. The type of gates and structures is determined based on not only the hydraulic dimensions but also the gate function. Considering the above requirements, the slide gate is employed. The basic structure is composed of floor slab with RC piles, operation deck, wing and parapet walls, and L-shaped concrete wall with PC piles. Major dimensions are shown is Fig. X.4.4.

(7) Railroad bridge

A railroad bridge is presently located 3.6 km from the river mouth. The bridge is to be reconstructed to have a clearance of 1.0 m above the high water level of a 25-year return period flood, because the present clearance of 30 cm is too small.

Major dimensions of the bridge are decided as shown in Fig. X.4.5 in consideration of the existing bridge dimensions and proposed river section.

From the structural consideration and economical aspect, steel structural warren truss type is employed for the superstructure

of the bridge. To ensure the stability of the bridge piers and abutments, PC pile foundation is employed.

(8) Flap gate

Some of the outlets of the existing drainage culverts along West Floodway/Garang River are equipped with wooden flap gates, and other culverts are not equipped with flap gates. Since the wooden flap gates attached to the existing culverts do not function well due to overage, these flap gates are to be replaced with aluminum flap gates. Aluminum flap gates are also to be installed at culverts without flap gates to prevent reverse flow to the landside area. The standard design is given in Fig. X.4.6.

TABLES

Table X.2.1 SUMMARY OF PROPOSED URBAN DRAINAGE STRUCTURES

Channel	Length (m)	Drainage Channel						Pump Station (place)	Gate Structure (place)	Bridge/Culvert		Inspection Road (m)
		Type-A (m)	Type-B (m)	Type-C (m)	Type-D (m)	Type-E (m)	Type-F (m)			Road (place)	Railway (place)	
(Eastern Semarang Area)												
Siringin	9,220	6,120	-	3,100	-	-	-	-	-	4	-	18,440
Tenggang	13,700	4,350	-	7,900	1,450	-	-	-	-	12	2	24,500
Total	22,920	10,470	0	11,000	1,450	0	0	0	0	16	2	42,940
(Central Semarang Area)												
Semarang	8,970	-	2,350	850	-	-	5,770	3	1	8	1	4,700
Asin	1,300	-	-	1,300	-	-	-	-	-	3	-	0
Banger	6,680	2,090	-	3,460	-	1,130	-	-	-	14	2	11,100
Bulu	1,750	-	-	1,750	-	-	-	-	-	5	-	3,500
Total	18,700	2,090	2,350	7,360	0	1,130	5,770	3	1	30	3	19,300
(Western Semarang Area)												
Ronggolawe	3,250	-	-	2,250	-	1,000	-	-	-	4	1	4,500
Karangayu	2,680	-	-	1,100	-	1,580	-	-	-	4	1	2,200
Tawang	1,200	-	-	-	-	1,200	-	-	-	3	-	0
Silandak	850	-	-	850	-	-	-	-	-	-	1	1,700
Total	7,980	0	0	4,200	0	3,780	0	0	0	11	3	8,400
(Kec.Tugu Area)												
Tambakharjo	1,550	1,250	-	300	-	-	-	-	-	1	1	3,100
Buntu	2,200	1,600	-	600	-	-	-	-	-	-	1	4,400
Jumbleng	2,700	2,000	-	700	-	-	-	-	-	-	1	5,400
Tugurejo	3,200	2,600	-	600	-	-	-	-	-	-	1	6,400
Tapak	3,900	2,400	-	1,500	-	-	-	-	-	-	1	7,800
Boom Karanganyar	3,100	3,100	-	-	-	-	-	-	-	-	1	6,200
Randugarut	3,800	3,400	-	400	-	-	-	-	-	-	1	7,600
Mangkang Wetan	4,600	4,150	-	450	-	-	-	-	-	1	1	9,200
Mangkang Kulon	4,150	3,750	-	400	-	-	-	-	-	1	1	8,300
Total	29,200	24,250	0	4,950	0	0	0	0	0	3	9	58,400

* Details of drainage channels are shown in Tables VI.6.4(2) and VI.6.4(3).

Table X.2.2(1/2) PROPOSED CHANNEL IMPROVEMENT WORKS

Channel No.		Required Hydraulic Section WbxWuxH (mxmxm)	Drainage Channel Type-A (m)	Type-B (m)	Type-C (m)	Type-D (m)	Type-E (m)	Type-F (m)	Land Acquisition (m2)
(Eastern Semarang Area)									
Siringin	Sr-9	40.0x50.4x2.6	1,500	-	-	-	-	-	54,900
	Sr-8	40.0x50.4x2.6	1,370	-	-	-	-	-	69,185
	Sr-6	13.0x14.6x2.4	-	-	2,200	-	-	-	43,692
	Sr-5	13.0x14.6x2.4	-	-	900	-	-	-	17,154
	Sr-3	9.0x17.0x2.0	1,650	-	-	-	-	-	40,095
	Sr-2	9.0x16.2x1.8	1,600	-	-	-	-	-	43,200
	Sub-total		6,120	0	3,100	0	0	0	268,226
Tenggang	Te-14	49.0x59.4x2.6	2,250	-	-	-	-	-	40,530
	Te-13	33.0x43.4x2.6	2,100	-	-	-	-	-	172,800
	Te-11	21.0x22.7x2.6	-	-	2,250	-	-	-	67,410
	Te-6	10.0x11.6x2.4	-	-	2,550	-	-	-	16,218
	Te-5	13.5x13.5x2.6	-	-	-	1,450	-	-	21,315
	Te-3	8.5x10.1x2.4	-	-	1,550	-	-	-	11,408
	Te-2	7.5x9.0x2.2	-	-	1,550	-	-	-	23,653
	Sub-total		4,350	0	7,900	1,450	0	0	353,334
	Total		10,470	0	11,000	1,450	0	0	621,560
(Central Semarang Area)									
Semarang	A-A'	29.2x37.0x2.6	-	310	-	-	-	-	0
	A'-B	29.2x37.0x2.6	-	310	-	-	-	-	899
	Sm-8	18.8x26.6x2.6	-	1,120	-	-	-	-	112
	Sm-7	18.8x26.6x2.6	-	610	-	-	-	-	3,410
	Sm-6	20.0x20.0x2.5	-	-	-	-	-	150	-
	Sm-5	20.0x20.0x2.5	-	-	-	-	-	600	-
	Sm-4	18.0x18.0x2.5	-	-	-	-	-	1,370	-
	Sm-3	13.0x13.0x1.9	-	-	-	-	-	1,020	-
	Sm-2	8.0x8.0x1.9	-	-	-	-	-	1,380	-
	Sm-1	3.4x4.0x0.9	-	-	850	-	-	-	-
	D-K	5.5x5.5x2.0	-	-	-	-	-	1,250	-
	Sub-total		0	2,350	850	0	0	5,770	4,421
Asin	As-2	16.3x18.0x2.6	0	0	1,300	0	0	0	-
Banger	Ba-8	28.8x39.2x2.6	1,400	-	-	-	-	-	840
	Ba-7	28.8x39.2x2.6	690	-	-	-	-	-	15,318
	Ba-6	23.3x25.0x2.6	-	-	560	-	-	-	11,906
	Ba-5	18.4x20.0x2.4	-	-	1,250	-	-	-	20,950
	Ba-4	13.5x15.0x2.3	-	-	-	-	550	-	-
	Ba-3	10.6x12.0x2.1	-	-	1,150	-	-	-	21,574
	Ba-2	6.6x8.0x2.1	-	-	500	-	580	-	6,880
	Sub-total		2,090	0	3,460	0	1,130	0	77,468
Bulu	Bu-4	3.5x4.5x1.5	-	-	275	-	-	-	3,289
	Bu-3	2.2x3.2x1.5	-	-	500	-	-	-	5,980
	Bu-2	1.7x2.6x1.3	-	-	450	-	-	-	5,562
	Bu-1	1.1x2.0x1.3	-	-	525	-	-	-	5,387
	Sub-total		0	0	1,750	0	0	0	20,218
	Total		2,090	2,350	7,360	0	1,130	5,770	102,106
(Western Semarang Area)									
Ronggolawe	Rg-5	16.0x17.4x2.1	-	-	450	-	500	-	6,147
	Rg-4	9.0x10.3x2.0	-	-	1,300	-		-	18,928
	Rg-3	3.5x4.8x2.0	-	-	-	-	500	-	-
	Rg-2	3.0x4.3x2.0	-	-	500	-	-	-	3,630
	Sub-total		0	0	2,250	0	1,000	0	28,705
Karangayu	Kr-4	10.5x11.8x2.0	-	-	800	-	700	-	13,248
	Kr-3	4.0x5.3x2.0	-	-	-	-	380	-	-
	Kr-2	3.5x4.8x2.0	-	-	300	-	500	-	2,178
	Sub-total		0	0	1,100	0	1,580	0	15,426
Tawang	Twe-3	7.5x8.9x2.1	-	-	930	-	-	-	-
	Twe-2	3.0x4.3x2.0	-	-	270	-	-	-	-
	Sub-total		0	0	1,200	0	0	0	0
Silandak	Si-2	7.0x8.0x1.5	0	0	850	0	0	0	14,671
	Total		0	0	5,400	0	2,580	0	58,802

Table X.2.2(2/2) PROPOSED CHANNEL IMPROVEMENT WORKS

Channel No.		Required Hydraulic Section WbxWuxH (mxmxm)	Drainage Channel Type-A (m)	Type-B (m)	Type-C (m)	Type-D (m)	Type-E (m)	Type-F (m)	Land Acquisition (m2)
(Kec.Tugu Area)									
Tambak-	Tam-2	10.0x18.0x2.0	1,250	-	-	-	-	-	-
harjo	Tam-1	4.0x5.3x2.0	-	-	300	-	-	-	-
	Sub-total		1,250	0	300	0	0	0	-
Buntu	Bun-3	15.0x23.0x2.0	1,600	-	-	-	-	-	-
	Bun-2	6.5x7.8x2.0	-	-	600	-	-	-	-
	Sub-total		1,600	0	600	0	0	0	-
Jumbleng	Jum-3	10.0x18.0x2.0	1,000	-	-	-	-	-	-
	Jum-2	10.0x18.0x2.0	1,000	-	-	-	-	-	-
	Jum-1	7.2x8.5x2.0	-	-	700	-	-	-	-
	Sub-total		2,000	0	700	0	0	0	-
Tugurejo	Tug-3	9.0x19.4x2.6	1,300	-	-	-	-	-	-
	Tug-2	9.0x19.4x2.6	1,300	-	-	-	-	-	-
	Tug-1	6.0x7.4x2.1	-	-	600	-	-	-	-
	Sub-total		2,600	0	600	0	0	0	-
Tapak	Tap-4	12.0x22.4x2.6	1,300	-	-	-	-	-	-
	Tap-3	12.0x22.4x2.6	1,100	-	-	-	-	-	-
	Tap-2	6.5x8.0x2.3	-	-	1,500	-	-	-	-
	Sub-total		2,400	0	1,500	0	0	0	-
Boom ka-	Boka-3	21.0x31.4x2.6	1,700	-	-	-	-	-	-
ranganyar	Boka-2	21.0x31.4x2.6	1,400	-	-	-	-	-	-
	Sub-total		3,100	0	0	0	0	0	-
Randugarut	Ran-3	27.0x37.4x2.6	1,800	-	-	-	-	-	-
	Ran-2	27.0x37.4x2.6	1,600	-	-	-	-	-	-
	Ran-1	13.3x15.0x2.6	-	-	400	-	-	-	-
	Sub-total		3,400	0	400	0	0	0	-
Mangkang	Mawe-3	12.0x22.4x2.6	2,200	-	-	-	-	-	-
Wetan	Mawe-2	10.0x20.4x2.6	1,950	-	-	-	-	-	-
	Mawe-1	8.3x10.0x2.6	-	-	450	-	-	-	-
	Sub-total		4,150	0	450	0	0	0	-
Mangkang	Maku-3	20.0x30.4x2.6	1,850	-	-	-	-	-	-
Kulon	Maku-2	18.0x28.4x2.6	1,900	-	-	-	-	-	-
	Maku-1	10.0x20.4x2.6	-	-	400	-	-	-	-
	Sub-total		3,750	0	400	0	0	0	-
	Total		24,250	0	4,950	0	0	0	-

Table X.3.1 PROPOSED URBAN DRAINAGE WORKS

Item	Unit	Bandarharjo West	Asin River Basin	Bandarharjo East	Semarang River	Baru River	Total
1. Pumping Station	m3/s	0.80	5.70	2.00	-	-	8.50
2. Gate Structure	place	1	1	1	-	1	4
3. Retarding Pond	ha	0.84	2.67	0.93	-	-	4.44
4. Channel Improvement							
(1) Open Channel (Type-A)	m	-	-	-	2,350	-	2,350
(2) Open Channel (Type-D)	m	800	1,300	700	500	300	3,600
(3) Open Channel (Type-F)	m	-	-	-	4,020	-	4,020
(4) Open Channel (Type-G)	m	-	-	-	-	500	500
5. Related Structures							
(1) Revetment (Type-D)	m2	-	-	-	9,529	-	9,529
(2) Revetment (Type-E)	m2	-	-	-	2,840	-	2,840
(3) Bridge	place	-	1	-	-	-	1
(4) Inspection Road	m2	3,246	20,050	5,600	25,500	6,400	60,796
6. Land Acquisition	m2	13,680	35,150	2,100	-	-	50,930
7. House Evacuation	unit	-	82	-	-	-	82

Table X.3.2 DESIGN CONDITIONS OF PUMPING STATION AND RETARDING BASIN

Pumping Station No. *1	Drainage Area (Km2)	Discharge Capacity (m3/s)	Design Water Level *2					Static Head		Rtarding Pond		Remarks
			Outer			Inner		Design	Max.	Area	Storage Capa.	
			H.H.W.L	H.W.L	L.W.L	H.W.L	L.W.L	(m)	(m)	(ha)	(x1000m3)	
P1	0.580	0.80	0.80	0.60	-0.40	0.20	-1.80	2.40	2.60	0.84	16.71	
P2	4.252	5.70	0.80	0.60	-0.40	0.20	-2.80	3.40	3.60	2.67	79.99	
P3	1.49	2.00	0.80	0.60	-0.40	0.20	-2.80	3.40	3.60	0.93	28.03	

Note: *1 Drainage Area of each pumping station
P1.. Bandarharjo West Drainage Area
P2.. Asin River Basin Area
P3.. Bandarharjo East Drainage Area
*2 Jakarta System is adopted for Design Water Level.

Table X.3.3 GENERAL COMPARISON OF PUMP TYPE

Item \ Type	Mixed Flow Pump	Axial Flow Pump
Suction Performance (Cavitation)	Superior to Axial Flow Pump	Inferior to Mixed Flow Pump
Pump Efficiency	2% High Against Axial Flow Pump	2% Low Against Mixed Flow Pump
Pump Efficiency Curve	Gentle Curve (desirable)	Sharp Curve (undesirable)
Q-H(Head) Curve	Smooth Slope (undesirable)	Sharpe Slope (desirable) It has Stall Range
Q-L(Load) Curve	Smooth Slope (Smaller Load to Motor)	Sharp Slope (Larger Load to Motor)
Shut off Operation	Possible	Impossible

Table X.3.4 GENERAL COMPARISON OF SHAFT DIRECTION

Item \ Type	Vertical	Horizontal
Area of Pumping Station	Small	Large
Priming	Unnecessary	Necessary
Suction Performance (Cavitation)	Superior to Horizontal Pump	Inferior to Vertical Pump
Starting	Easy	Complecated
Maintenance	Complecated	Easy
Durability for Corrosion & Erosion	Inferior	Superior
Cost	Expensive	Economical

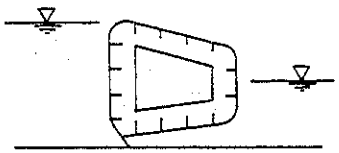
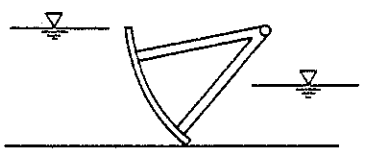
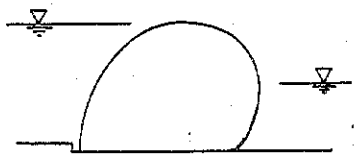
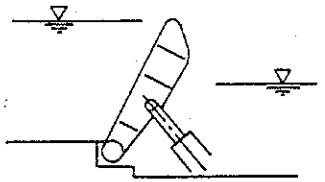
Table X.4.1 PROPOSED WORKS FOR WEST FLOODWAY

ITEM	UNIT	QUANTITY	REMARKS
1. River Improvement			
(1) Excavation (common 1)	m3	339,000	
(2) Excavation (common 2)	m3	226,000	
(3) Excavation (Riverbed)	m3	98,000	
(4) Retaining Wall (Type-A)	m	-	
(5) Retaining Wall (Type-B)	m	2,996	
2. Reconstruction of Railroad Bridge			
(1) Demolishment (Concrete)	m3	1,052	
(2) Demolishment (Steel)	L.S.	1	
(3) Excavation (common 2)	m3	11,620	
(4) Back Filling	m3	10,657	
(5) Reinforced Concrete	m3	963	
(6) P.C. Pile (ø500, L=15.0m)	p.c.	100	
(7) Superstructure	m2	488	
(8) Temporary Work	L.S.	1	
3. Flap Gate			
(1) 1.0m x 1.0m	place	2	
(2) 2.0m x 2.0m	place	11	

Table X.4.2 PROPOSED WORKS FOR GARANG RIVER

ITEM	UNIT	QUANTITY	REMARKS
1. River Improvement			
(1) Excavation (common 1)	m3	276,800	
(2) Excavation (common 2)	m3	10,200	
(3) Excavation (Riverbed)	m3	72,000	
(4) Embankment	m3	10,189	
(5) Revetment (Type-A)	m2	2,113	
(6) Revetment (Type-B)	m2	32,175	
(7) Sodding	m2	3,882	
(8) Retaining Wall (Type-A)	m	-	
(9) Retaining Wall (Type-E)	m	200	
(10) Ground Sill (Type-A)	Place	1	
(11) Ground Sill (Type-B)	Place	1	
(12) Ground Sill (Type-C)	Place	1	
(13) Ground Sill (Type-D)	Place	1	
2. Reconstruction of Simongan Weir			
(1) Demolishment	m3	12,000	
(2) Excavation (common 2)	m3	6,713	
(3) Revetment (Type-C)	m2	1,105	
(4) Sodding	m2	566	
(5) Conc. Apron Block (3t)	m2	2,828	
(6) Gabion Mattress	m2	2,020	
(7) Reinforced Concrete	m3	6,788	
(8) P.C.Pile (ø500,L=12.0m)	p.c.	216	
(9) P.C.Pile (ø400,L=12.0m)	p.c.	135	
(10) R.C.Pile (ø350,L=12.0m)	p.c.	480	
(11) Concrete Sheet Pile (t=0.2m)	m2	1,381	
(12) Gate Leaf	L.S.	1	
(13) Hoist Machine	L.S.	1	
(14) Bridge	m2	1,040	
(15) Retaining Wall (Type-C)	m	80	
(16) Retaining Wall (Type-D)	m	-	
(17) Control House	L.S.	1	
3. Intake Structure			
(1) Demolishment	m3	348	
(2) Excavation (common 2)	m3	153	
(3) Reinforced Concrete	m3	512	
(4) R.C.Pile (ø350,L=12.0m)	p.c.	60	
(5) Concrete Sheet Pile (t=0.2m)	m2	240	
(6) Gate Leaf	L.S.	1	
(7) Hoist Machine	L.S.	1	
(8) Retaining Wall (Type-C)	m	55	
(9) Retaining Wall (Type-D)	m	80	

Table X.4.3 COMPARATIVE STUDY ON GATE TYPE OF SIMONGAN WEIR

Item	Roller Gate	Radial Gate	Rubber Gate	Tilting Gate
General View				
Mechanical & Structural Character	Gate body is lifted vatically by Hoisting Device. Structure and mechanical system is so simple that reliability is high.	Gate body is lifted by Hoisting Device and turn round Trunnion Axis. Mechanical system is complicated.	Gate body is infrated by air or water. Gate body is made of synthetic rubber which is fragile against sharp edged matters. Mechanical system is simple.	Gate body is lifted by Hydraulic Hoist. Deck Slab must have a drop for the storing space.
Flood Control Ability	As gate body can be lifted upto the safety position during flood, control ability is better than other types.	Owing to the limitation of span length, the possibility of the flow blocking by driftwoods is high.	There is possibility of incomplete open by sediment or boulder stone.	(The same as left)
Control Ability of Upstream Water Level	At the time of medium and small scale flood,the upstream side water level shall be maintained at more than 5.6m.			
	Possible	Possible	Difficult	Possible
Maintenance	Inspection of gate and parts exchange is easier than Rubber and Tilting Gate. Painting should be done in every seven (7) years. Working Life: 50 years	(The same as left)	Inspection of gate and parts exchange is difficult. Painting is unneccessary. Working Life: 25 years	Inspection of gate and parts exchange is difficult. Painting should be done in every seven (7) years. Working Life: 50 years
Manufacture	Domestic manufacture in Indonesia is possible.	Though domestic manufacture in Indonesia is possible, high grade manufacturing technique is required.	Gate body should be imported from abroad.	Though domestic manufacture in Indonesia is possible, high grade manufacturing technique is required.
Civil Structure	Because of the tall pier for gate operation, foundation is large scale.	As the whole loads concentrate to Trunnion Axis, designing and construction is complicated.	As the gate weight is small, civil structure can be simple.	As the weight of the structure is smaller than other steel gate, foundation can be small scale.
Construction Cost	Aprox.18,000 Mill.Rp.	Aprox.19,100 Mill.Rp.	Aprox.18,300 Mill.Rp.	Aprox.17,900 Mill.Rp.
Evaluation	Adequate	Inadequate	Inadequate	Moderate

FIGURES

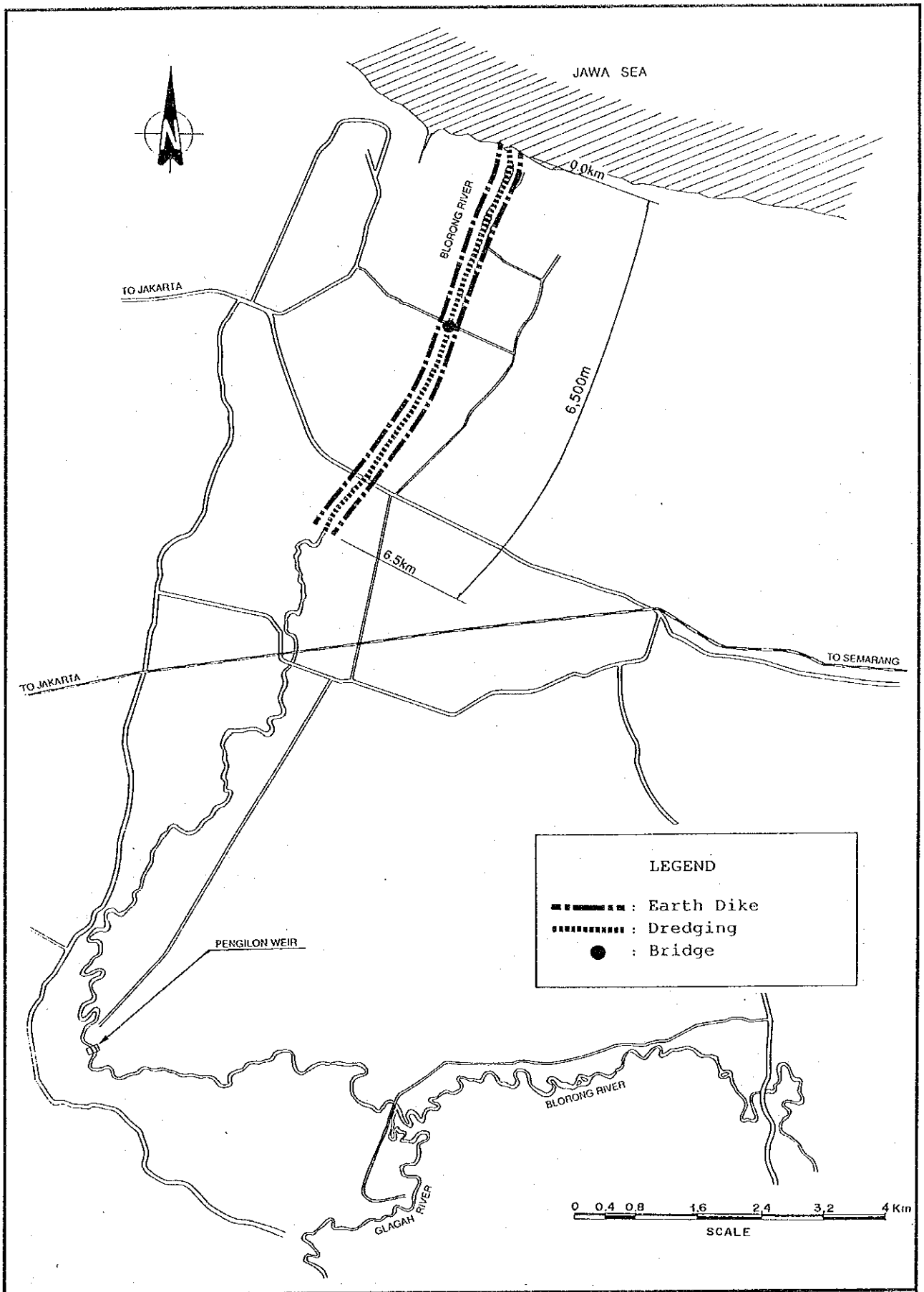


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Fig.X.2.1
PROPOSED FACILITIES FOR FLOOD CONTROL (BLORONG R.)

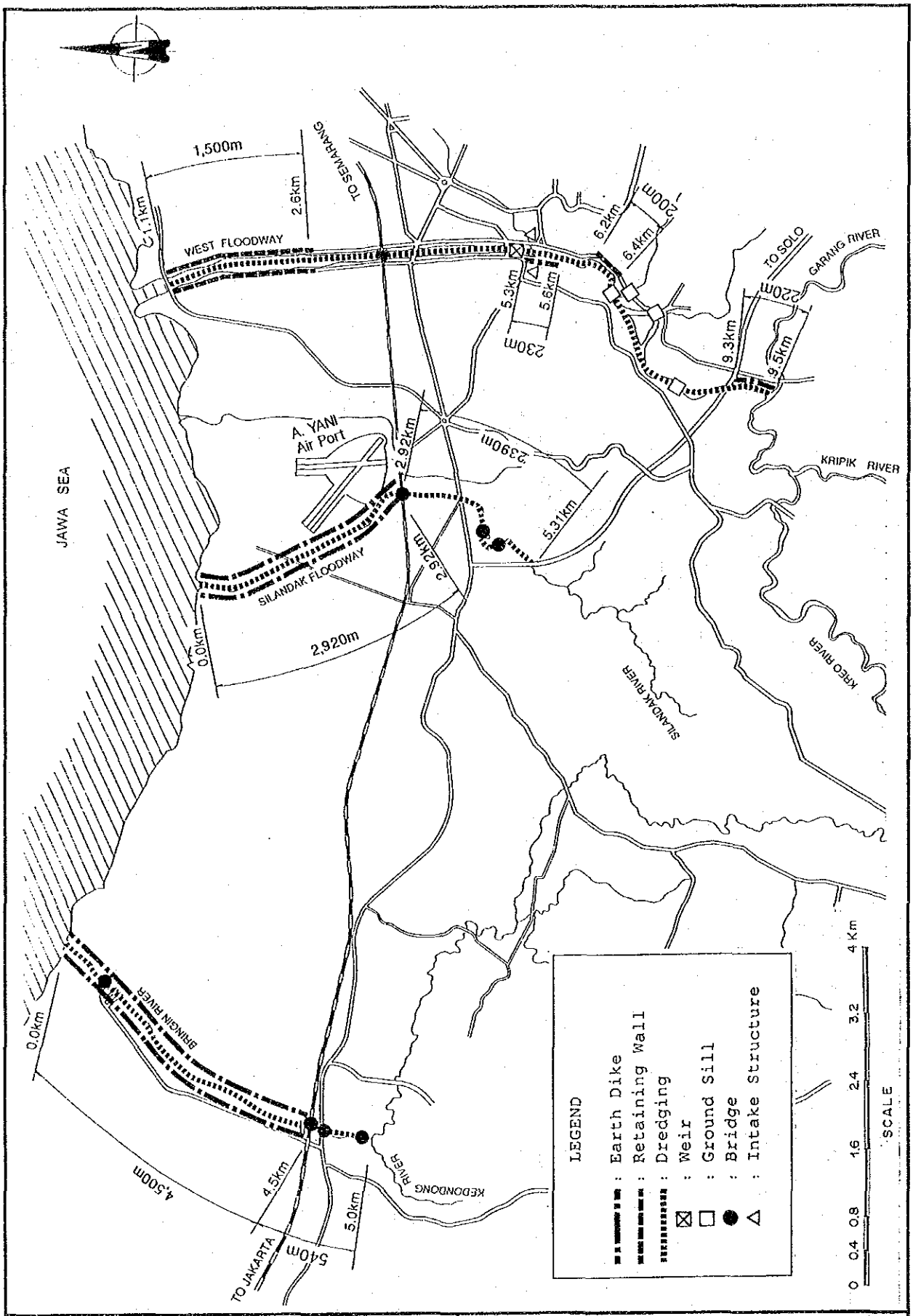

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Fig. X.2.2
PROPOSED FACILITIES FOR FLOOD CONTROL (W. FLOODWAY/GARANG R., SILANDAK R., BRINGIN R.)

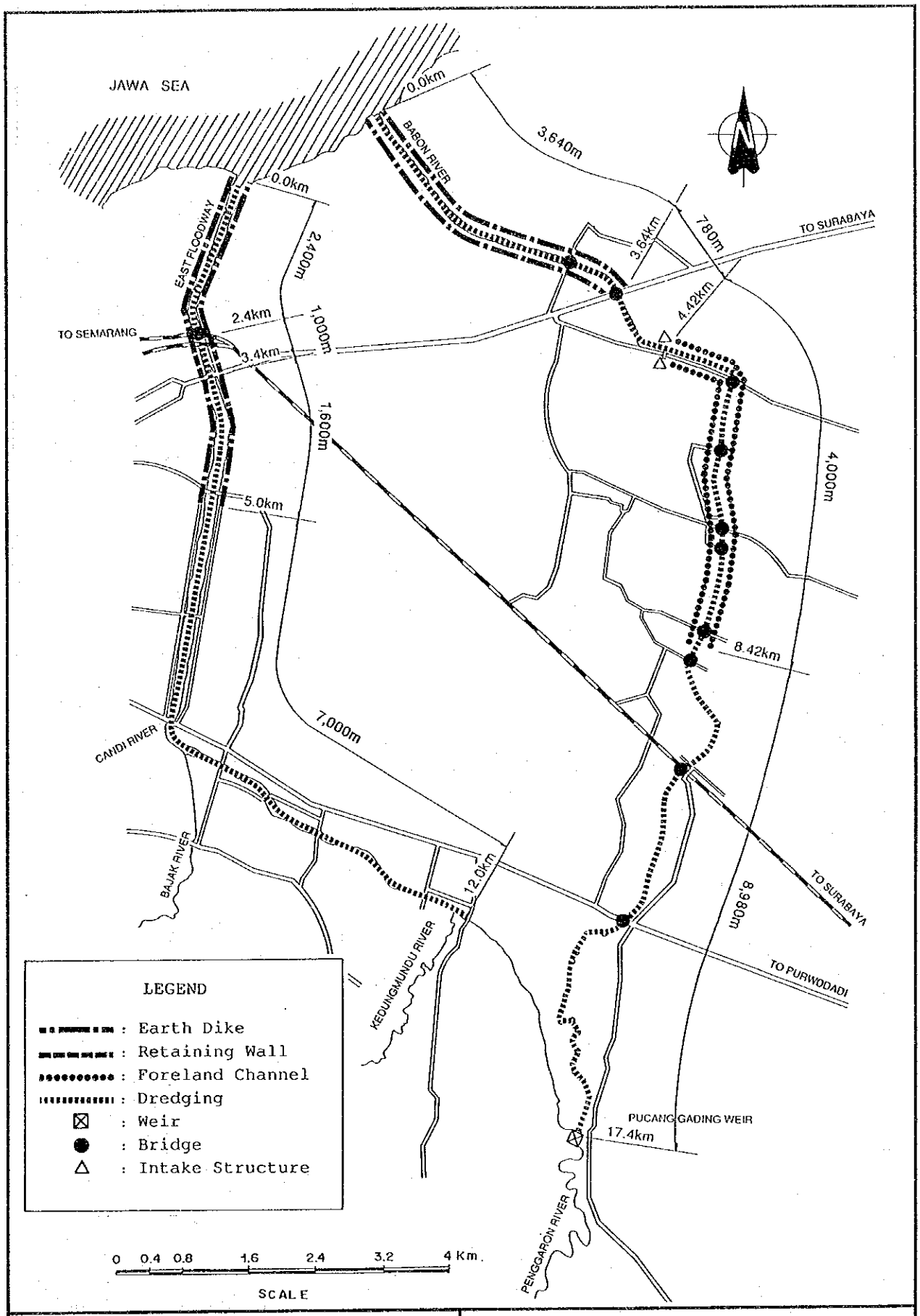

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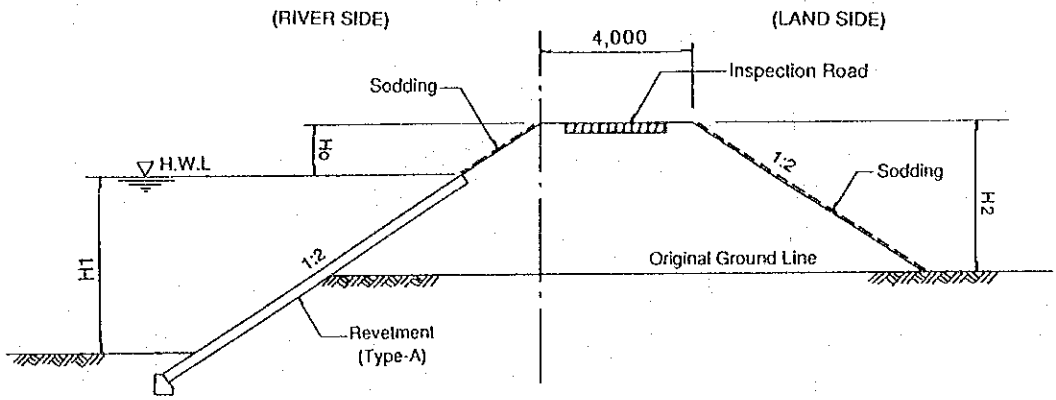
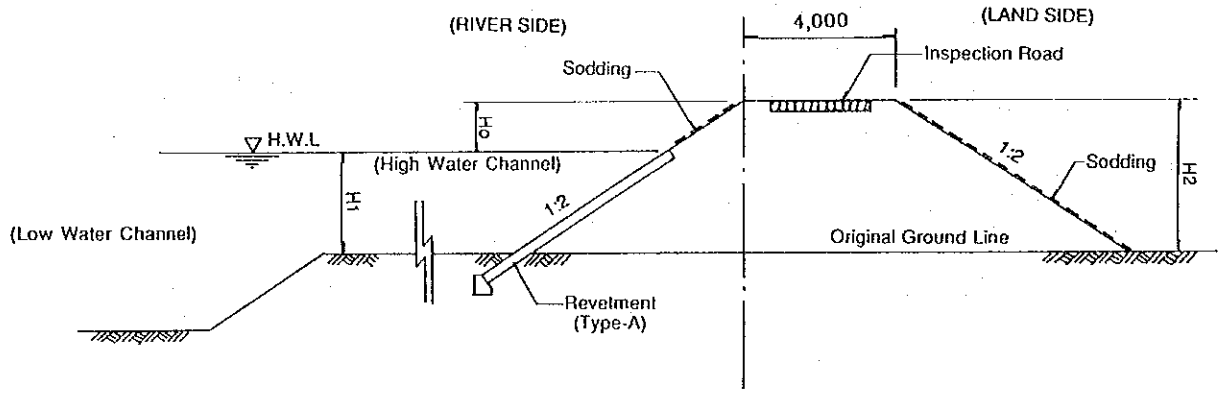
Fig.X.2.3
PROPOSED FACILITIES FOR FLOOD CONTROL
(BABON R. AND EAST FLOODWAY)



SINGLE CROSS SECTION (TYPE-A)



COMPOUND CROSS SECTION (TYPE-B)

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.2.4 TYPICAL SECTIONS OF EARTH DIKE

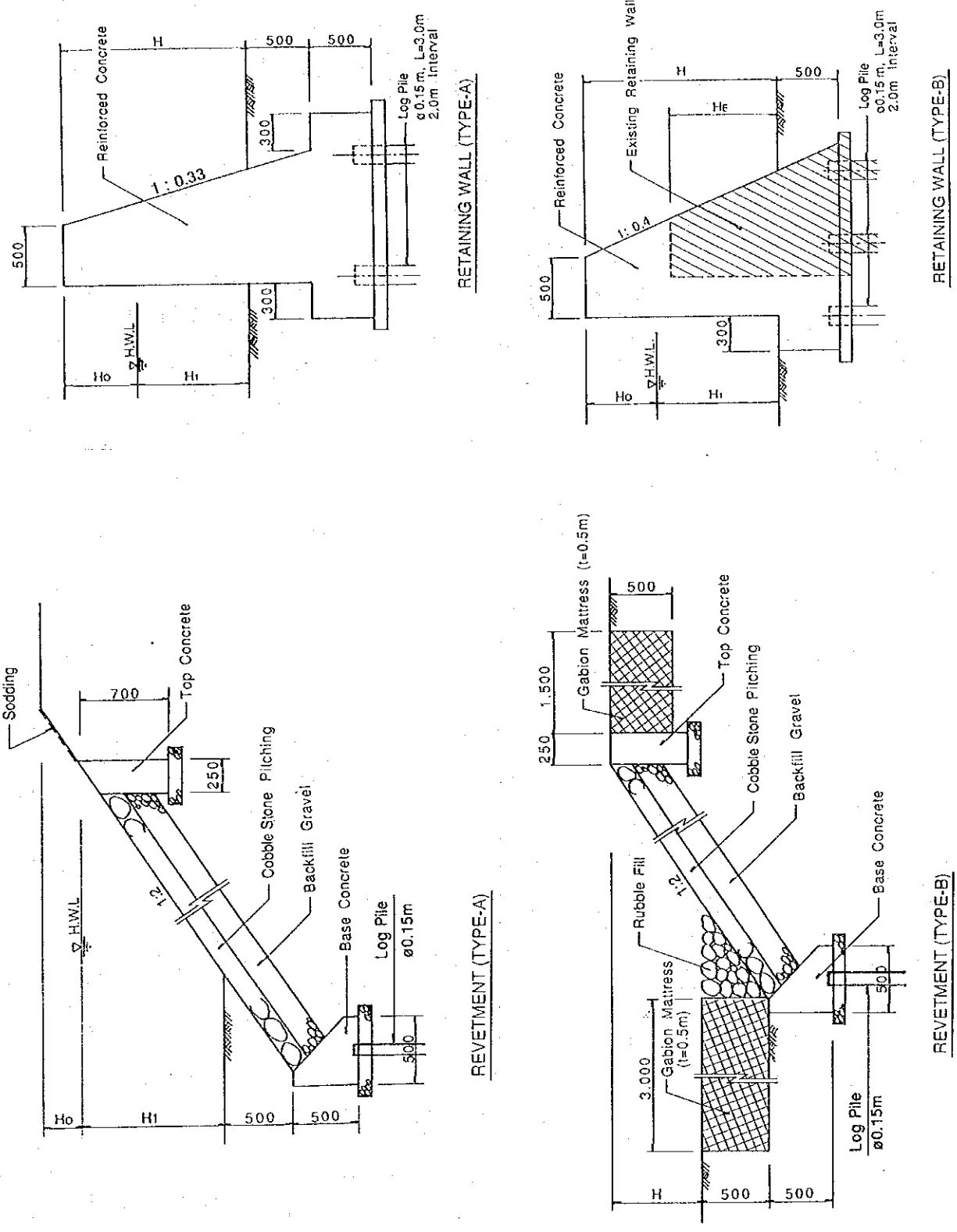


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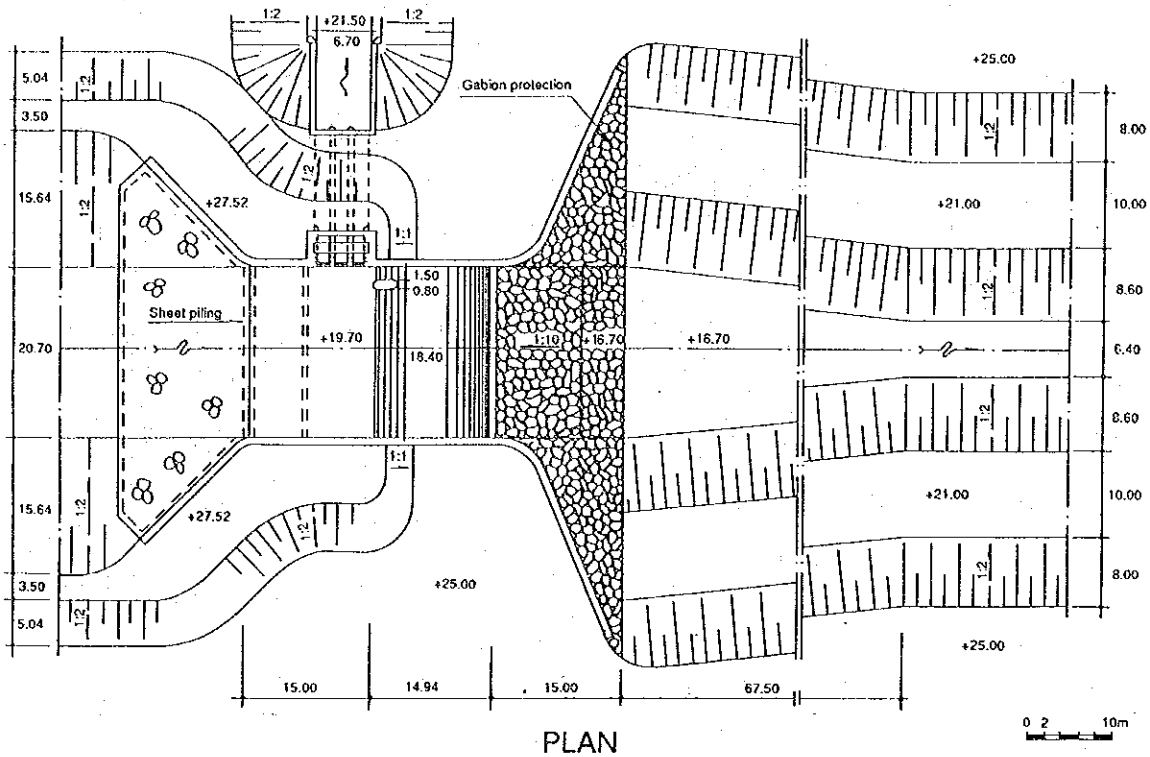
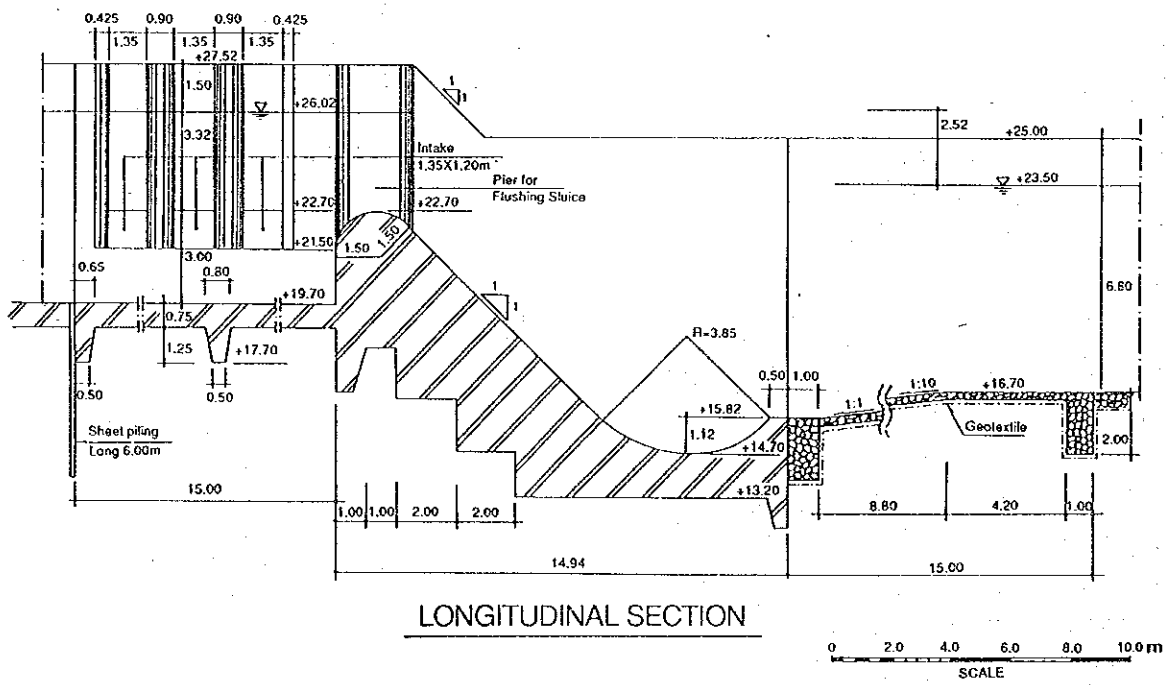
Fig.X.2.5
TYPICAL SECTIONS OF REVETMENT AND RETAINING WALL



PLAN

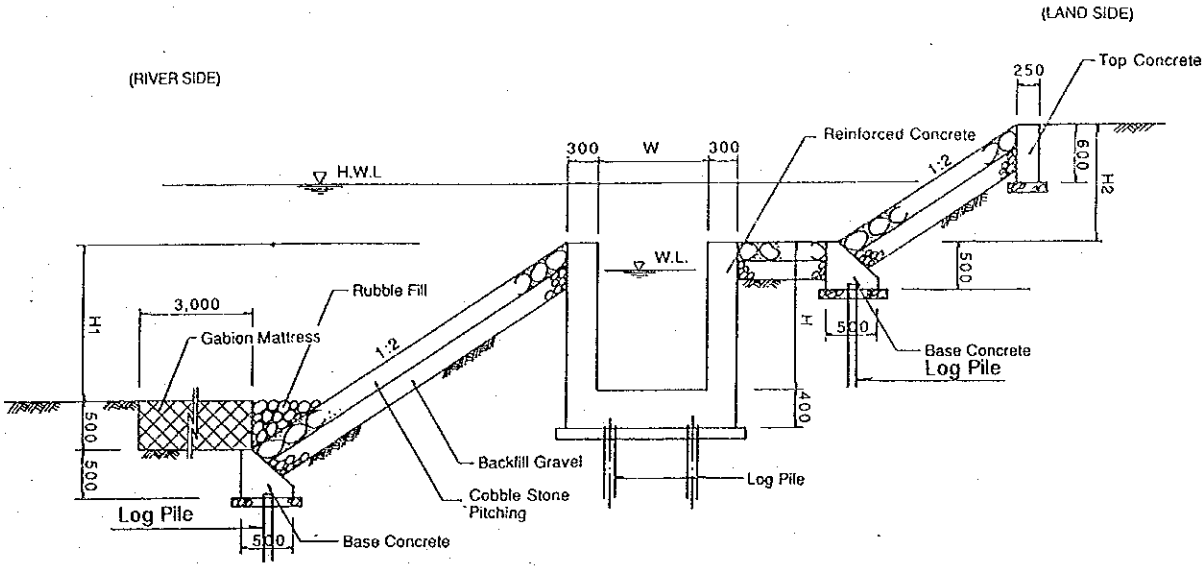


LONGITUDINAL SECTION

Source: Jratunseluna Project

* The weir width(20.7m) shall be modified to 33.4m, considering the difference of Design Scale between Jratunseluna Project and JICA Project.

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.2.6 TYPICAL DESIGN OF RECONSTRUCTION OF PUCANG GADING WEIR



Dimensions of Foreland Channel

Channel Type	Location (Km)	W (m)	H (m)
	(Babon R.)		
Type-A	4.42 ~ 5.82	2.40	1.50
Type-B	5.82 ~ 8.42	1.10	1.50

* Location is shown by distance from the mouth.

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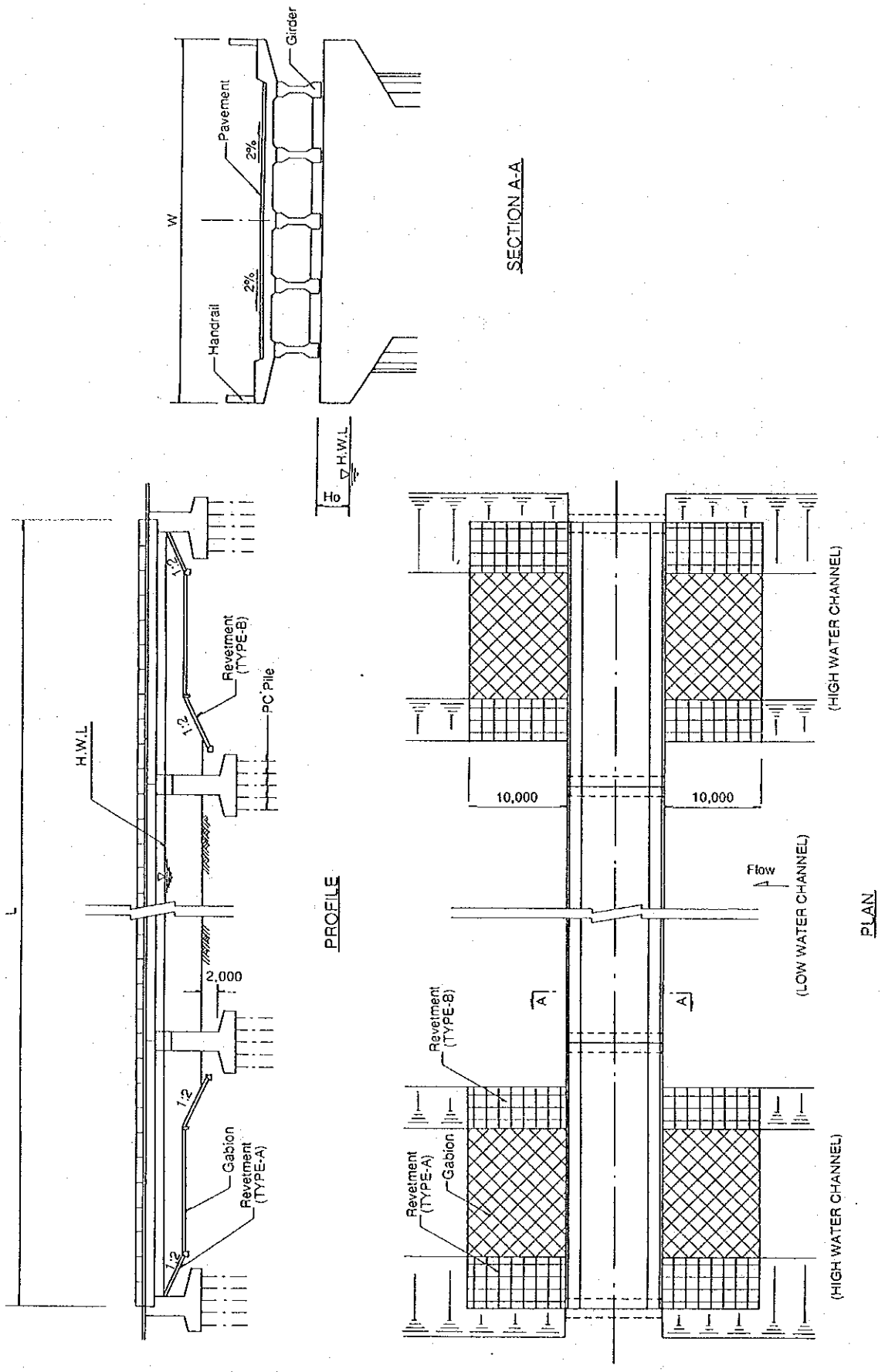
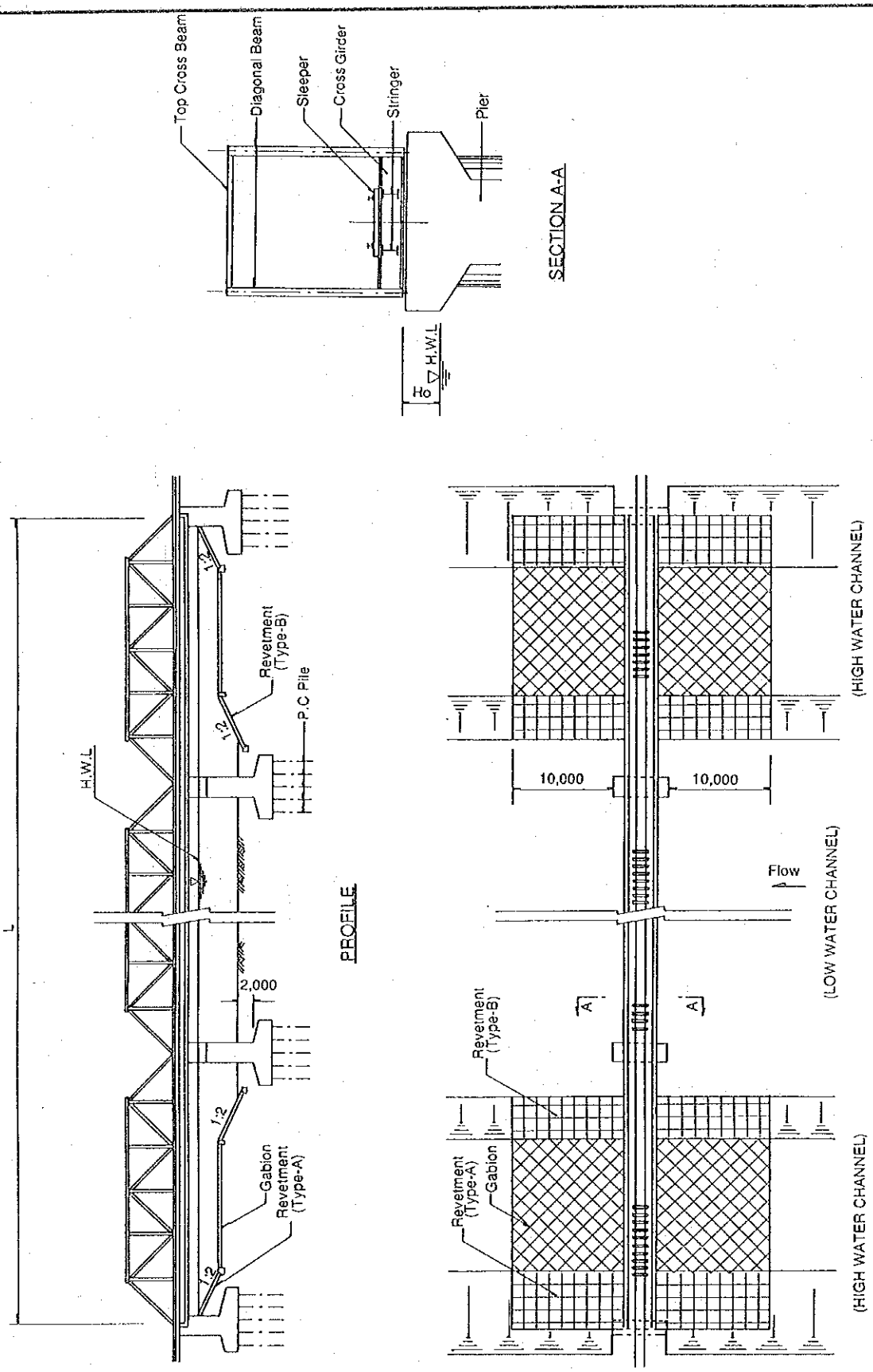
Fig.X.2.7

TYPICAL SECTION OF FORELAND CHANNEL



MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.2.8 TYPICAL DESIGN OF ROAD BRIDGE FOR RIVER IMPROVEMENT



MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.2.9 TYPICAL DESIGN OF RAILWAY BRIDGE FOR RIVER IMPROVEMENT

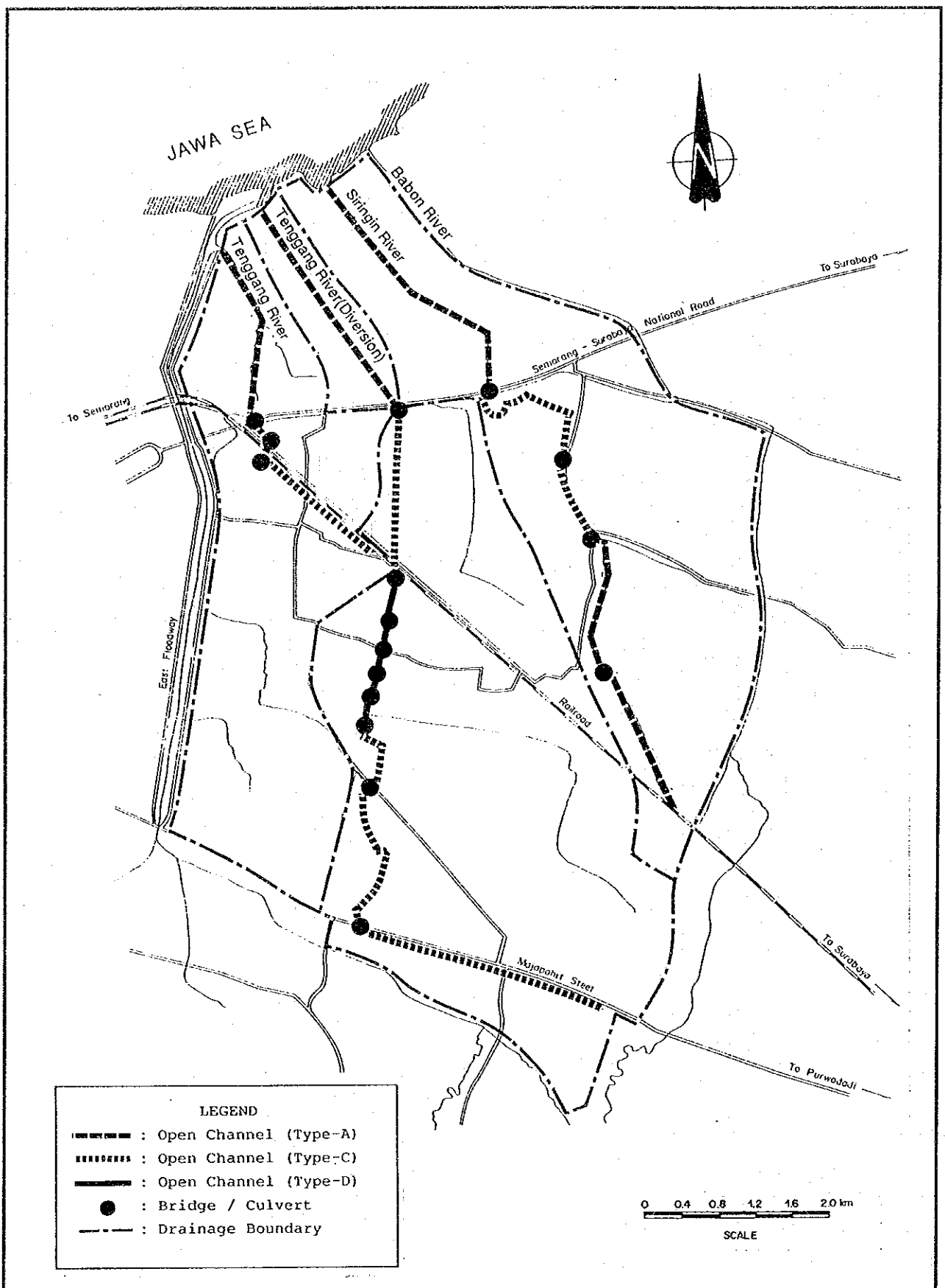


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Fig. X.2.10
PROPOSED FACILITIES FOR URBAN DRAINAGE
(EASTERN SEMARANG AREA)

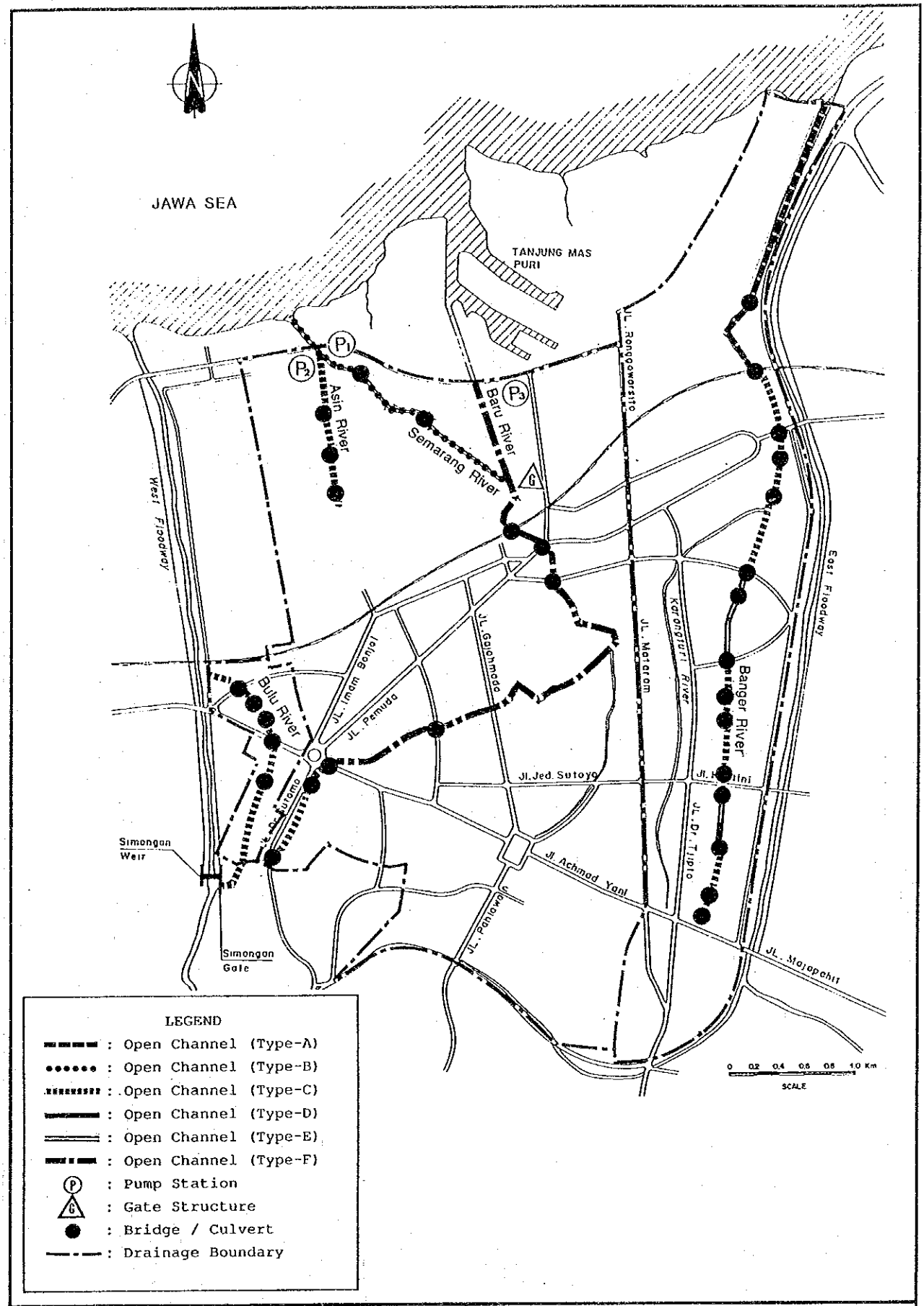

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Fig.X.2.11
PROPOSED FACILITIES FOR URBAN DRAINAGE (CENTRAL SEMARANG AREA)

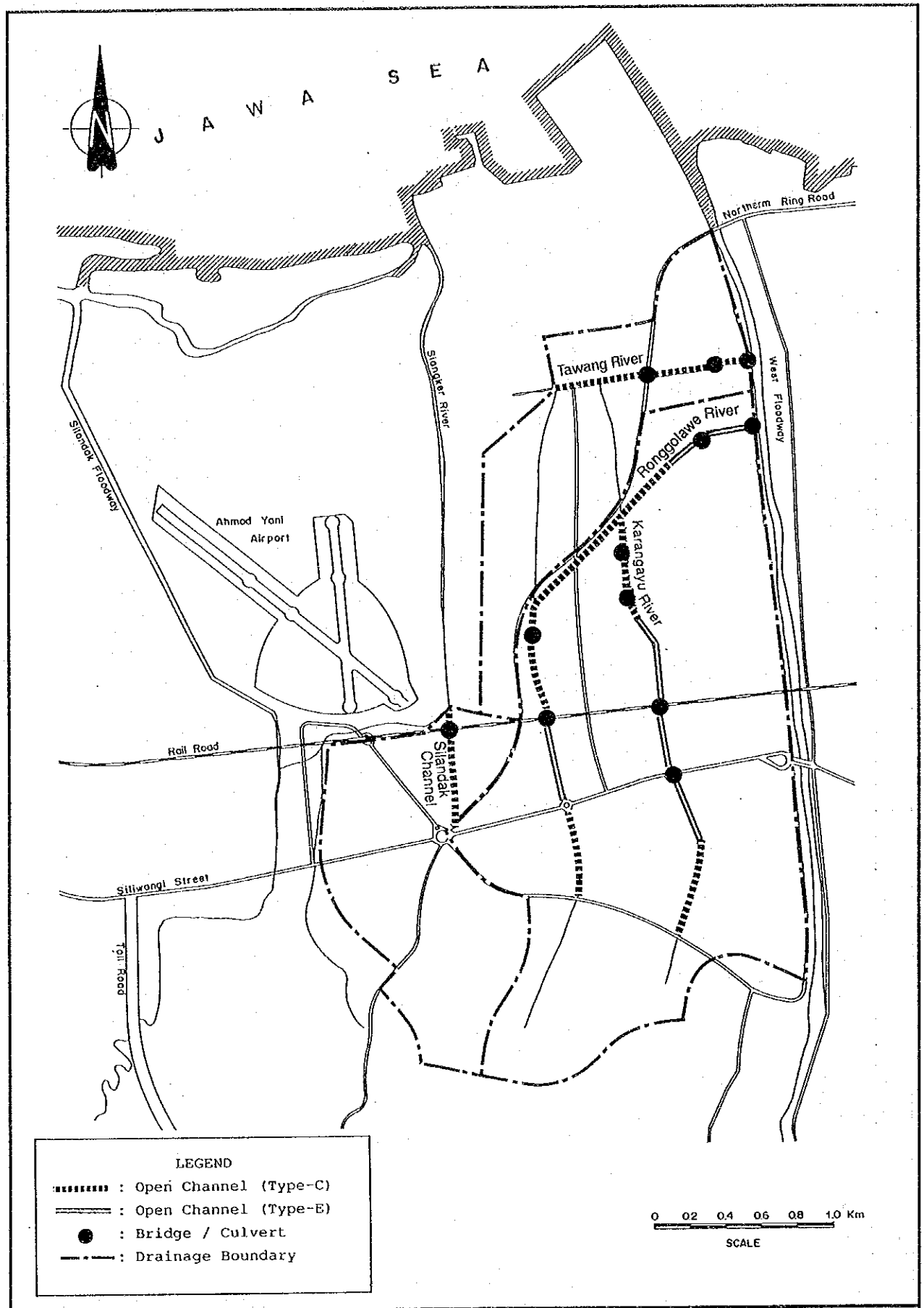

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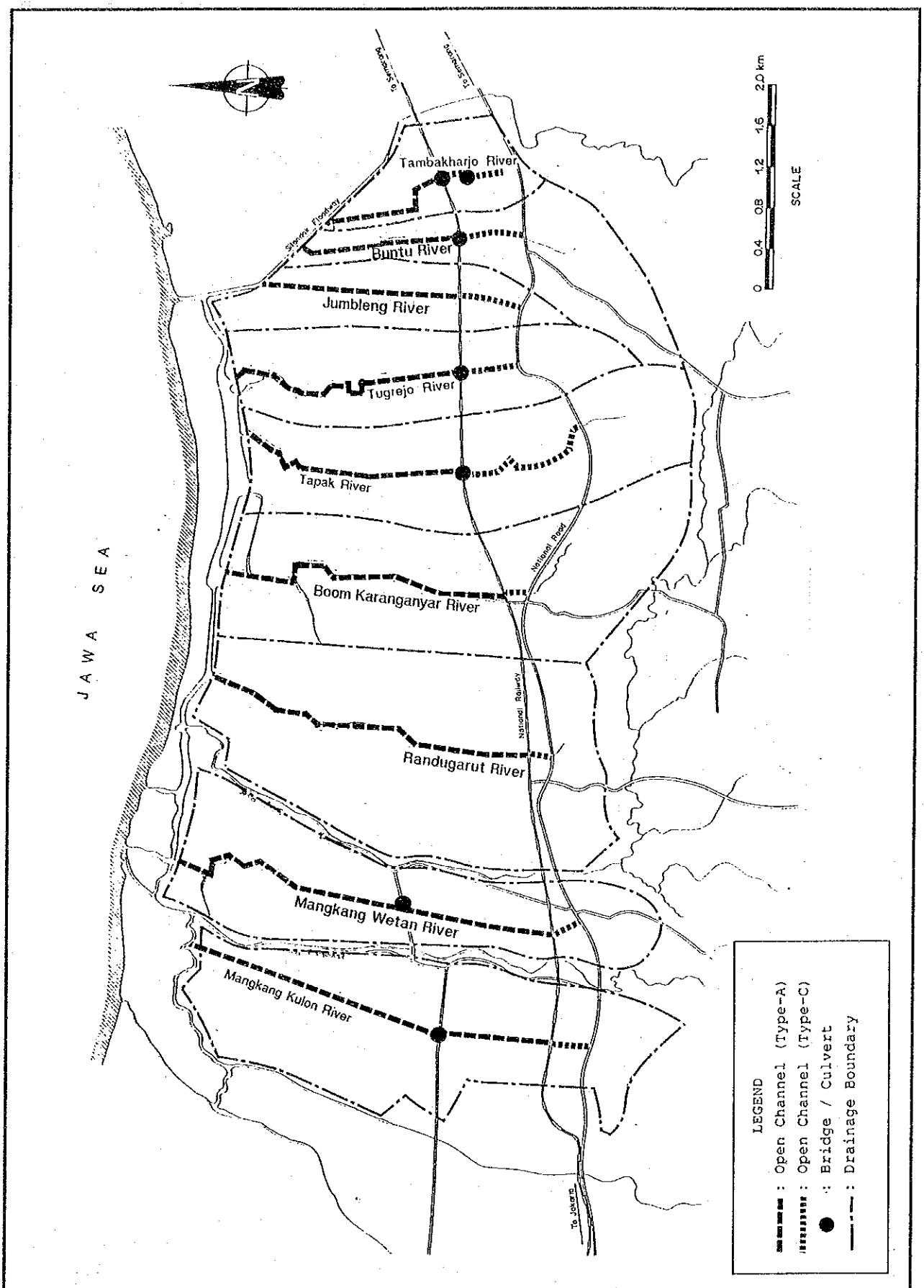
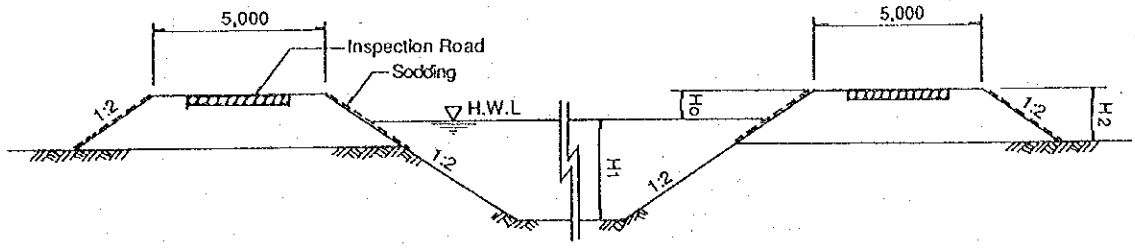
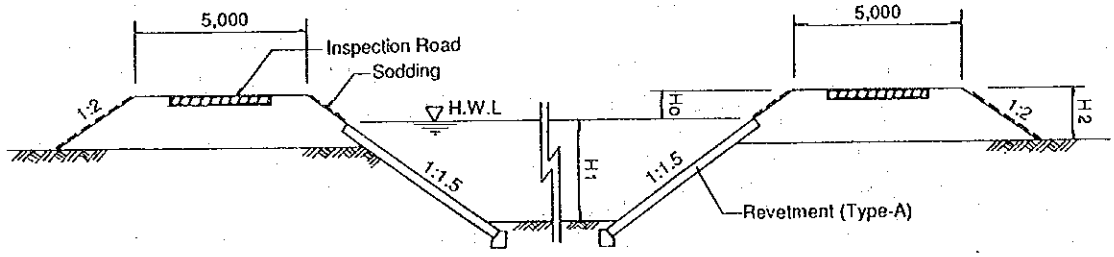
Fig. X.2.12
PROPOSED FACILITIES FOR URBAN DRAINAGE (WESTERN SEMARANG AREA)



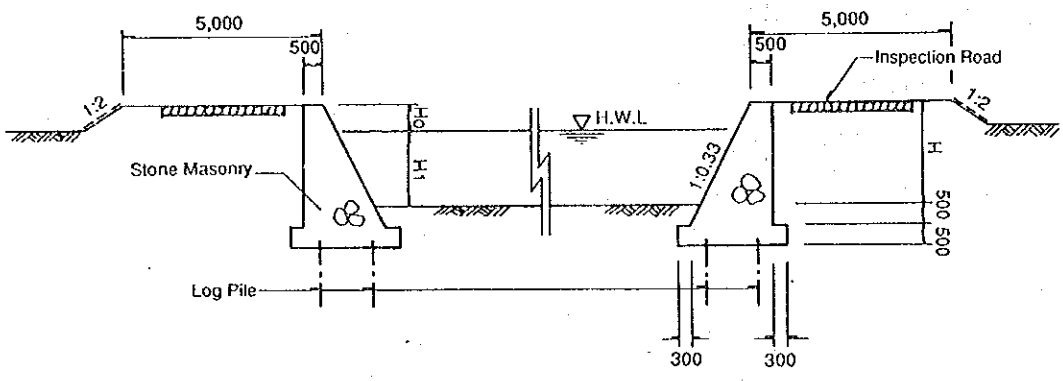
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.2.13 PROPOSED FACILITIES FOR URBAN DRAINAGE (KEC. TUGU AREA)



OPEN CHANNEL (Type-A)

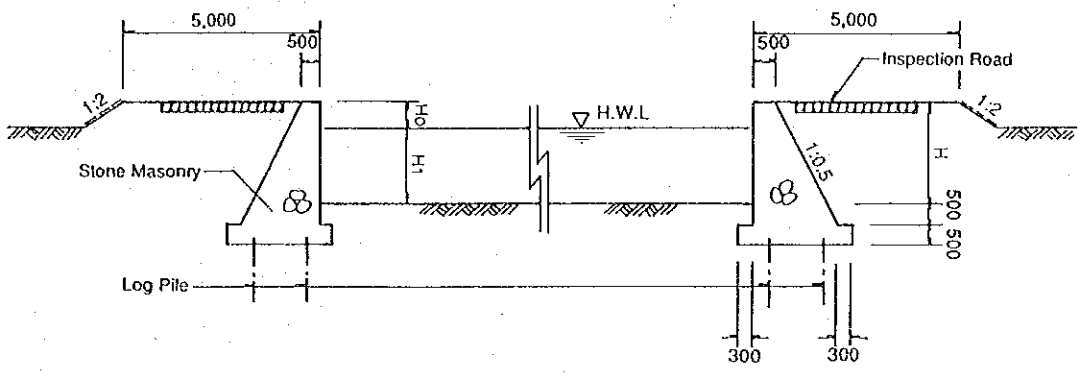


OPEN CHANNEL (Type-B)

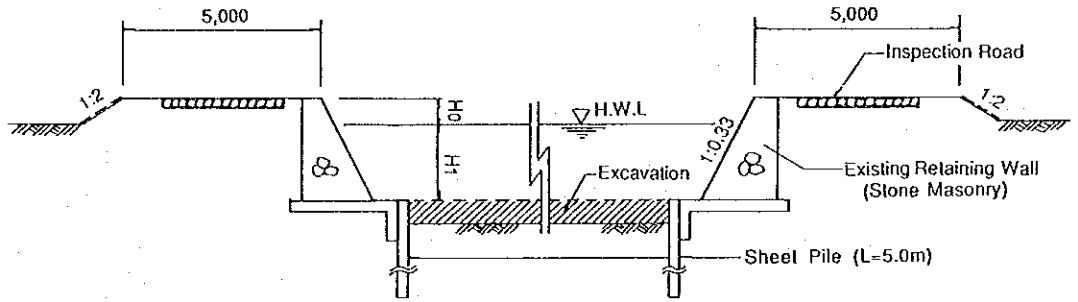


OPEN CHANNEL (Type-C)

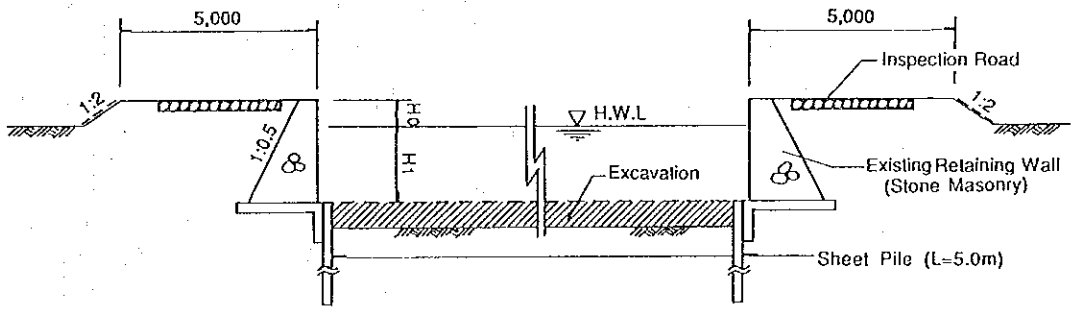
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.2.14 TYPICAL SECTIONS OF URBAN DRAINAGE CHANNEL (Type A, B and C)



OPEN CHANNEL (Type-D)

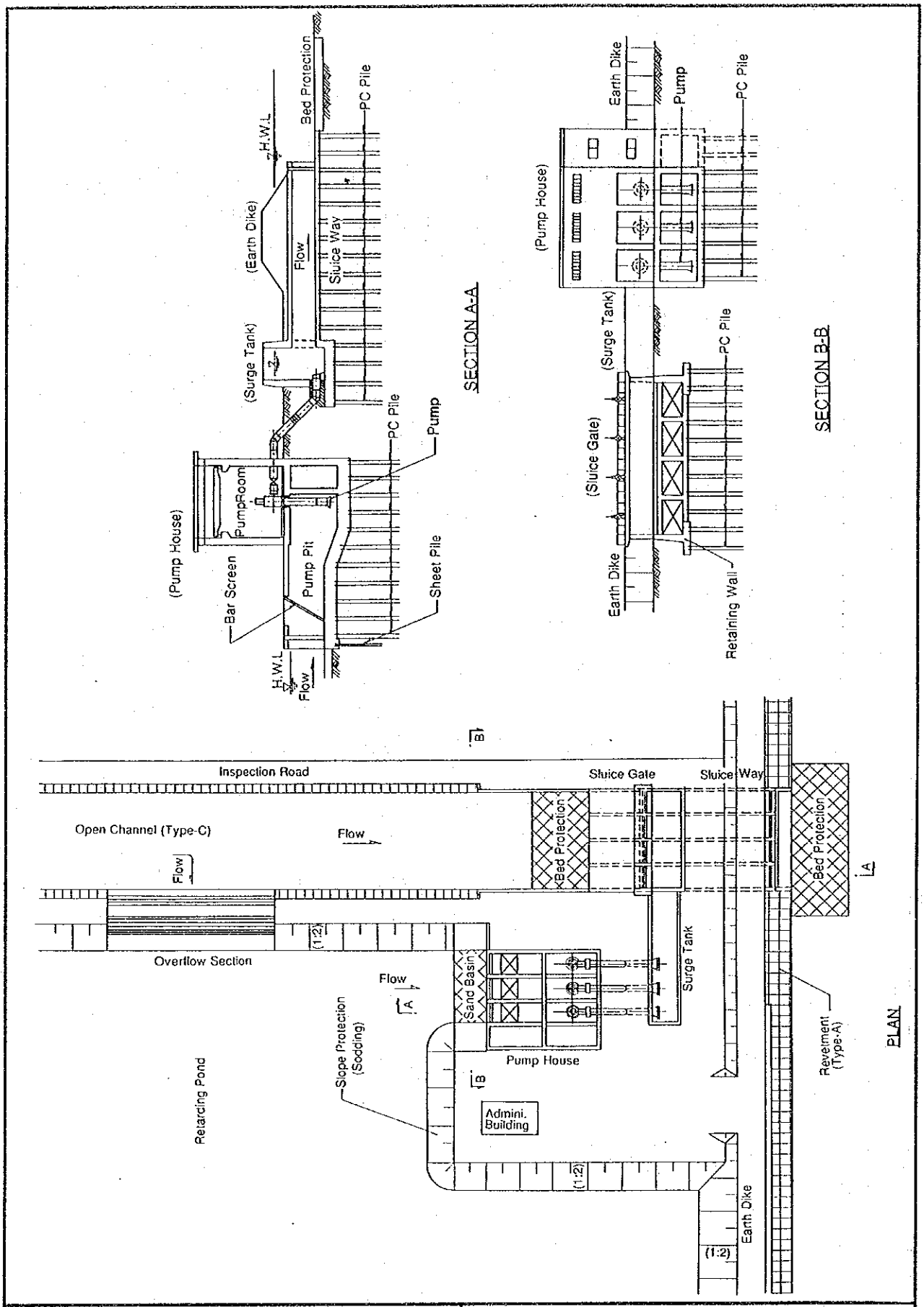


OPEN CHANNEL (Type-E)

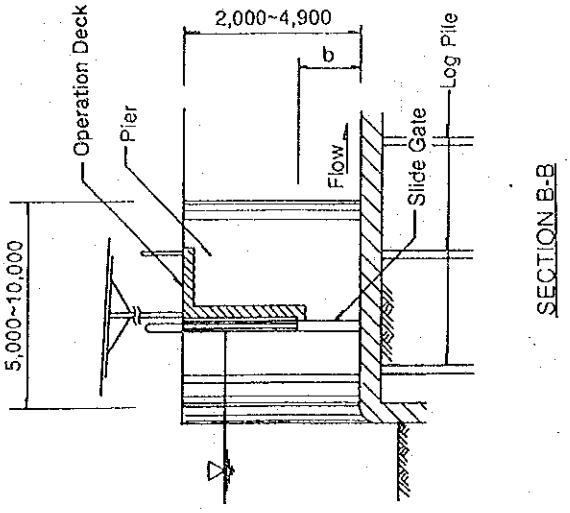


OPEN CHANNEL (Type-F)

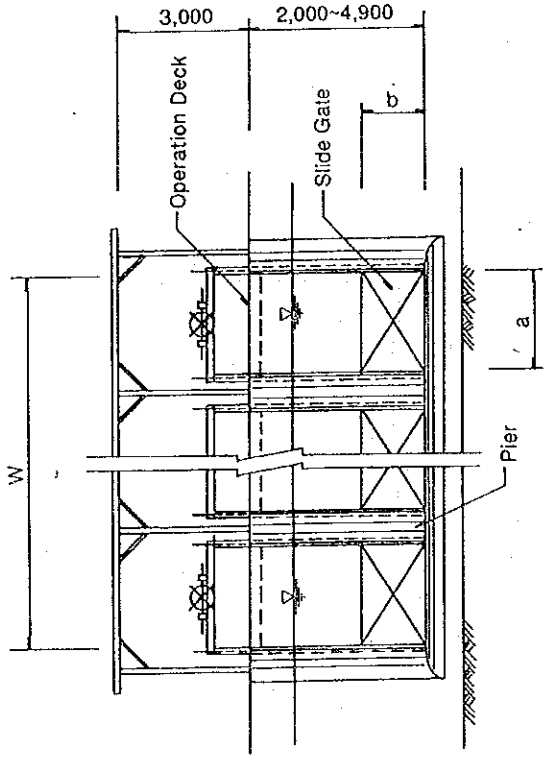
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.2.15 TYPICAL SECTIONS OF URBAN DRAINAGE CHANNEL (Type D, E and F)



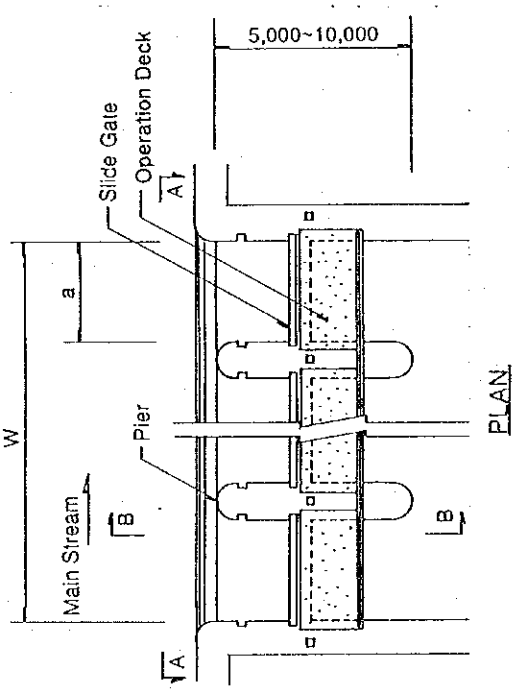
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.2.16 TYPICAL DESIGN OF PUMP STATION FOR URBAN DRAINAGE



SECTION B-B

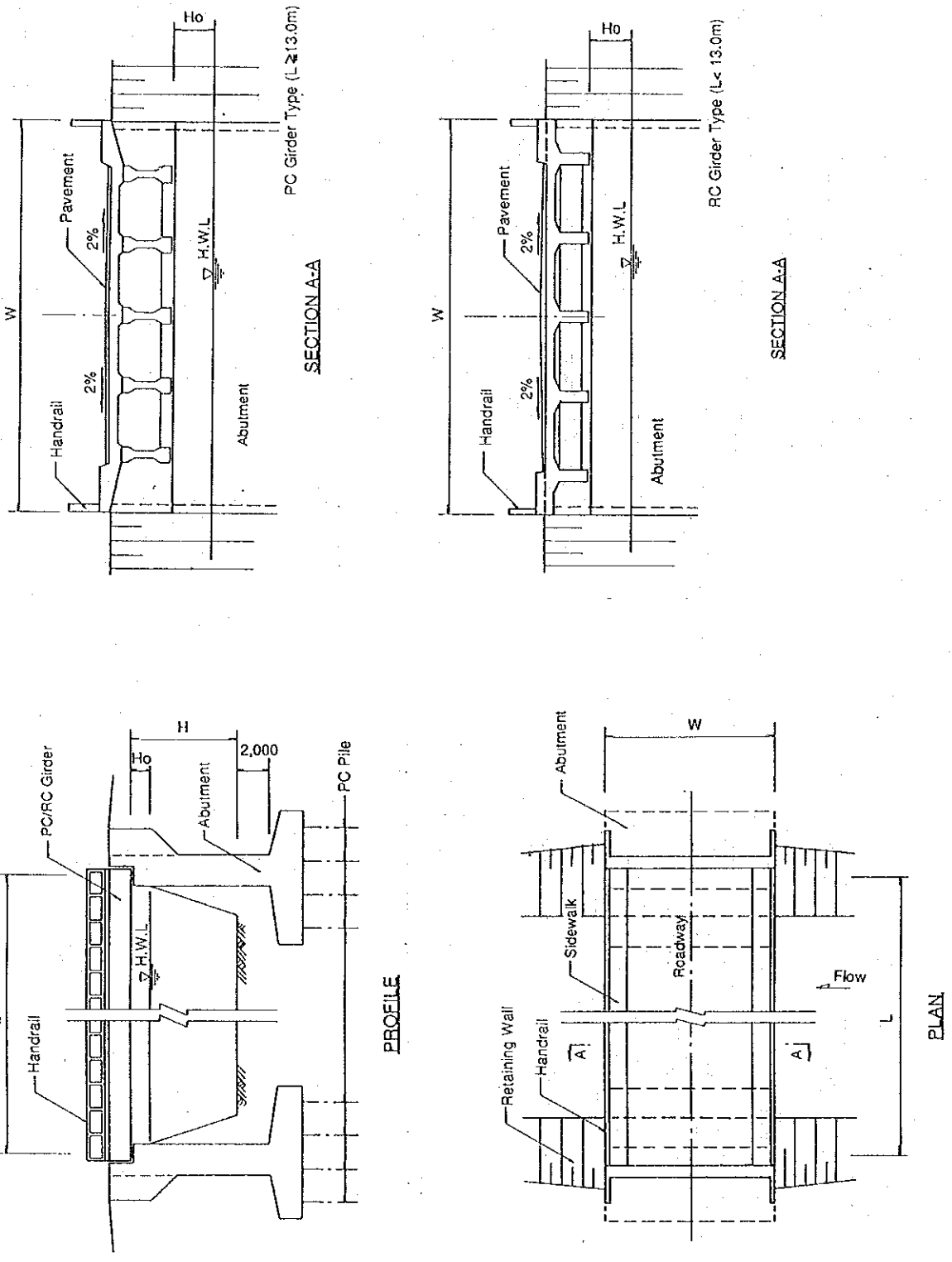


SECTION A-A

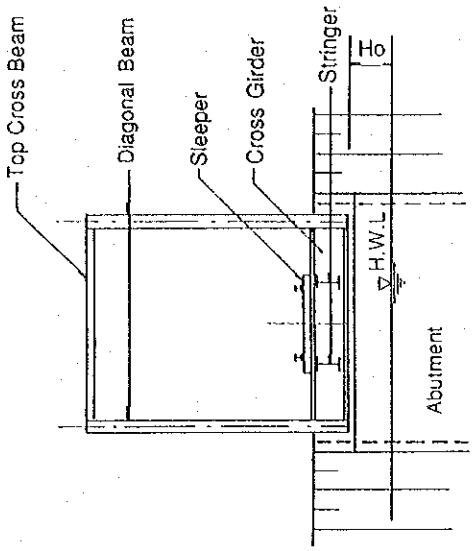


PLAN

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.2.17 TYPICAL DESIGN OF GATE STRUCTURE



MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.2.18 TYPICAL DESIGN OF ROAD BRIDGE FOR CHANNEL IMPROVEMENT



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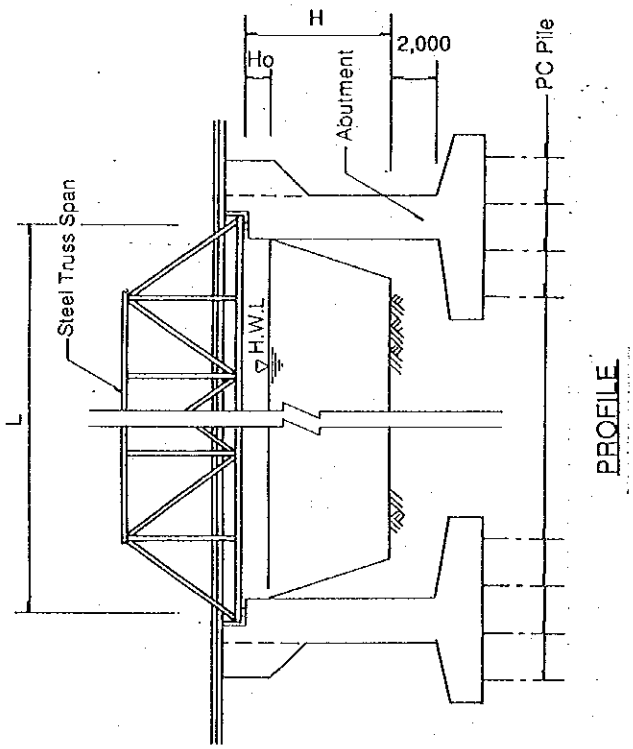
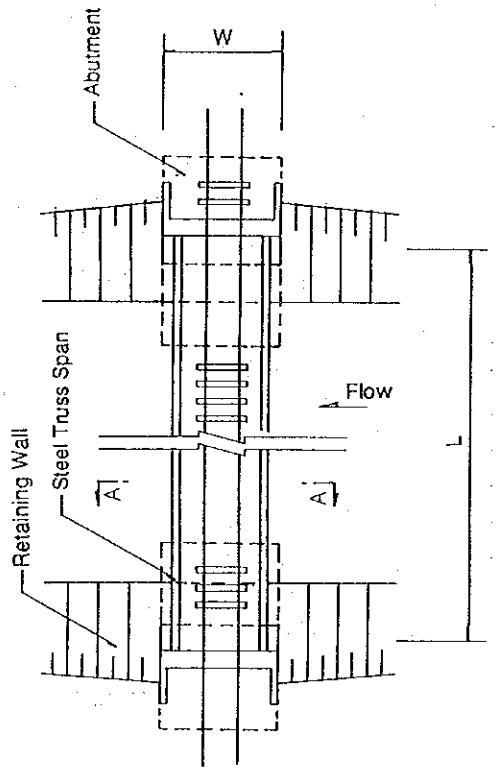
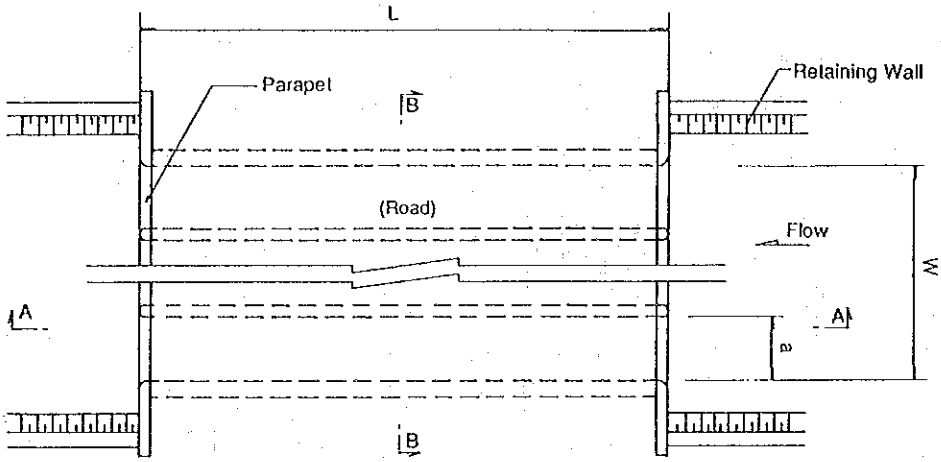


PROFILE

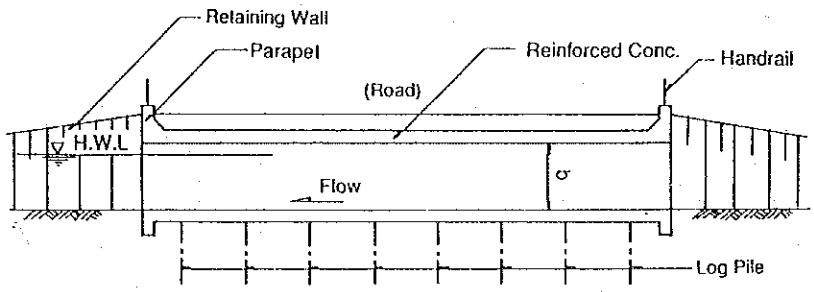


PLAN

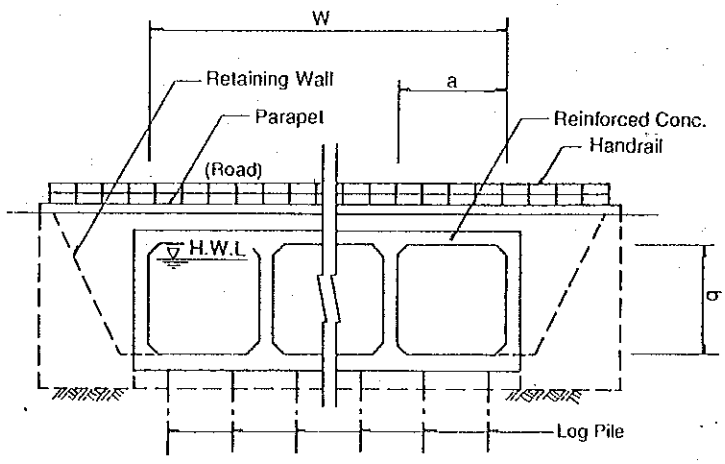
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.2.19 TYPICAL DESIGN OF RAILWAY BRIDGE FOR CHANNEL IMPROVEMENT



PLAN



SECTION A-A



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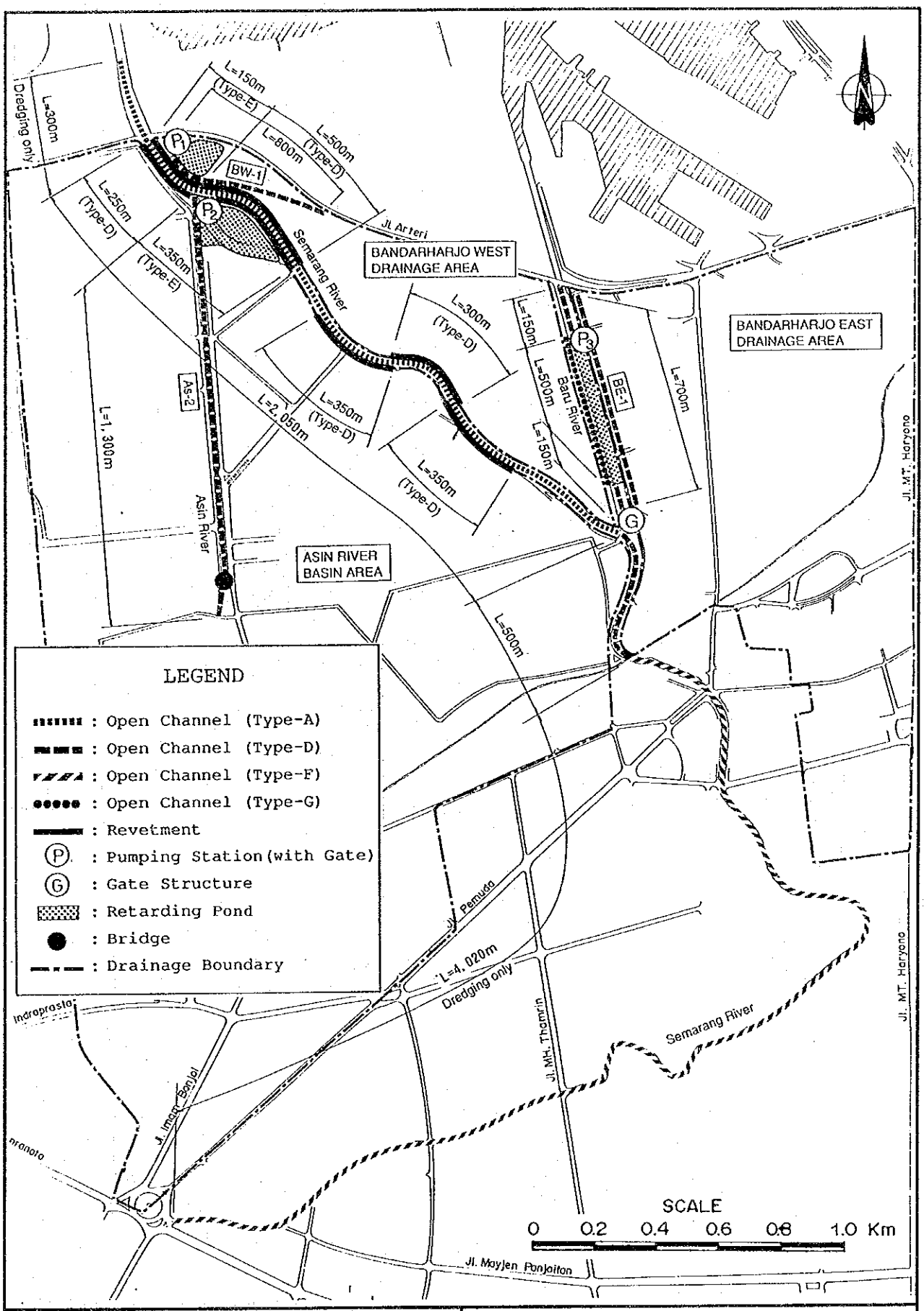
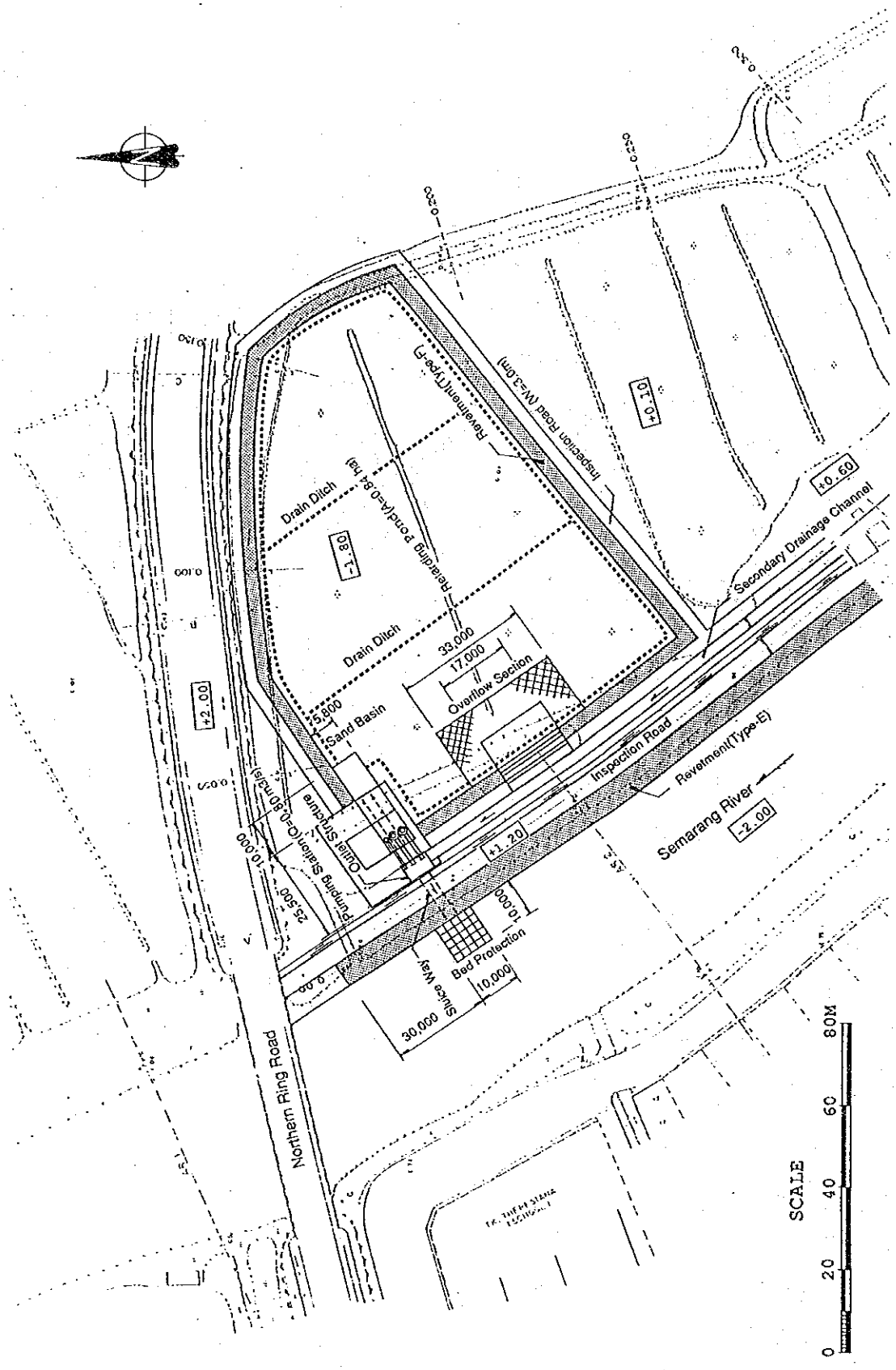
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.2.20 TYPICAL DESIGN OF BOX CULVERT FOR CHANNEL IMPROVEMENT



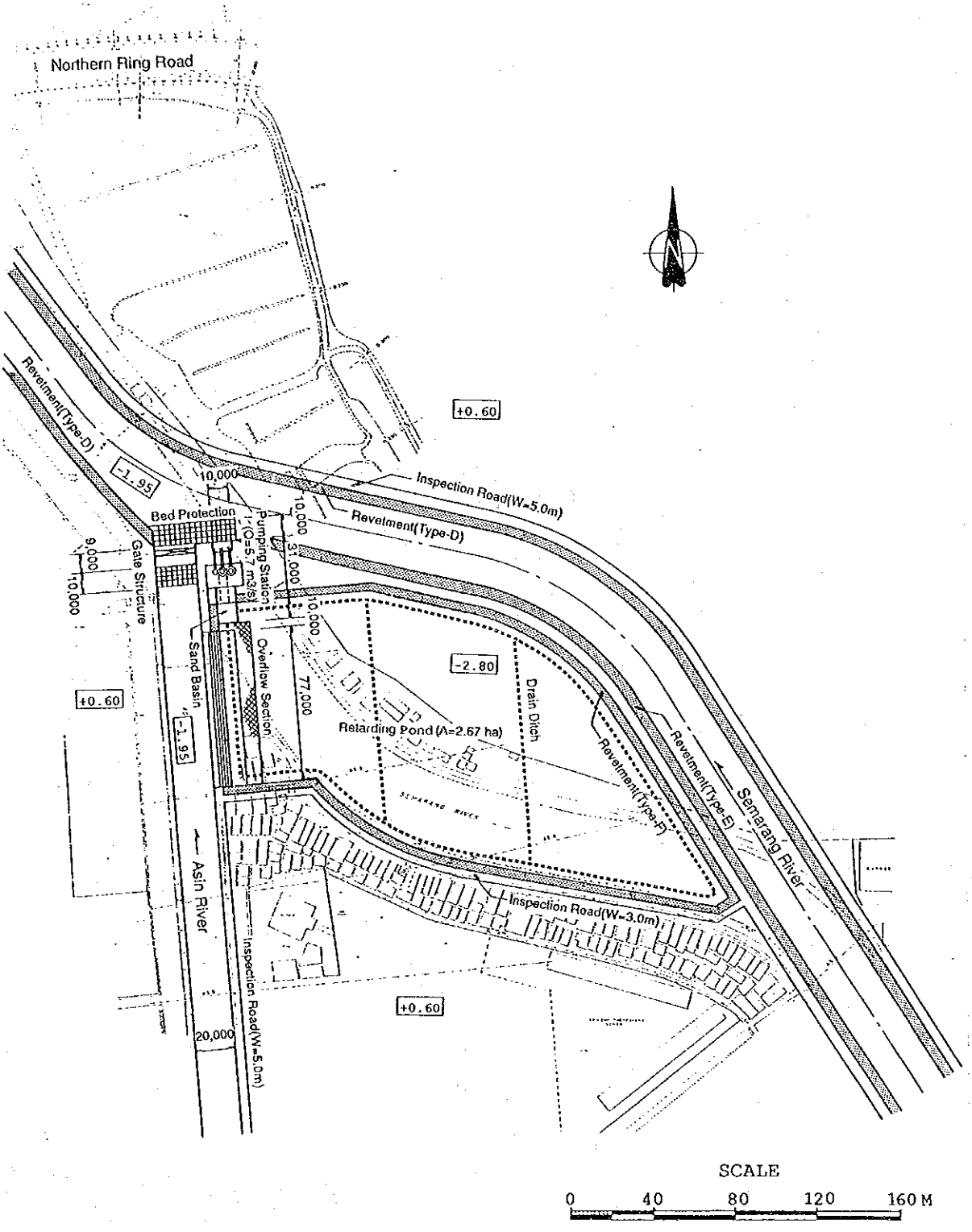
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

JAPAN INTERNATIONAL COOPERATION AGENCY

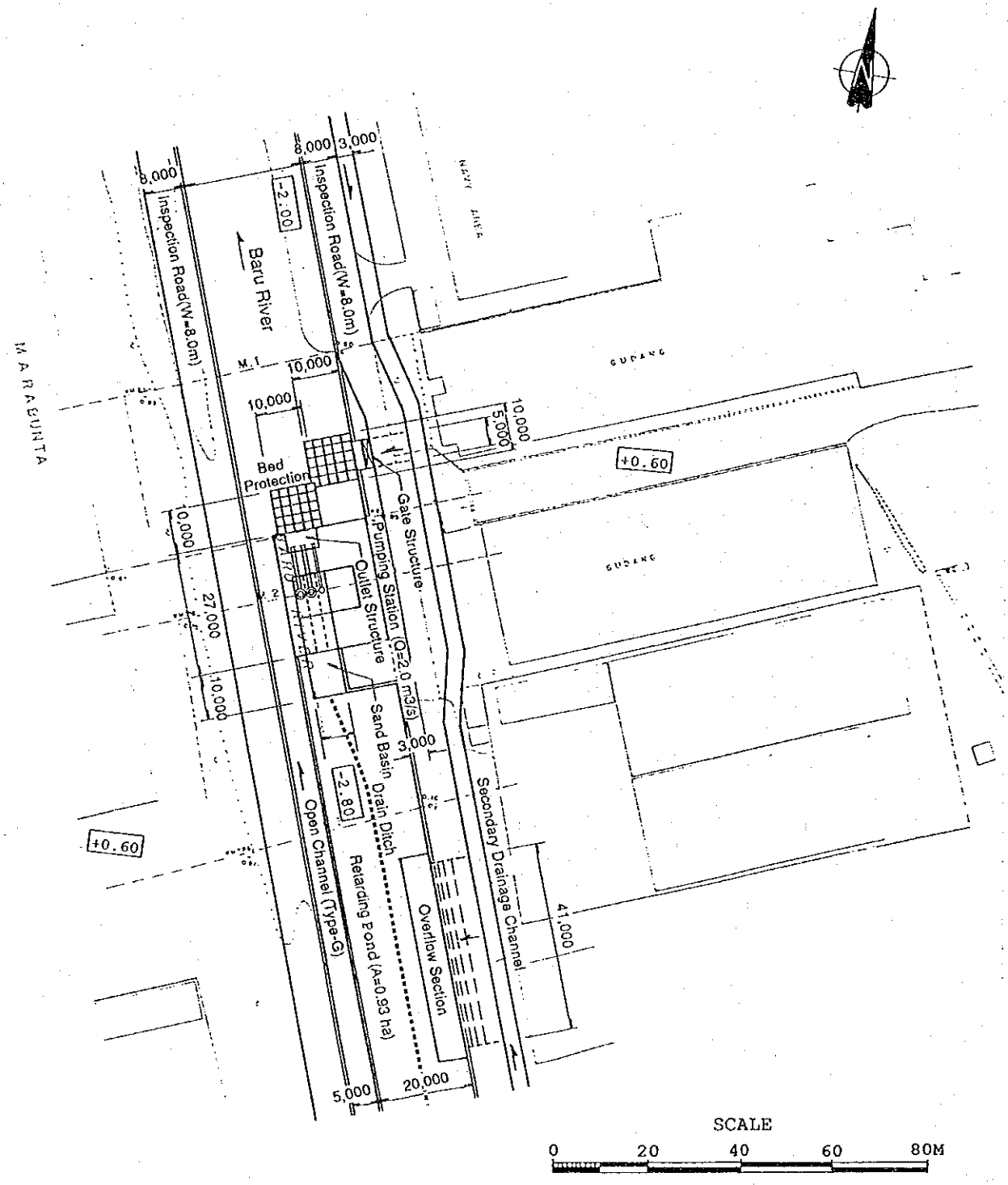
Fig.X.3.1
PROPOSED URBAN DRAINAGE FACILITIES



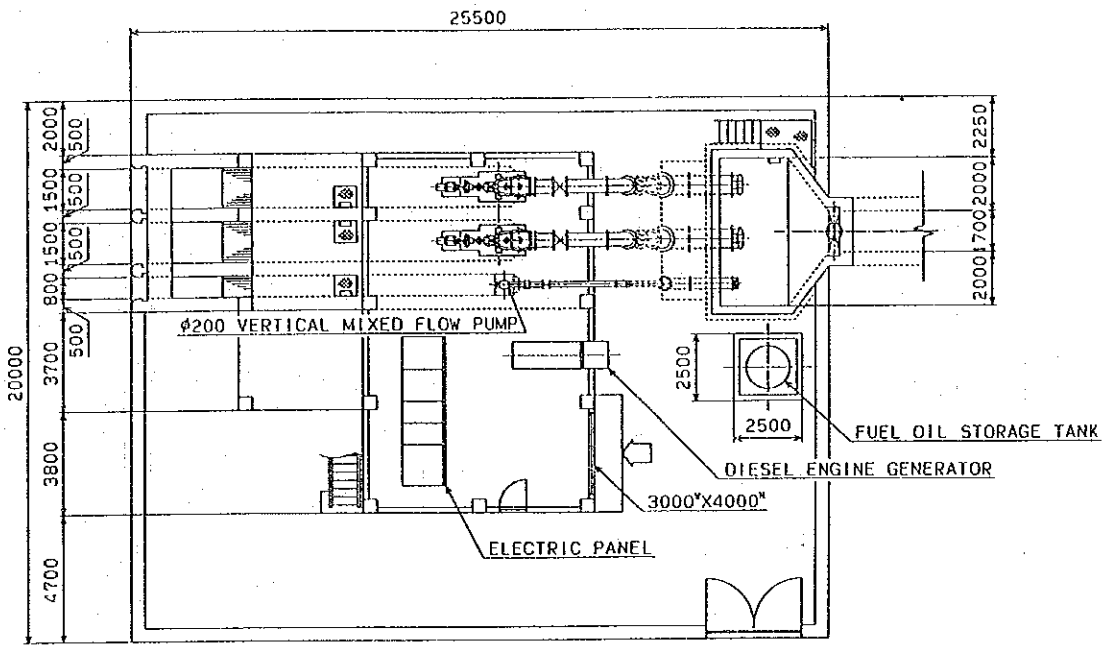
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.2 LAYOUT OF PROPOSED PUMPING STATION (P1)



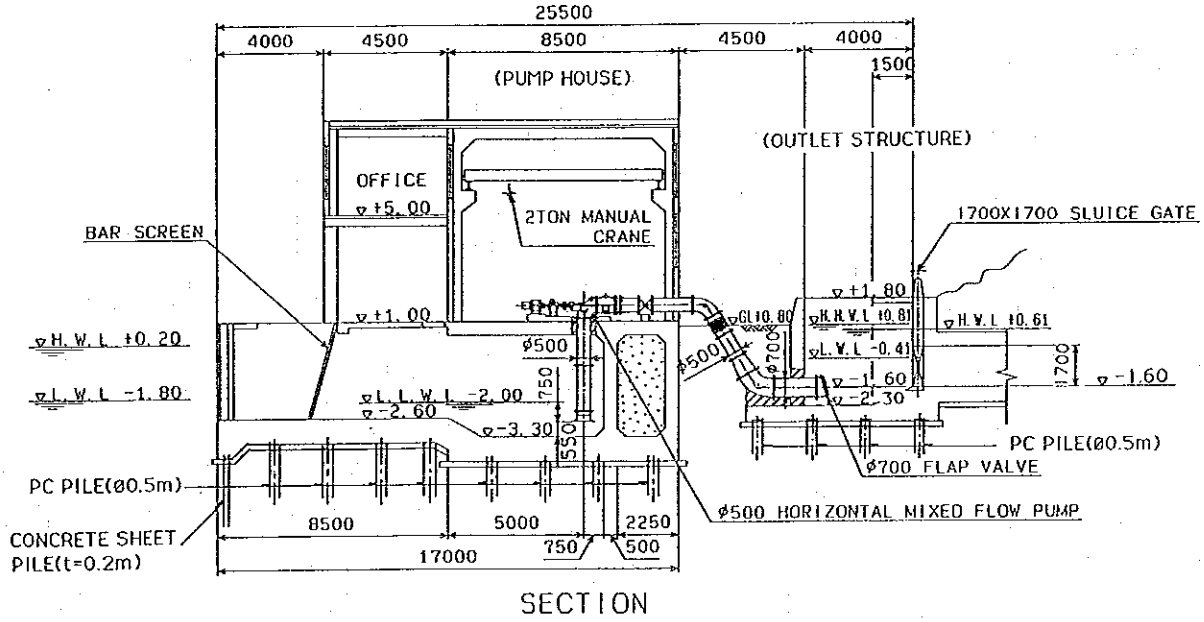
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.3 LAYOUT OF PROPOSED PUMPING STATION (P2)



MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.4 LAYOUT OF PROPOSED PUMPING STATION (P3)



P L A N



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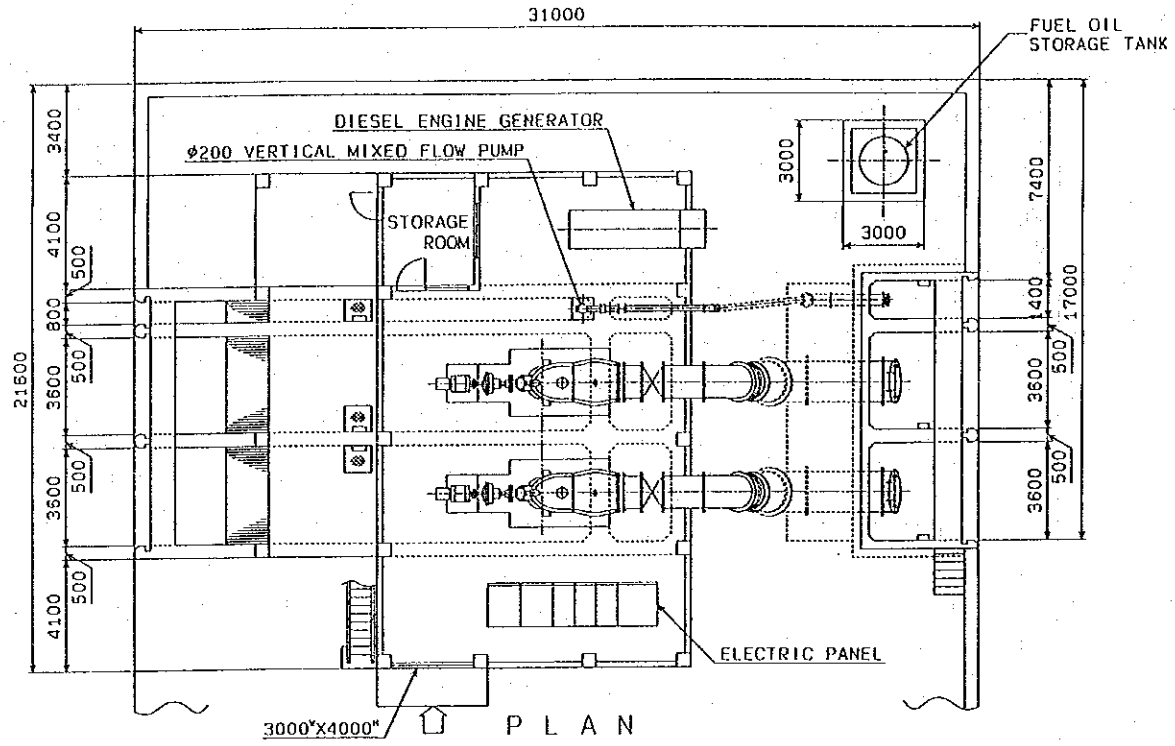
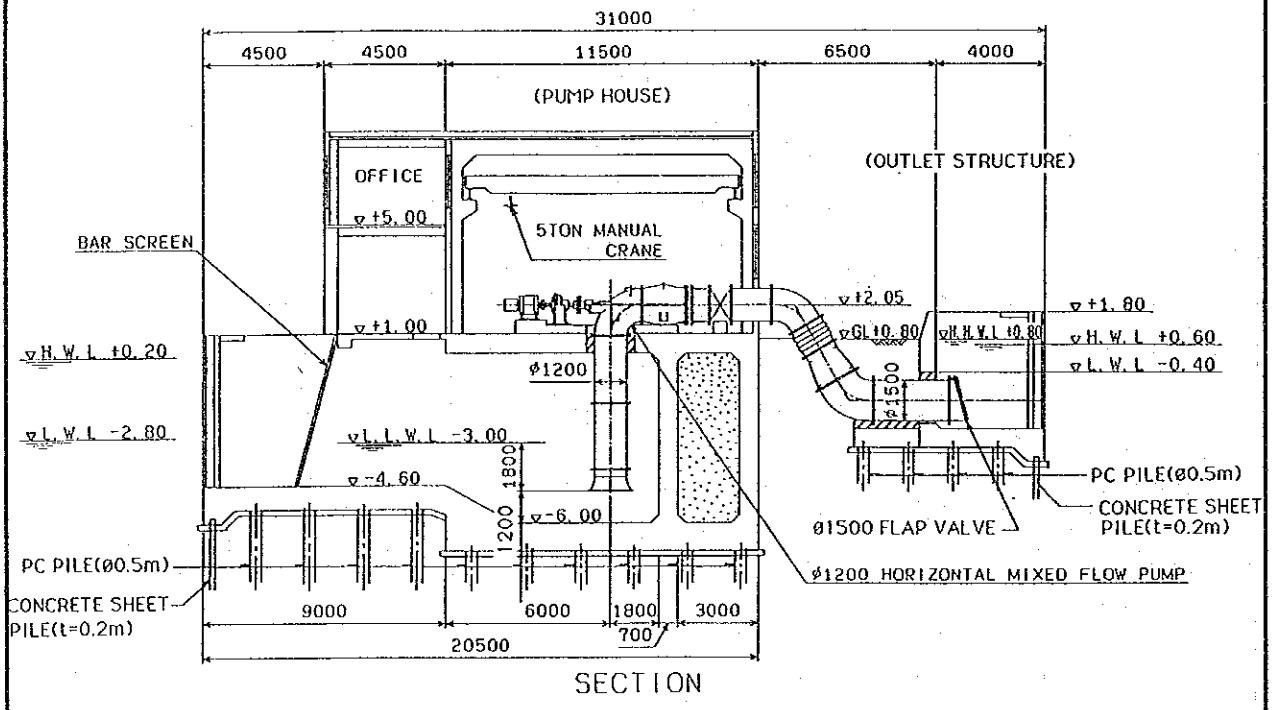
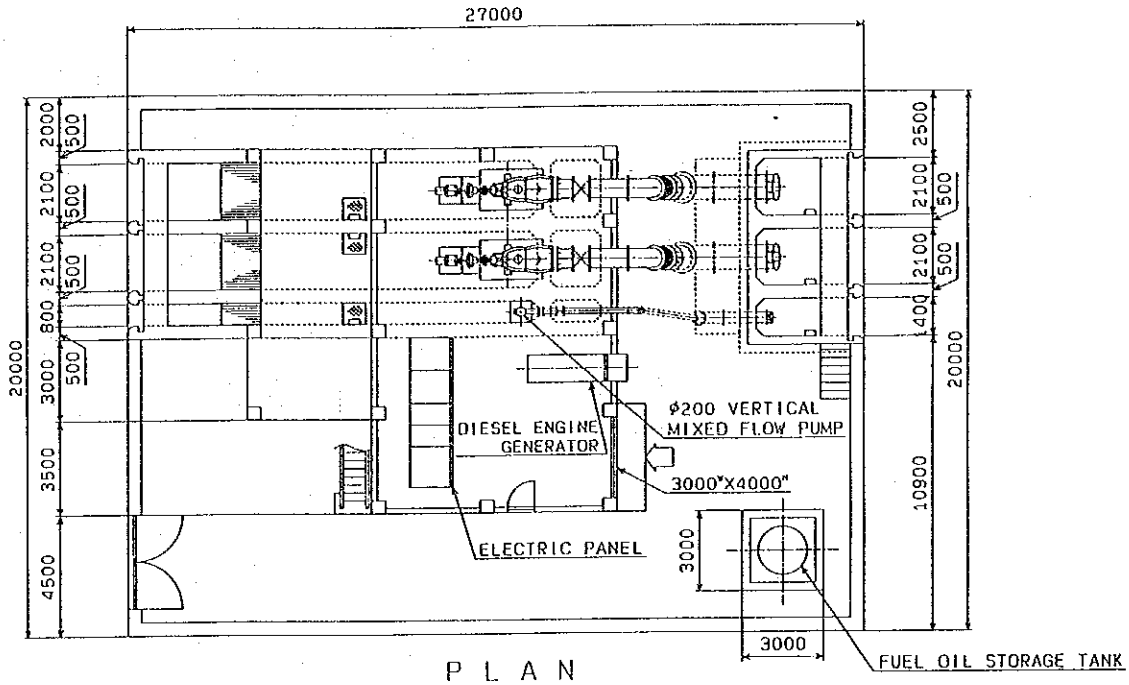
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.5 TYPICAL DESIGN OF PUMPING STATION (P1)

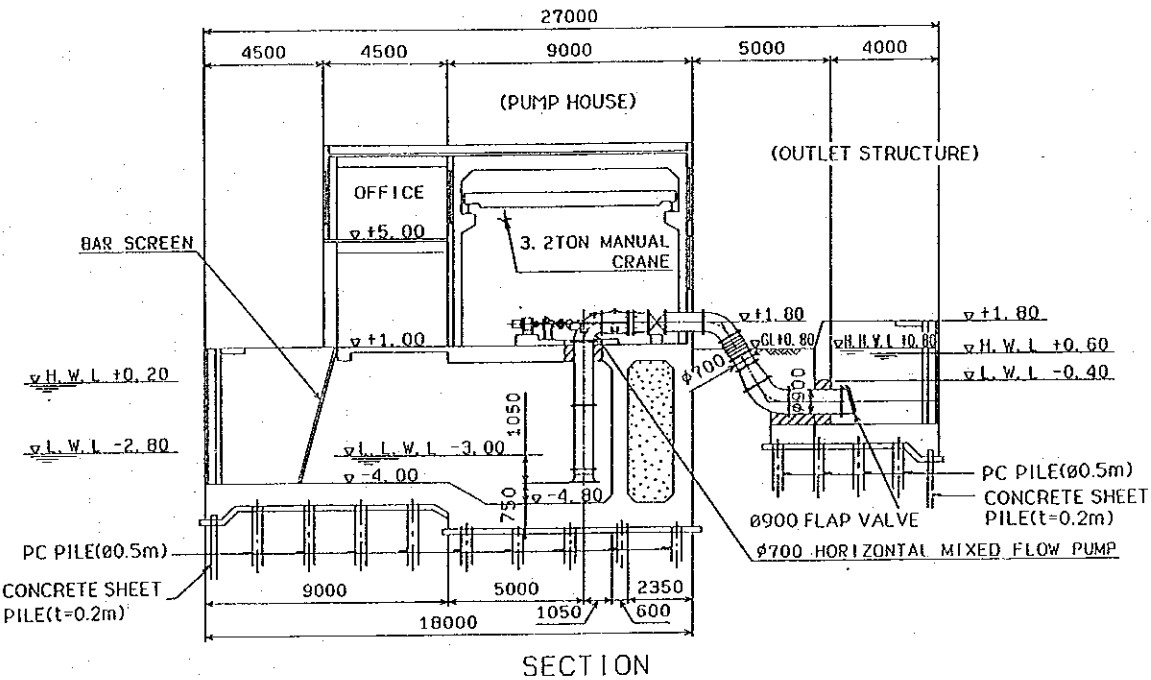




MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.6 TYPICAL DESIGN OF PUMPING STATION (P2)



P L A N



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MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.7 TYPICAL DESIGN OF PUMPING STATION (P3)

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

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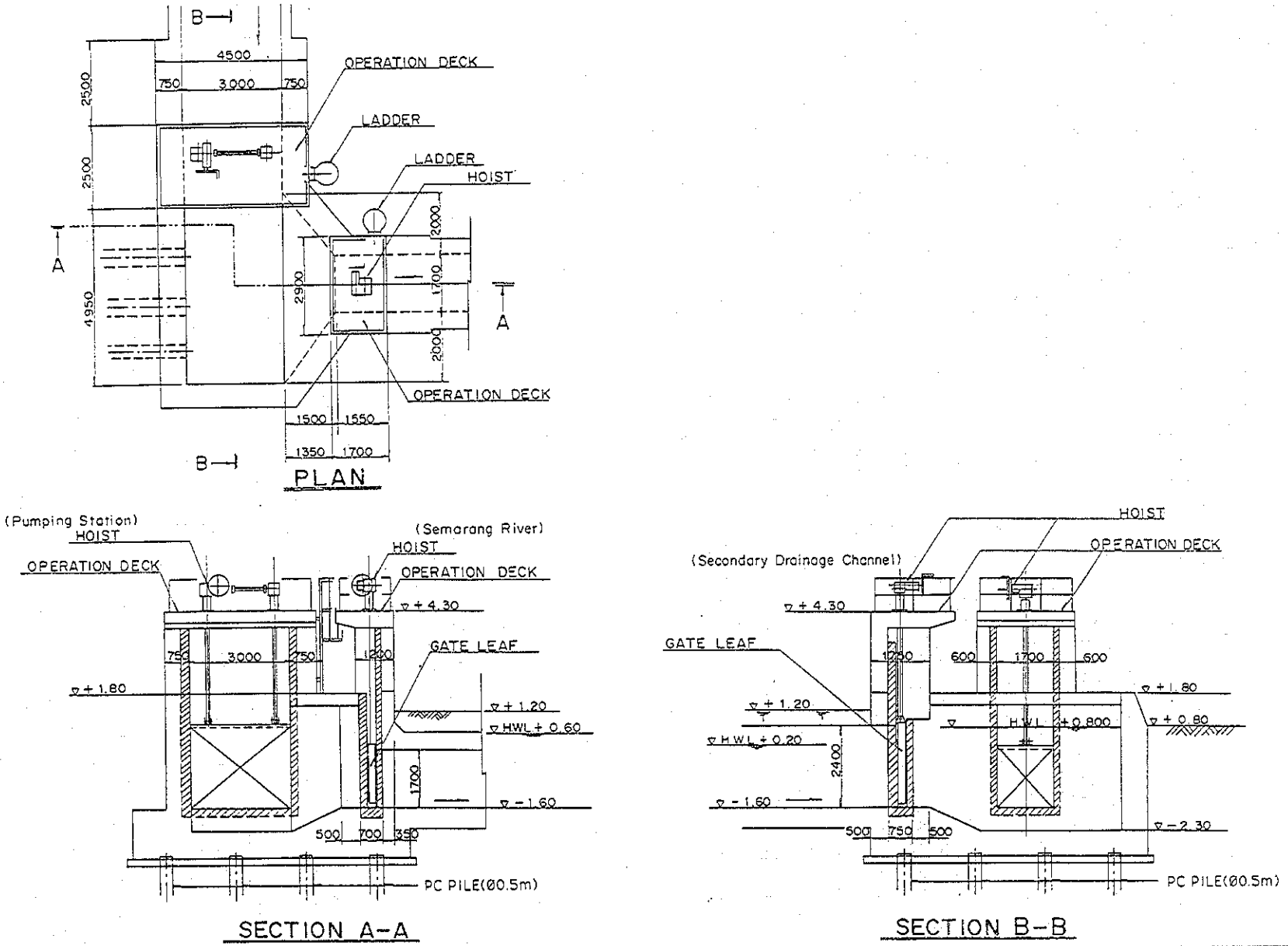
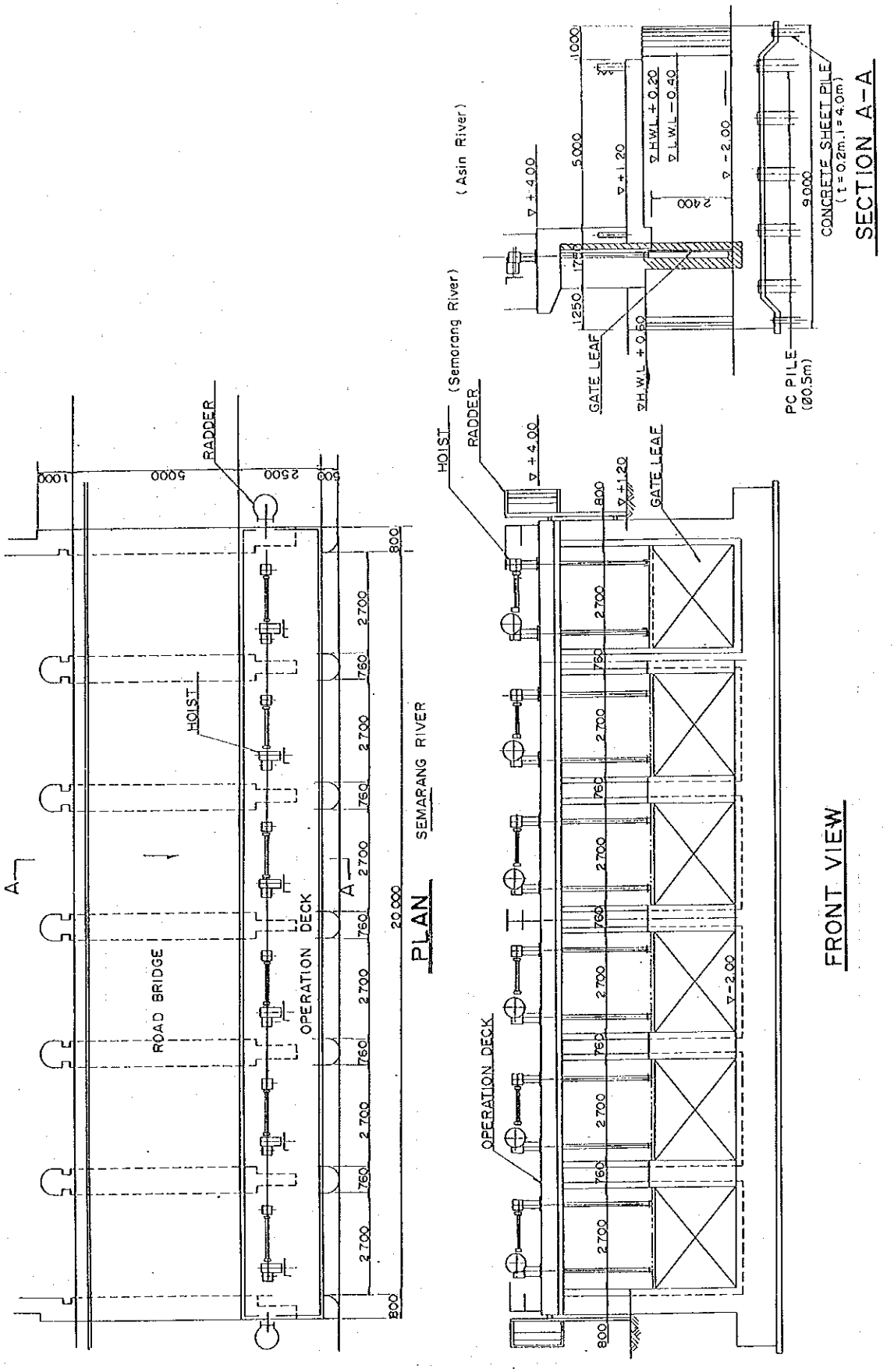


Fig. X. 3. 8

TYPICAL DESIGN OF GATE STRUCTURE

(BANDARHARJO WEST)



MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

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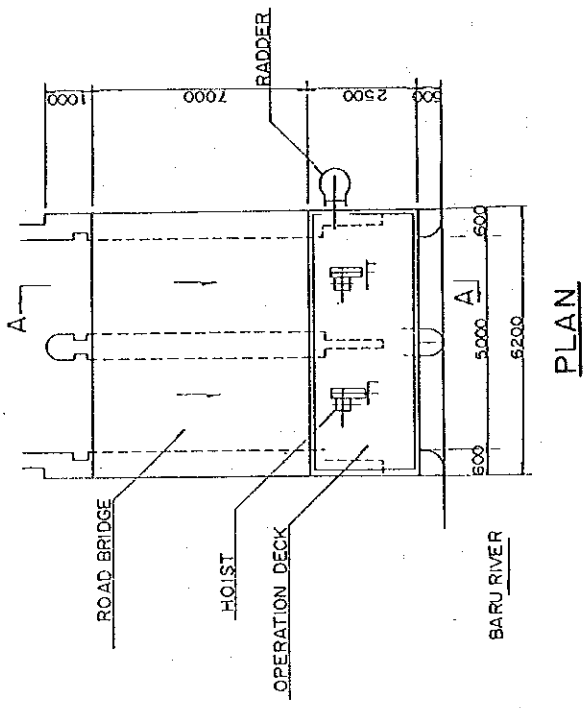
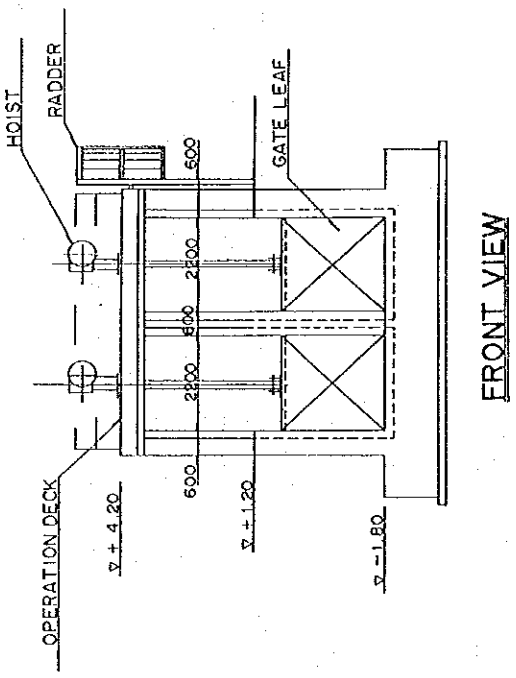
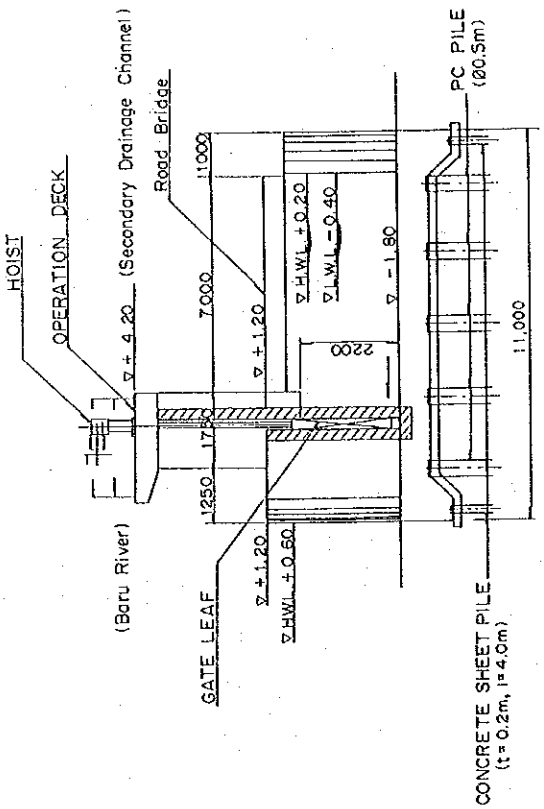
Fig.X.3.9
TYPICAL DESIGN OF GATE STRUCTURE
(ASIN RIVER BASIN)



PLAN

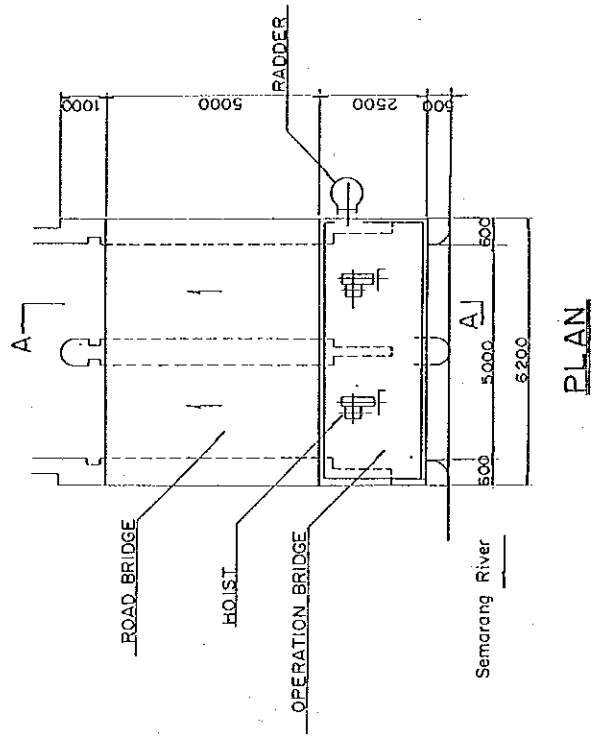


FRONT VIEW

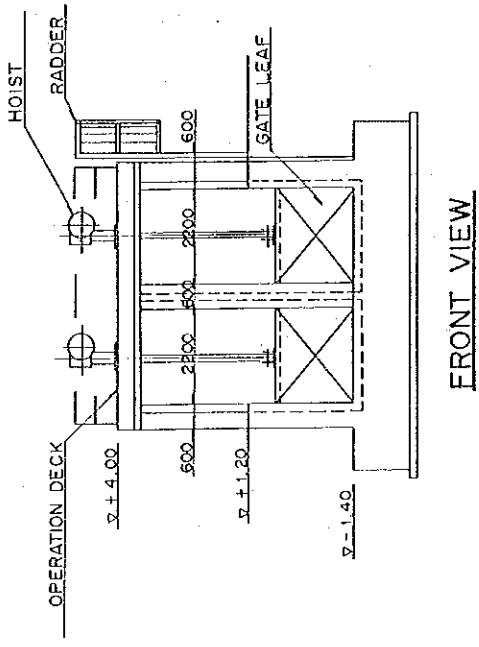


SECTION A—A

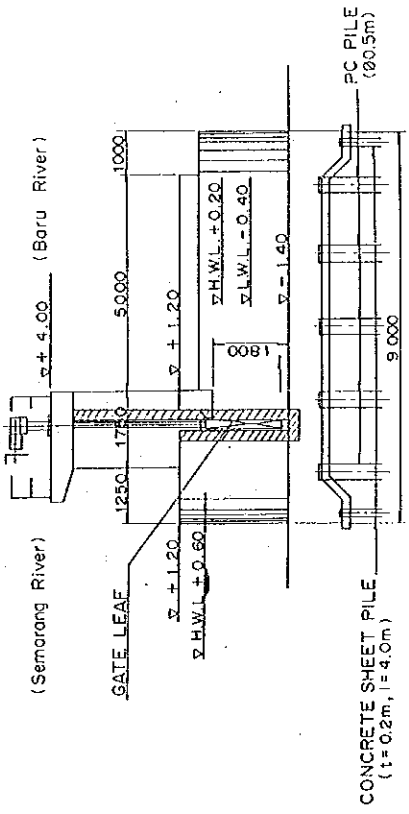
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.10 TYPICAL DESIGN OF GATE STRUCTURE (BANDARHARJO EAST)



PLAN



FRONT VIEW



SECTION A-A

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

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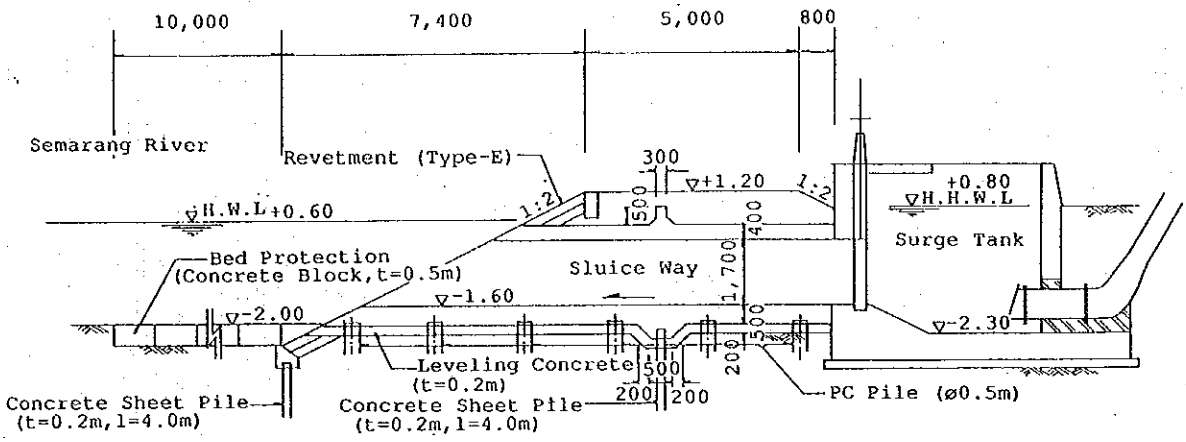
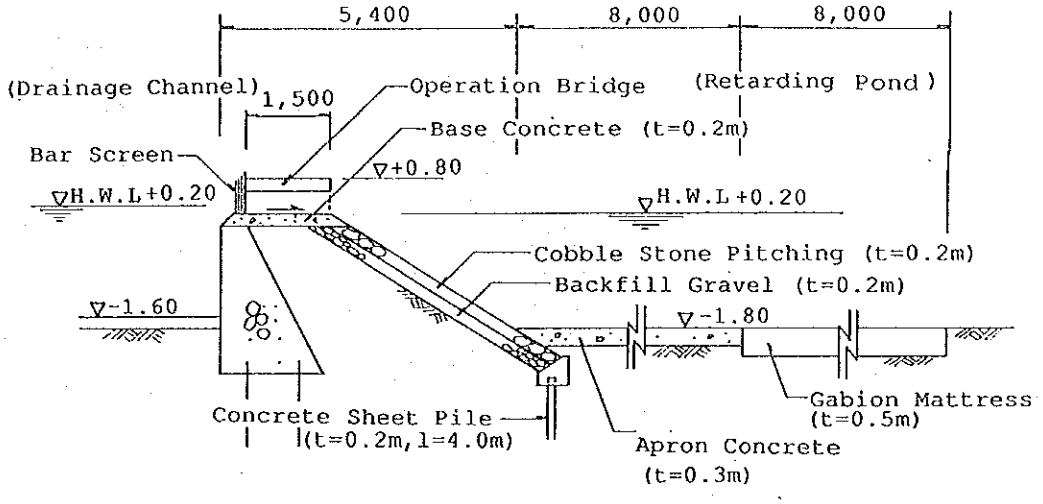
Fig.X.3.11
TYPICAL DESIGN OF GATE STRUCTURE
(BARU RIVER)

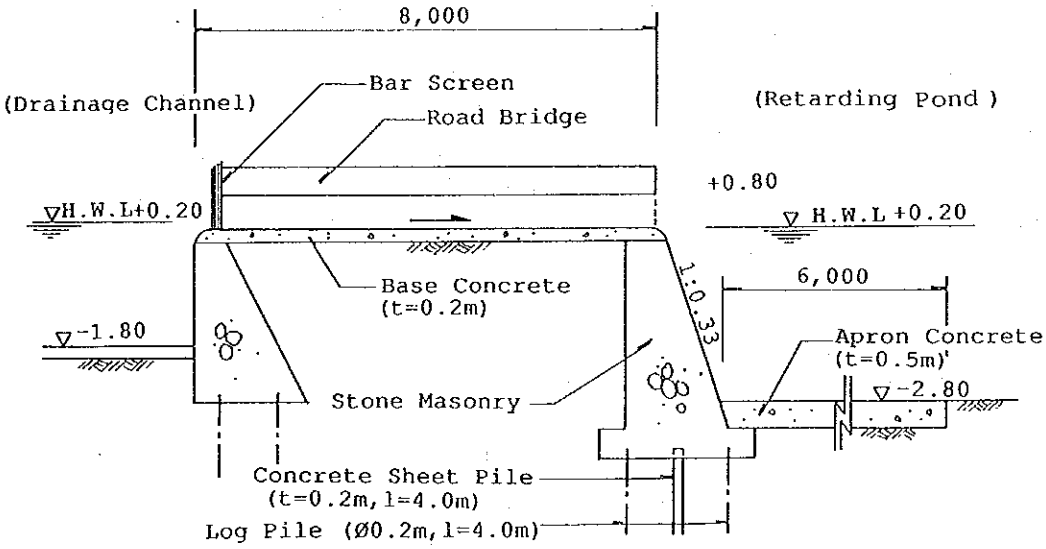


SLUICE WAY IN BANDARHARJO WEST

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.3.12 TYPICAL SECTION OF SLUICEWAY

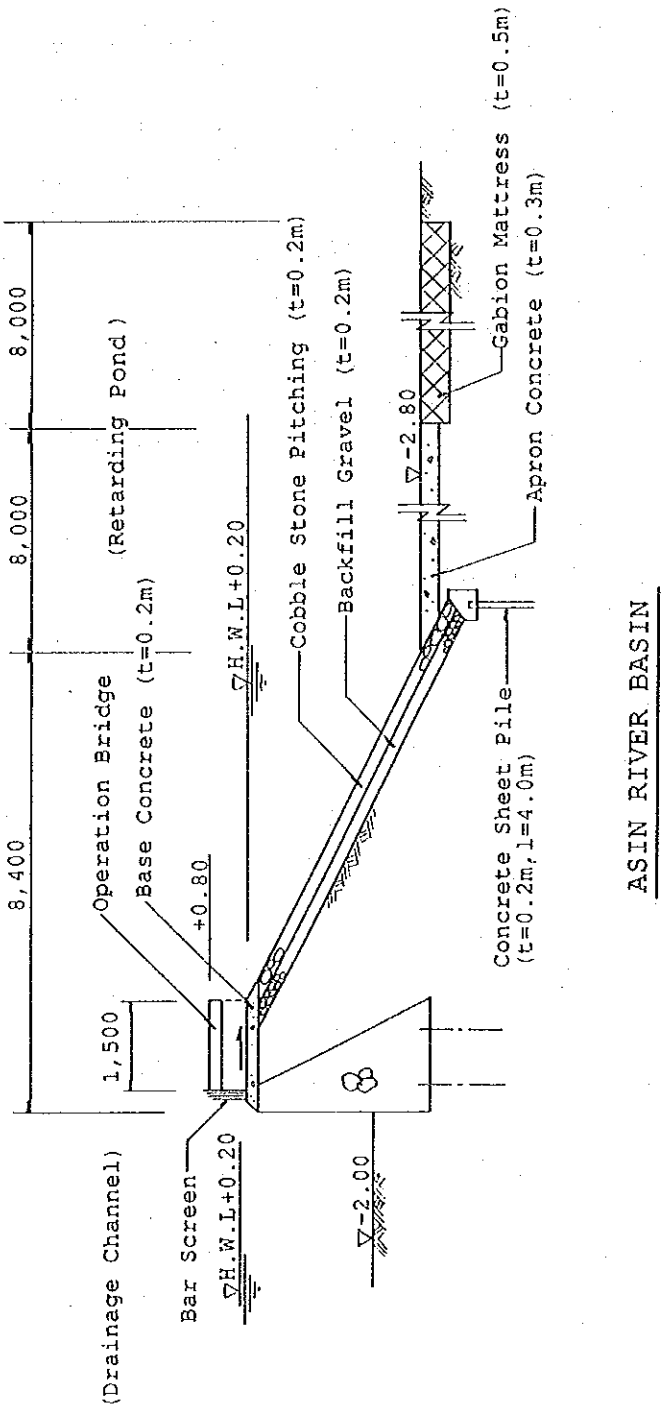


BANDARHARJO WEST

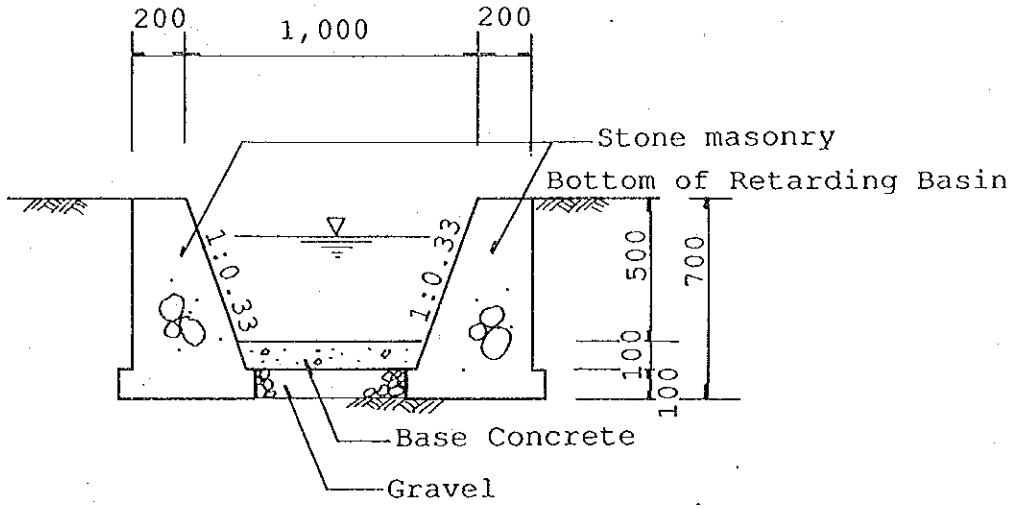


BANDARHARJO EAST

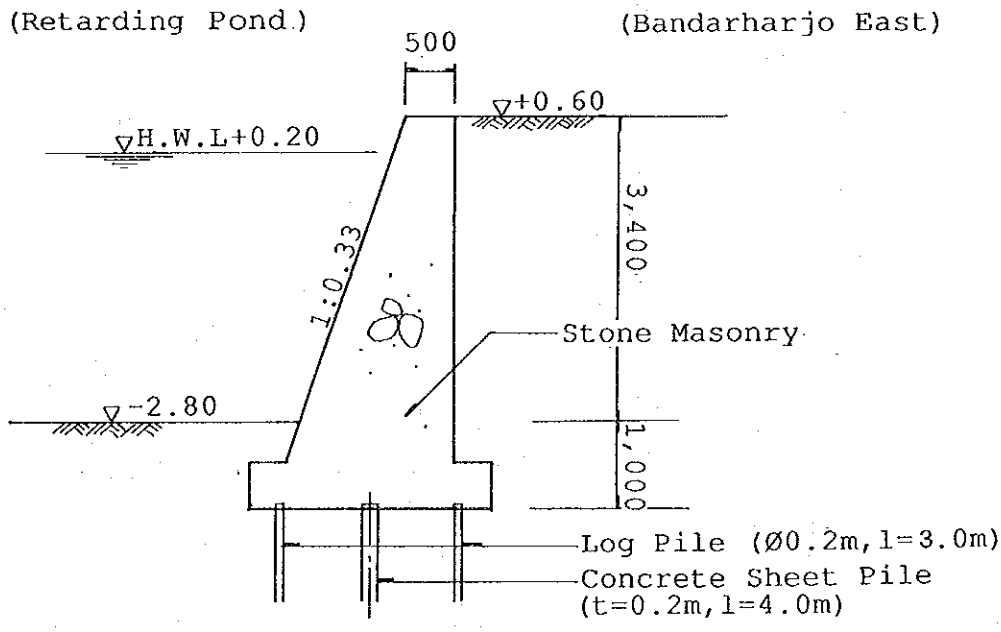
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.13(1/2) TYPICAL SECTIONS OF OVERFLOW SECTION



MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.13(2/2) TYPICAL SECTION OF OVERFLOW SECTION

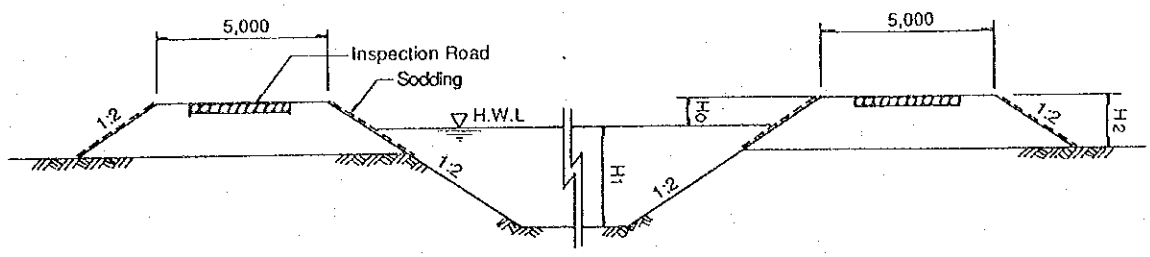


DRAIN DITCH

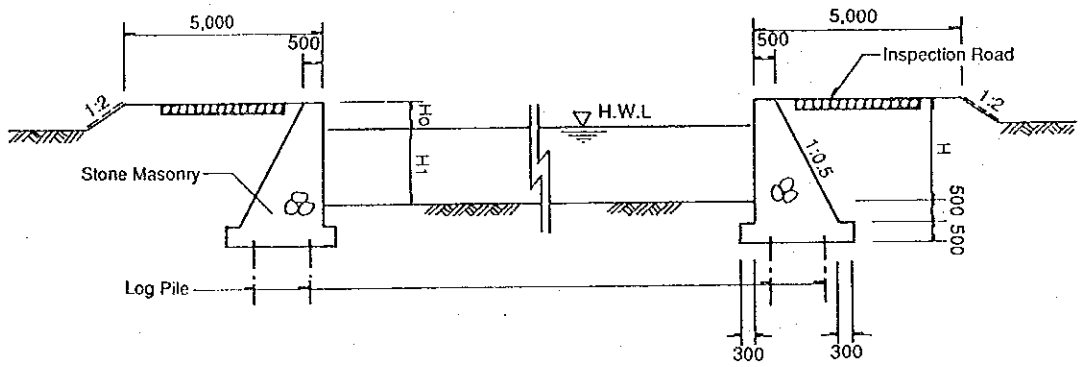


RETAINING WALL

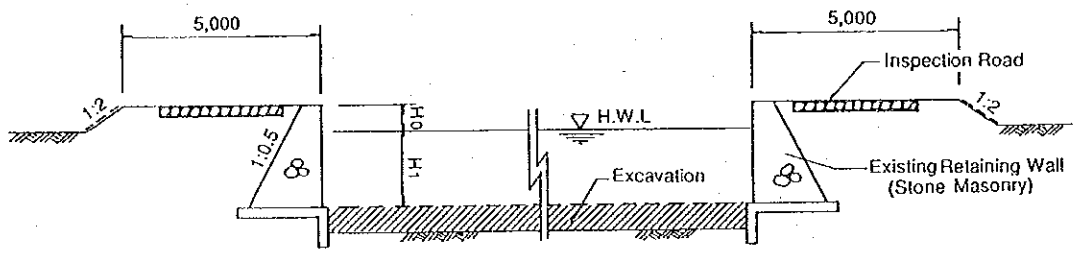
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.14 TYPICAL SECTION OF DRAIN DITCH AND RETAINING WALL IN RETARDING BASIN



OPEN CHANNEL (Type-A)

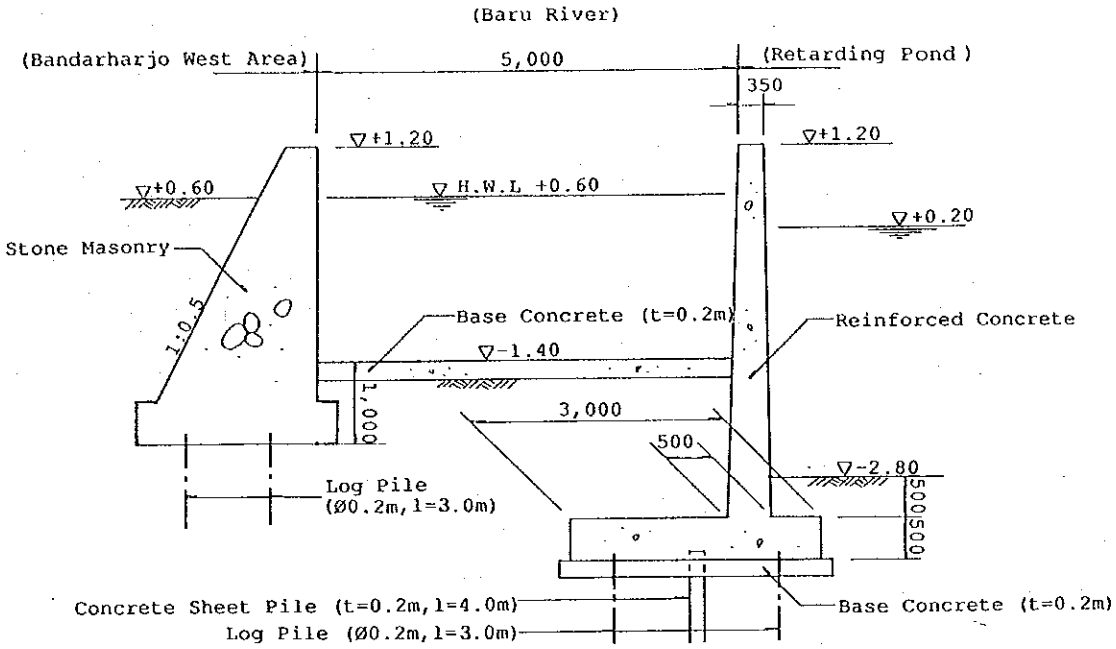


OPEN CHANNEL (Type-D)



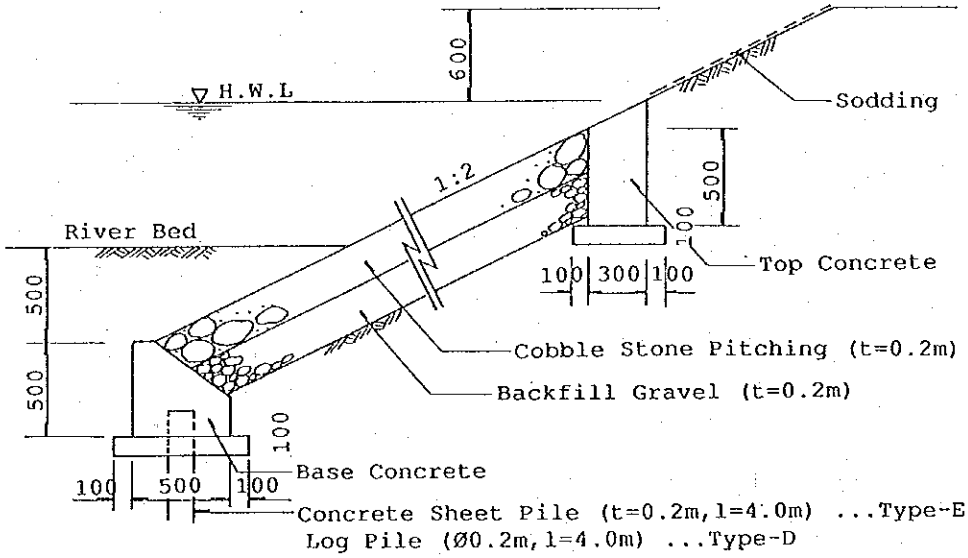
OPEN CHANNEL (Type-F)

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.15(1/2) TYPICAL SECTIONS OF OPEN CHANNEL

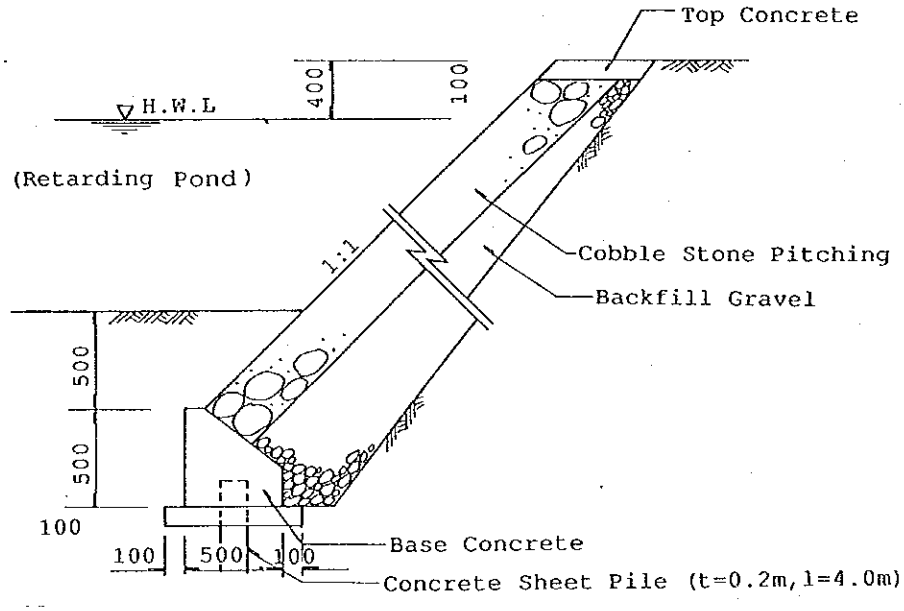


OPEN CHANNEL (Type-G)

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.15(2/2) TYPICAL SECTION OF OPEN CHANNEL

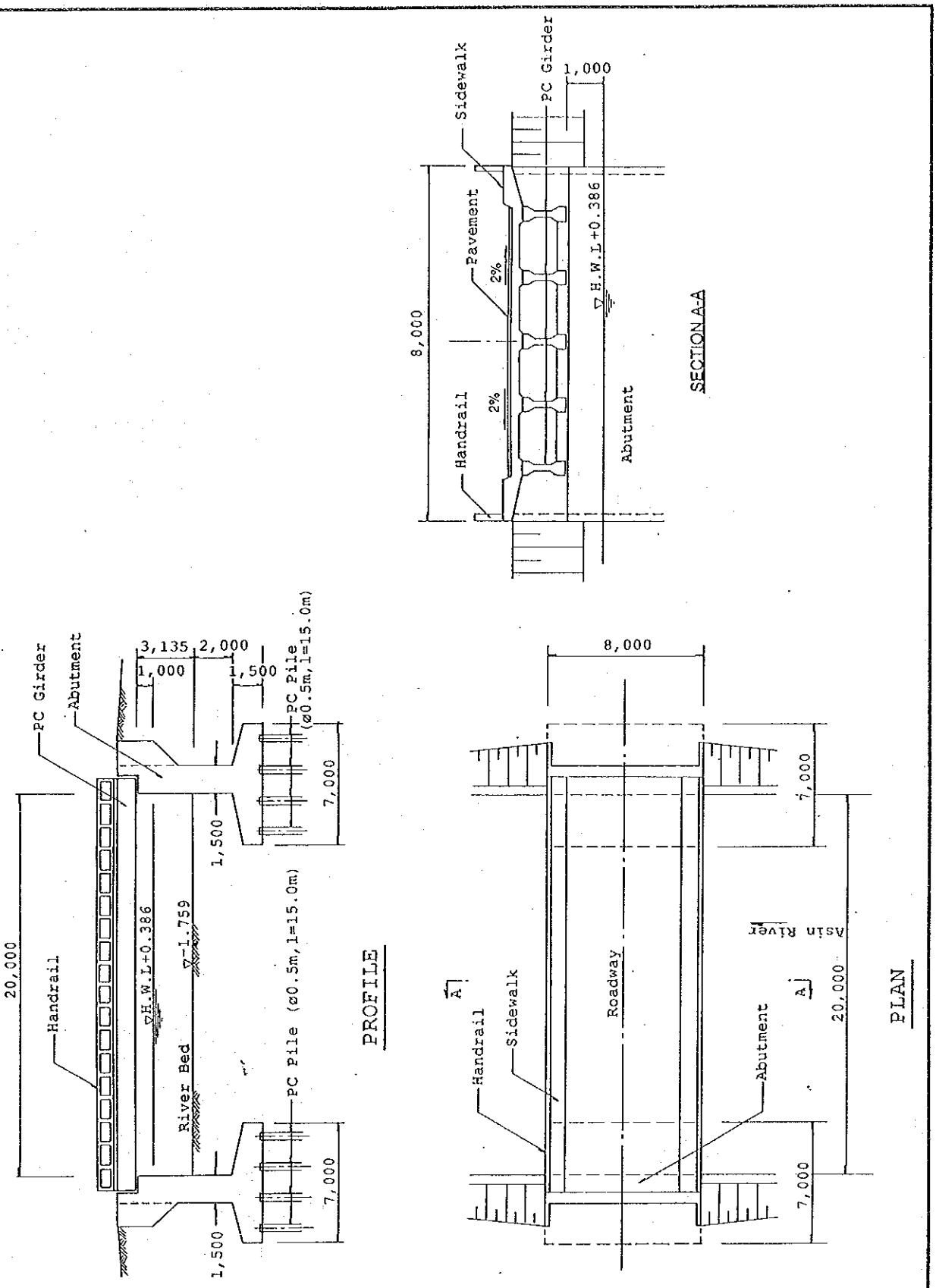


REVETMENT (Type-D & E)

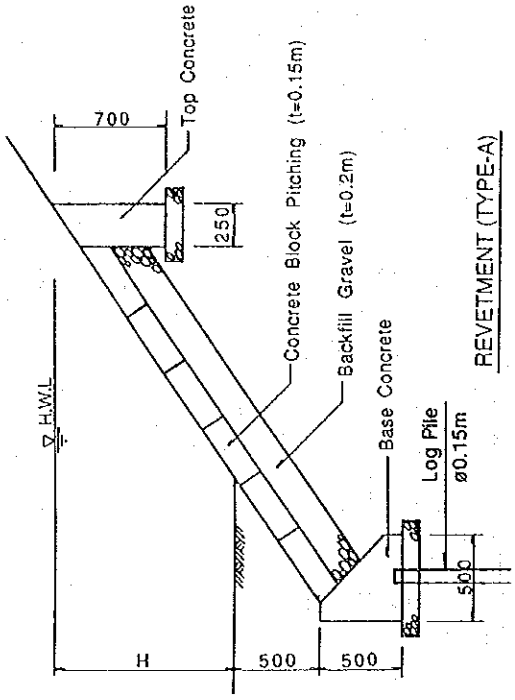


REVETMENT (Type-F)

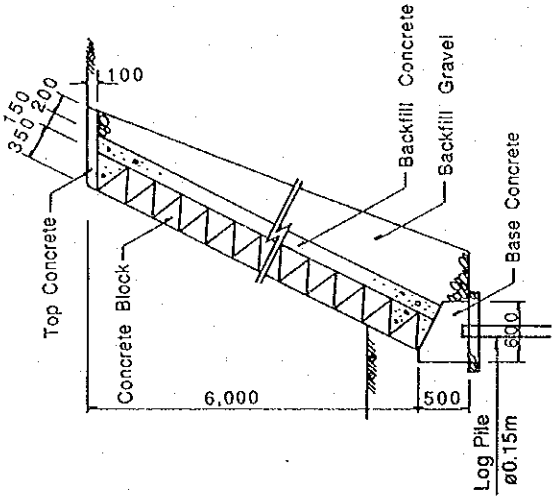
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.16 TYPICAL SECTIONS OF REVETMENT



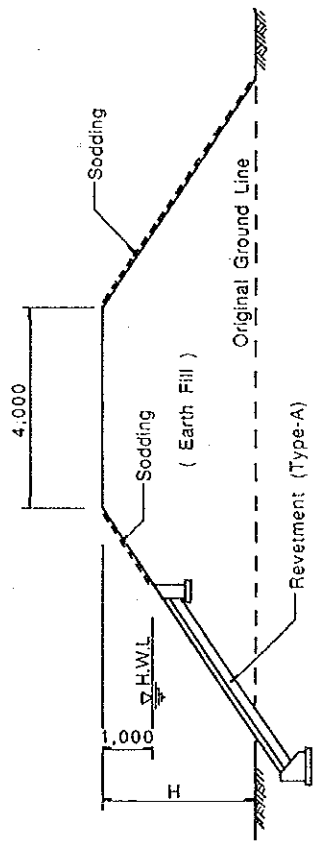
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.X.3.17 TYPICAL DESIGN OF ROAD BRIDGE



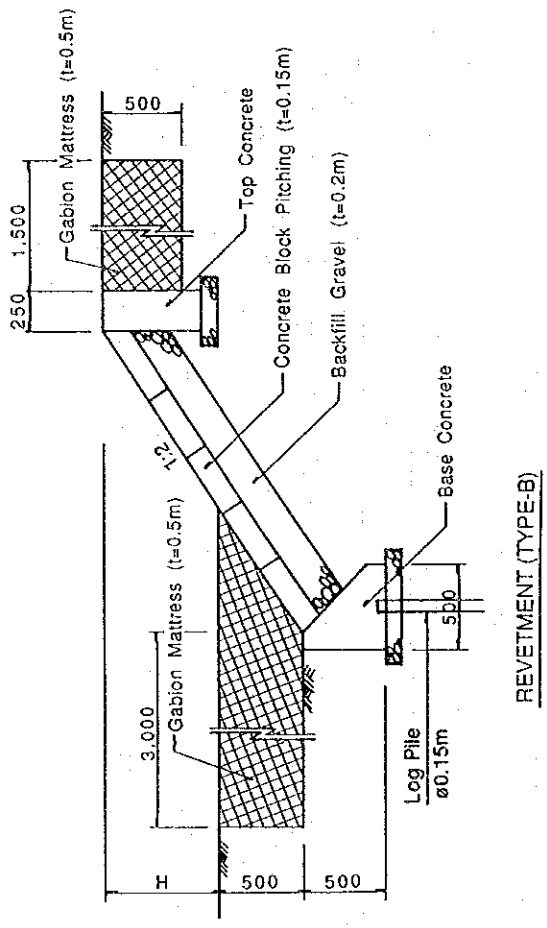
REVETMENT (TYPE-A)



REVETMENT (TYPE-C)

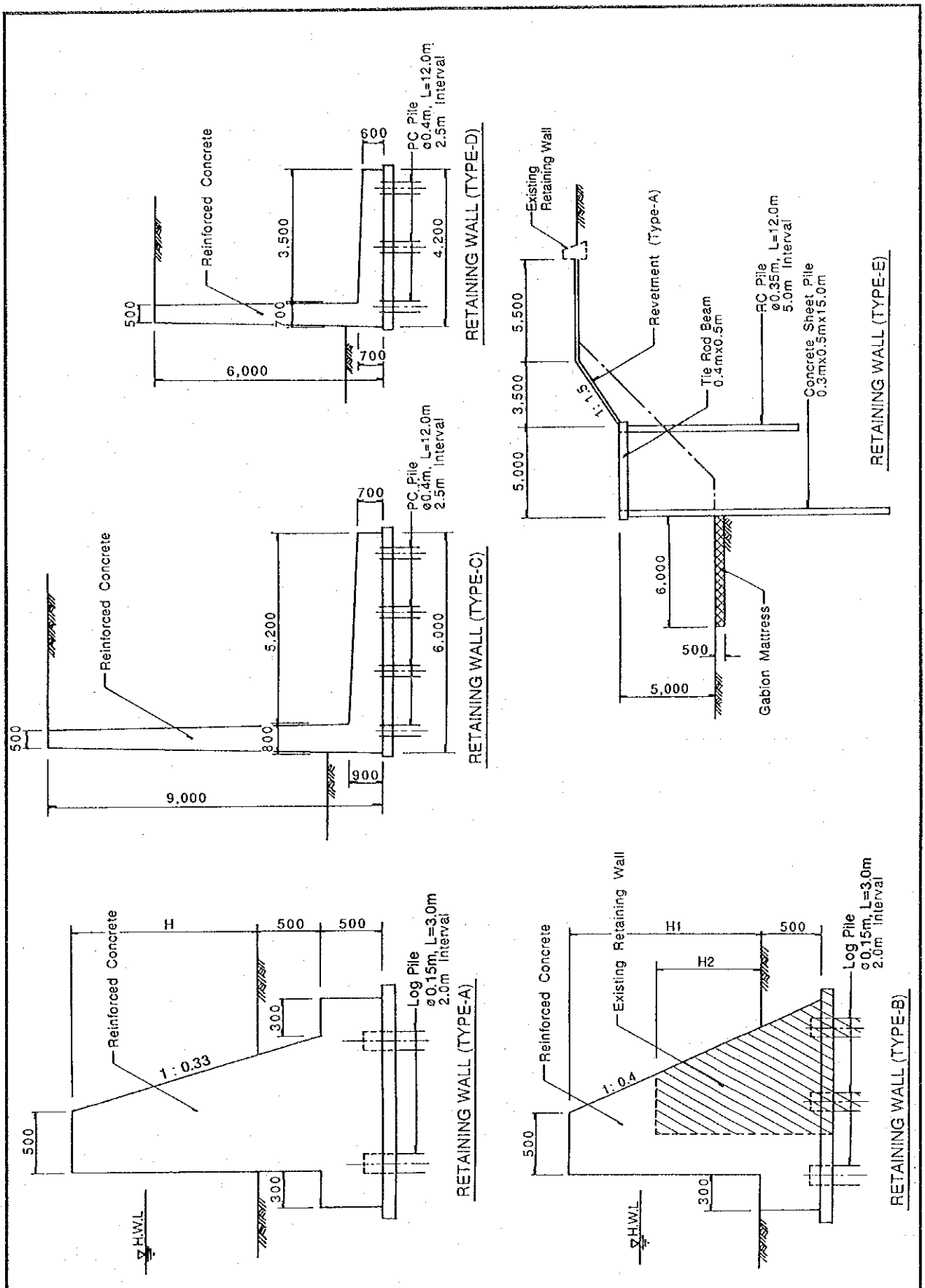


EARTH DIKE



REVETMENT (TYPE-B)

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.4.1 STANDARD DESIGN SECTION OF EARTH DIKE AND REVETMENT

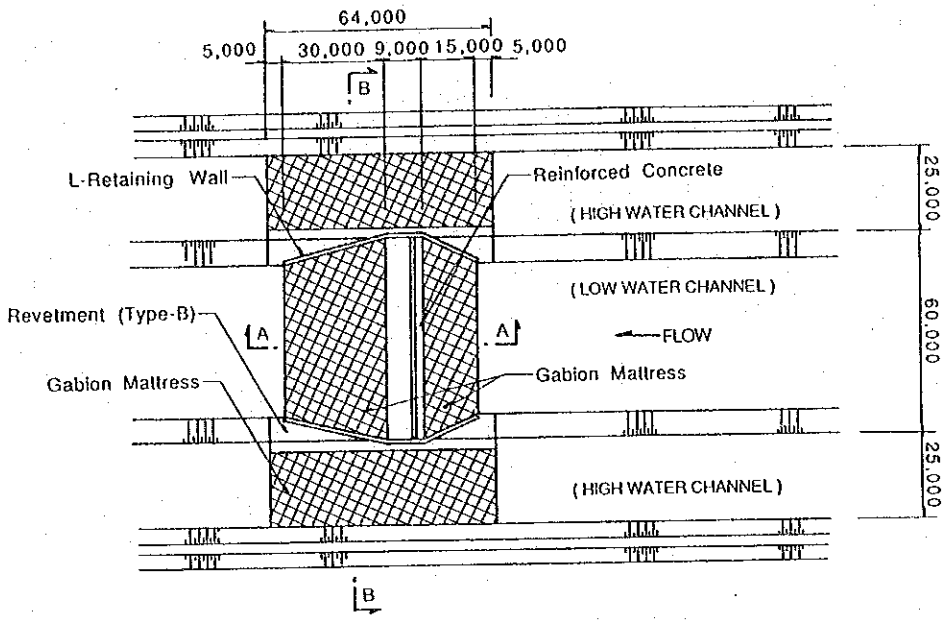


MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

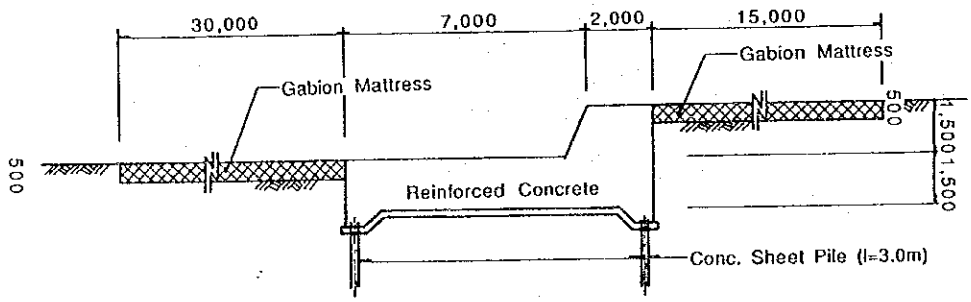
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. X.4.2

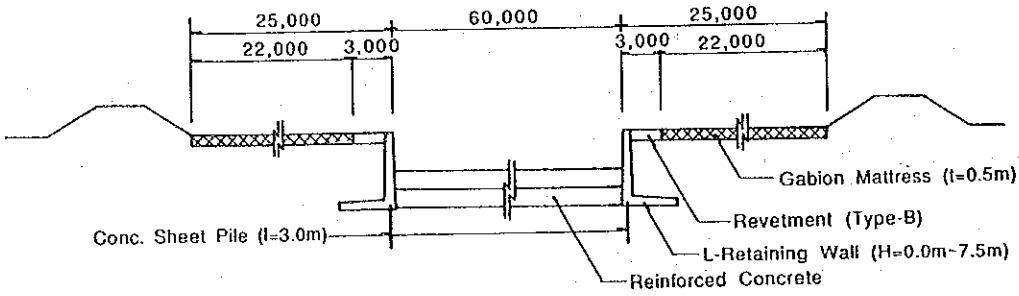
STANDARD DESIGN SECTION OF RETAINING WALL



PLAN



SECTION A-A



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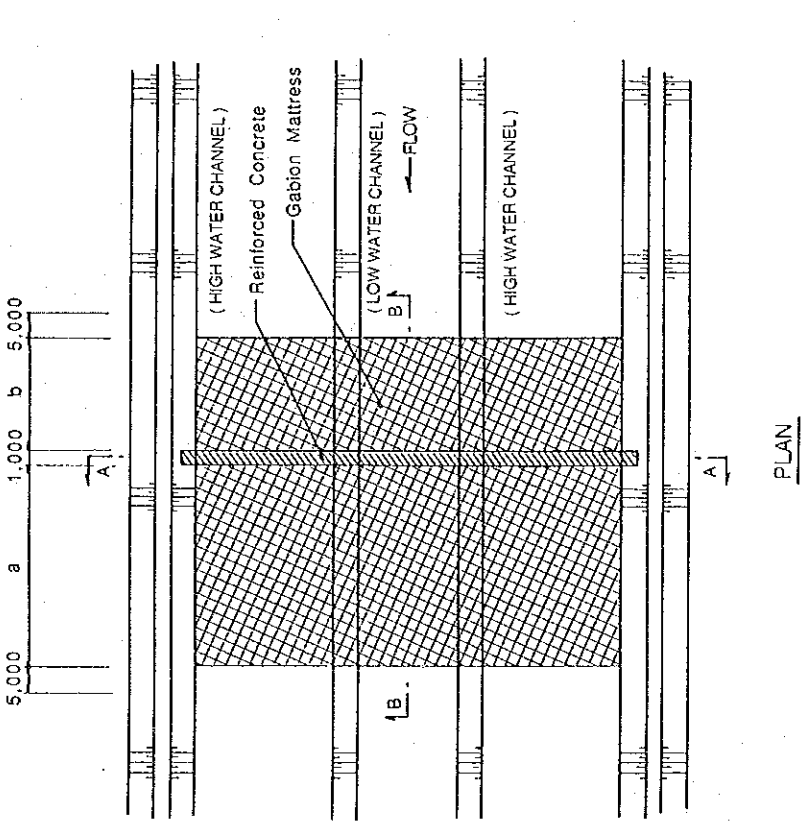
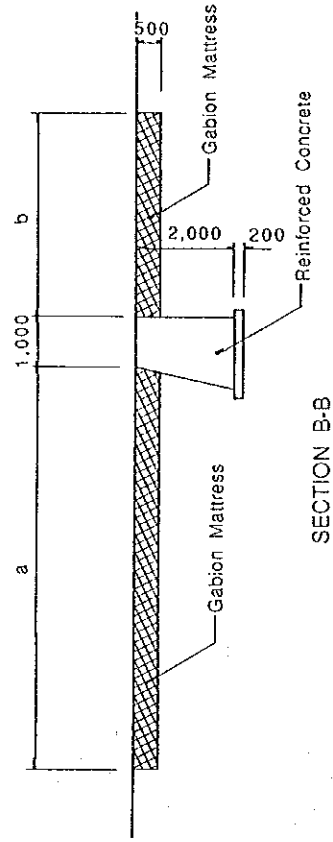
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.4.3(1/2) STANDARD DESIGN OF GROUNDSILL (TYPE A)



PLAN



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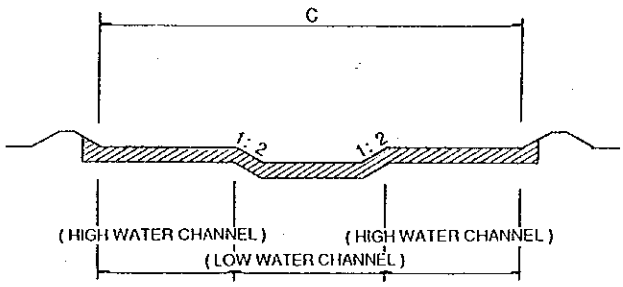


SECTION A-A

NOTE:

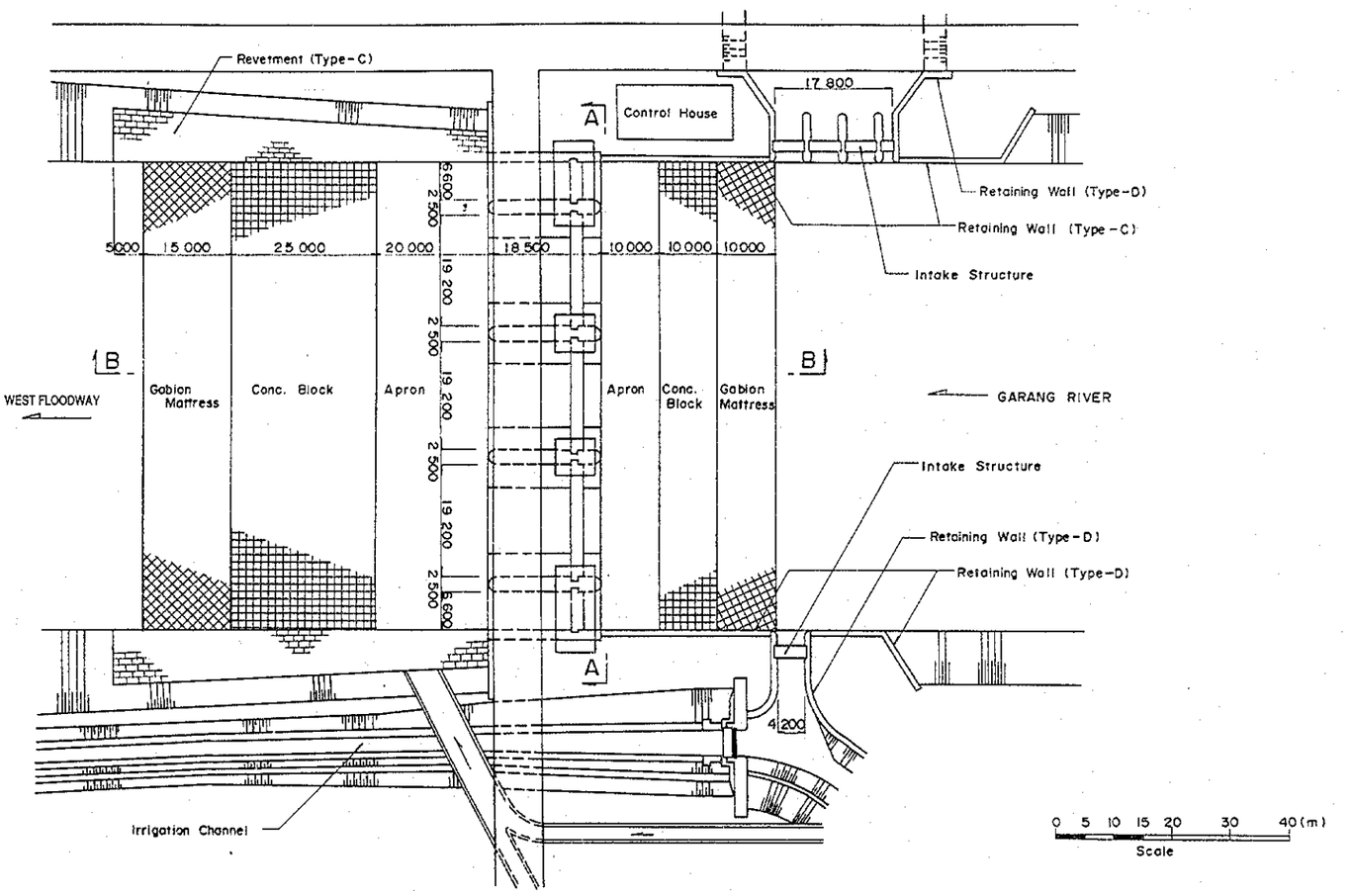
1) LOCATION AND DIMENSIONS

	LOCATION (from the mouth)	a (m)	b (m)	c (m)
TYPE-B	6.90 km	20	10	40
TYPE-C	7.50 km	20	10	10
TYPE-D	9.20 km	30	15	150

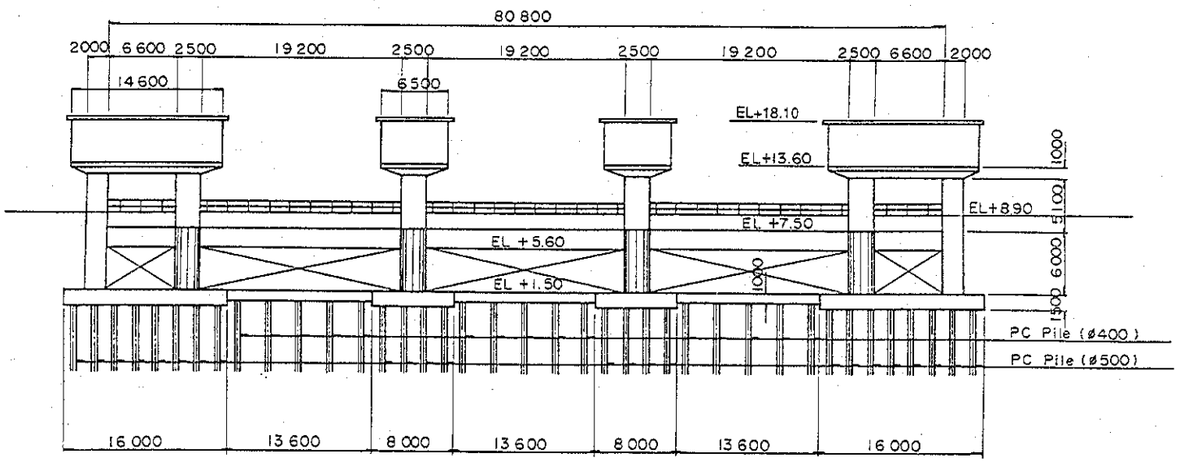
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. X.4.3(2/2)
STANDARD DESIGN OF GROUNDSILL
(TYPE B, C, D)



PLAN



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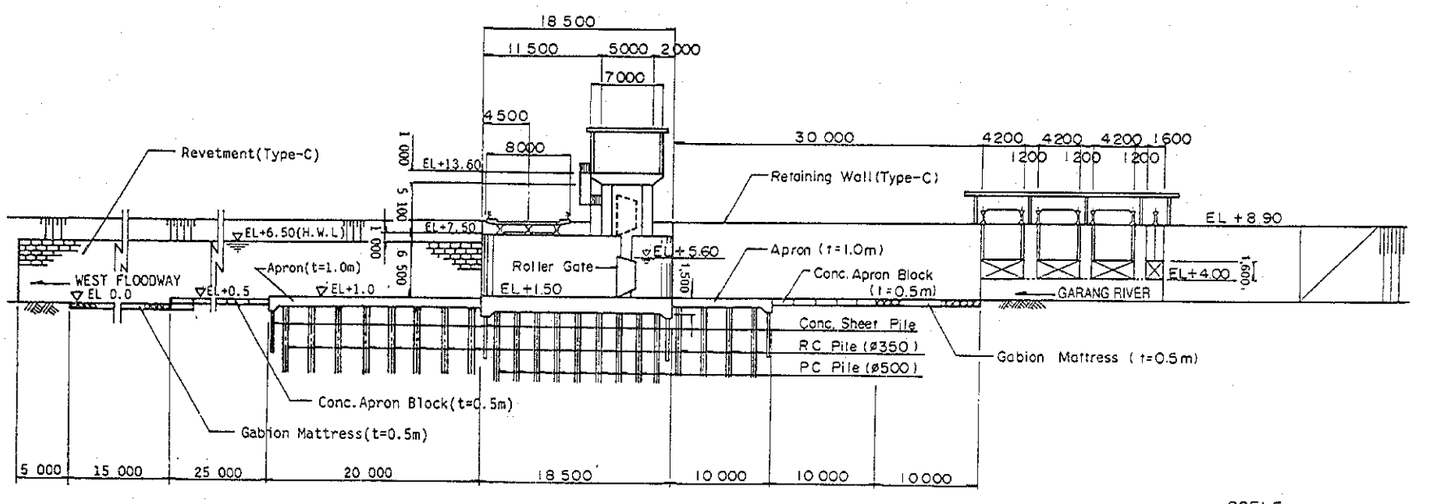

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MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
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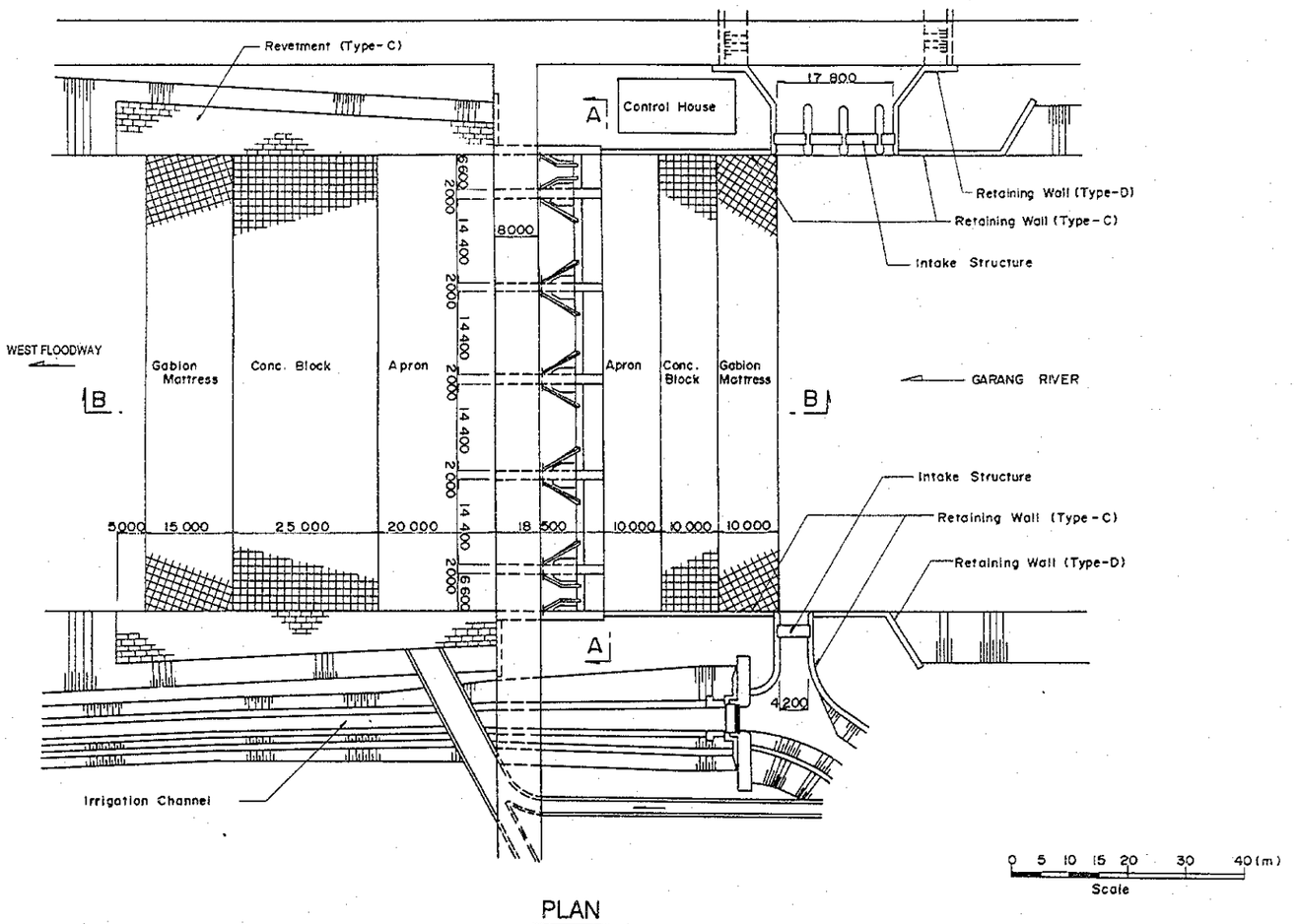
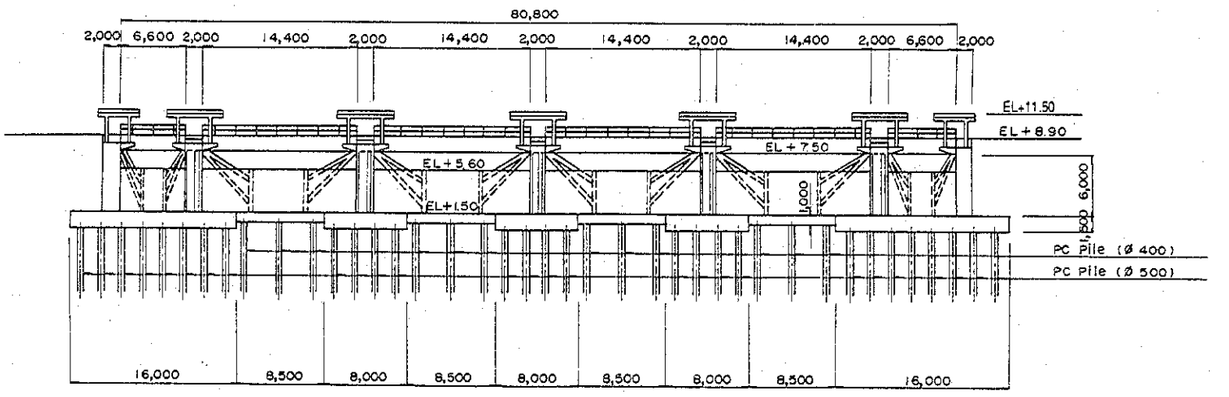
Fig. X.4.4(1/4)
STANDARD DESIGN OF SIMONGAN WEIR
(ROLLER GATE TYPE)



PLAN



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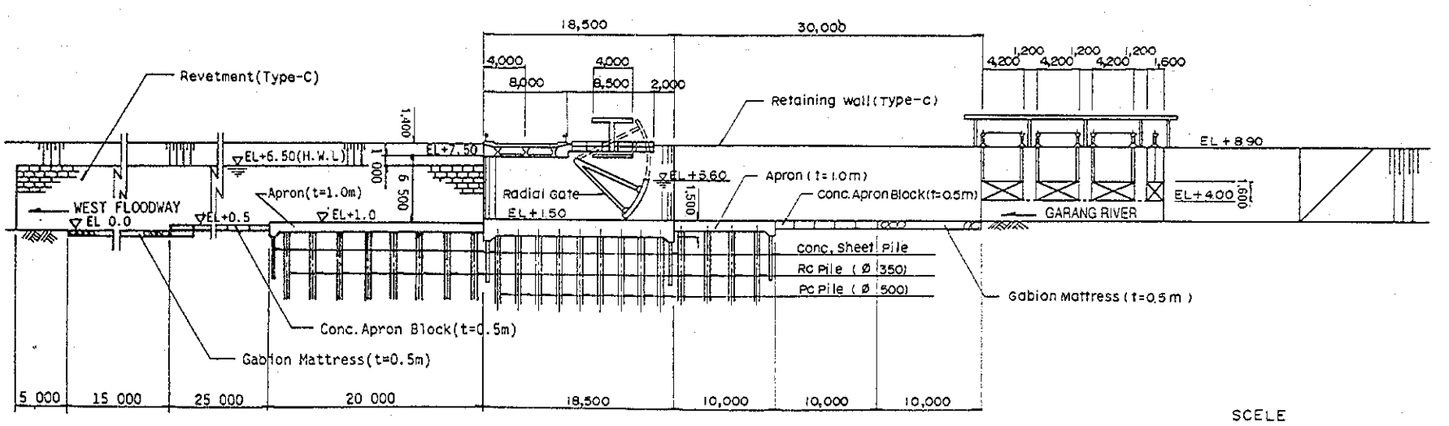

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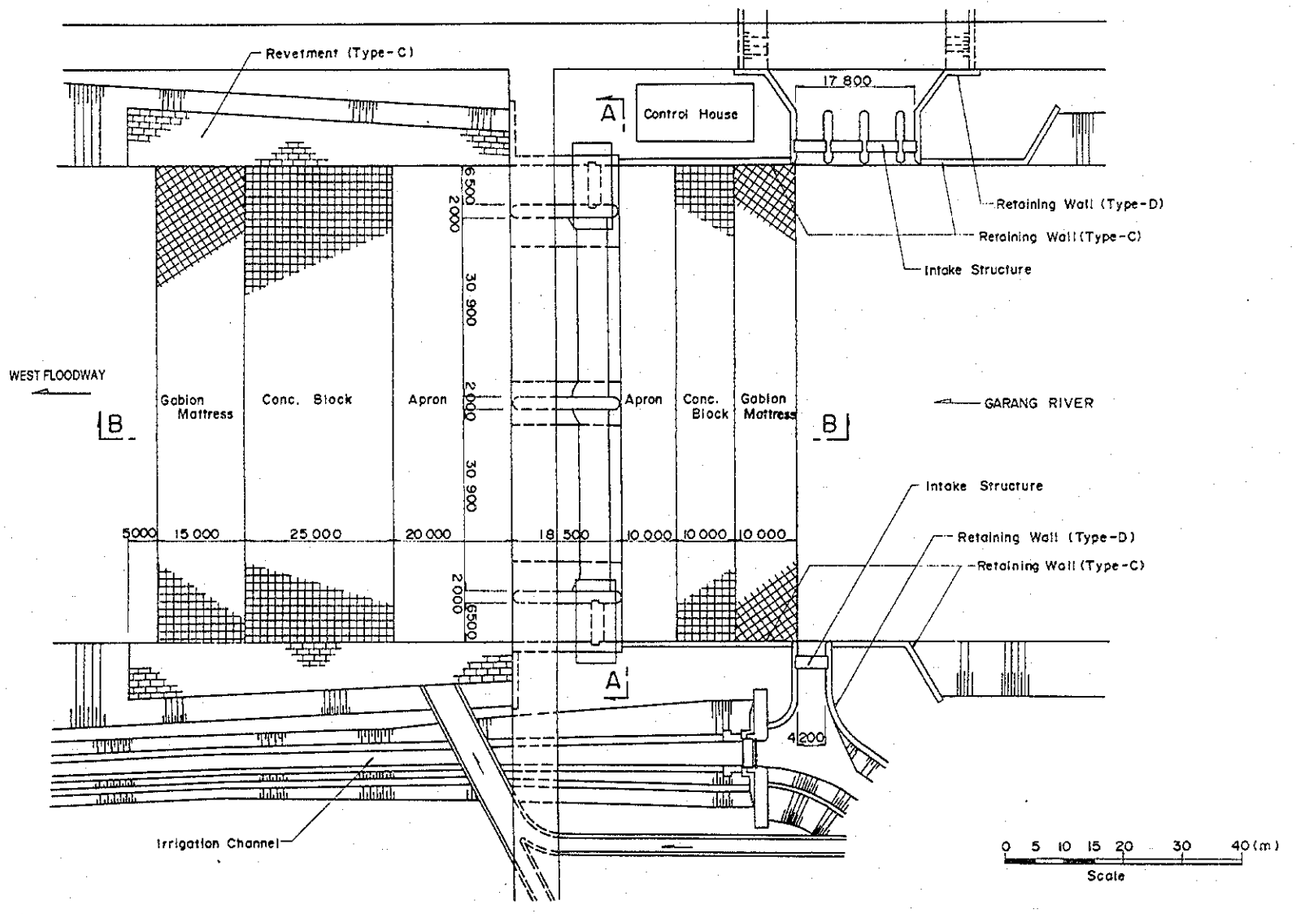
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

JAPAN INTERNATIONAL COOPERATION AGENCY

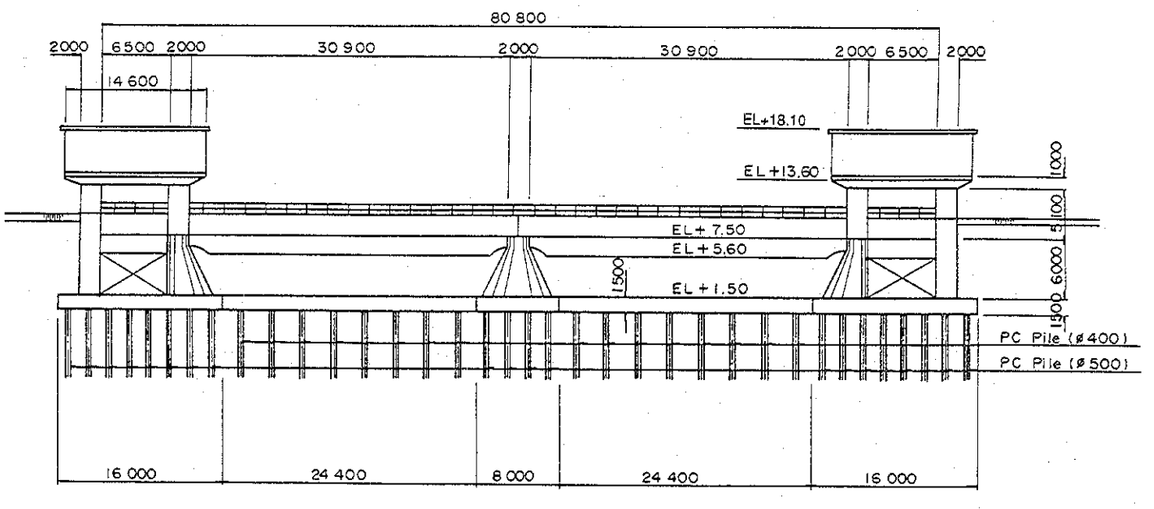
Fig. X.4.4 (2/4)

STANDARD DESIGN OF SIMONGAN WEIR

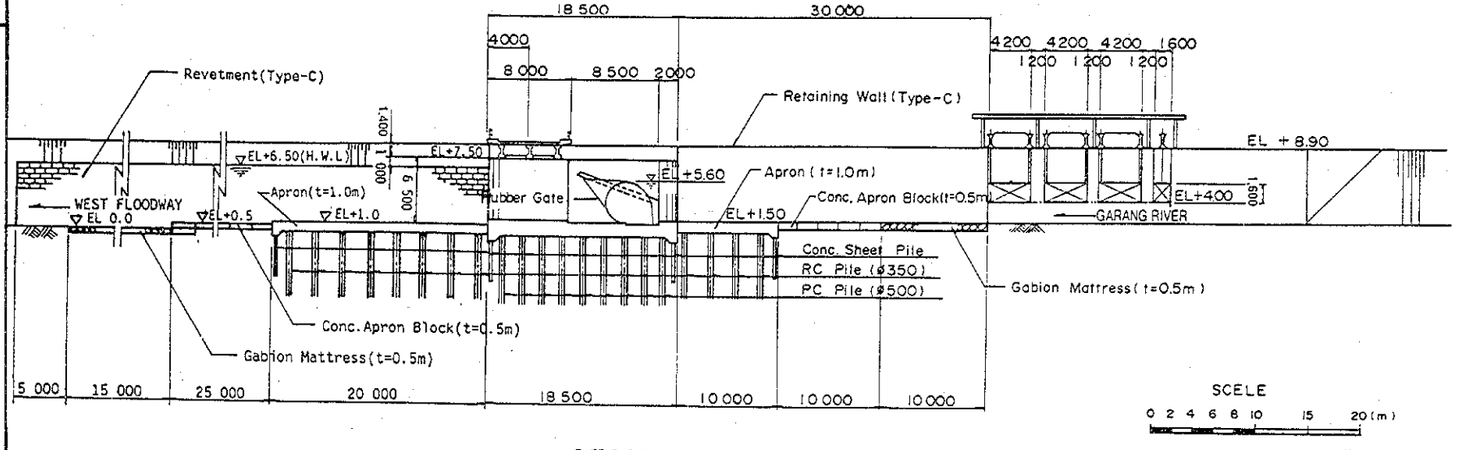
(RADIAL GATE TYPE)



PLAN



SECTION A – A



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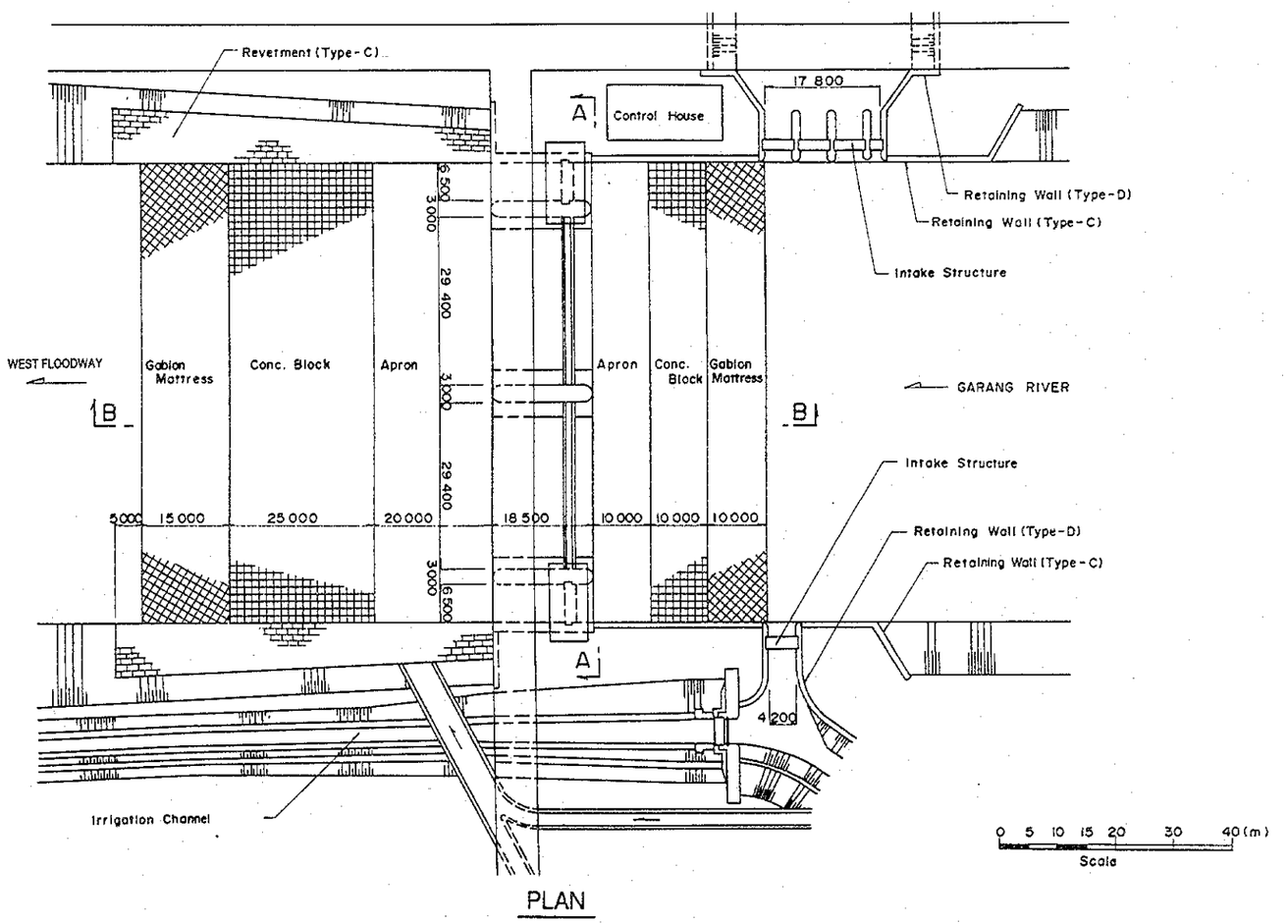
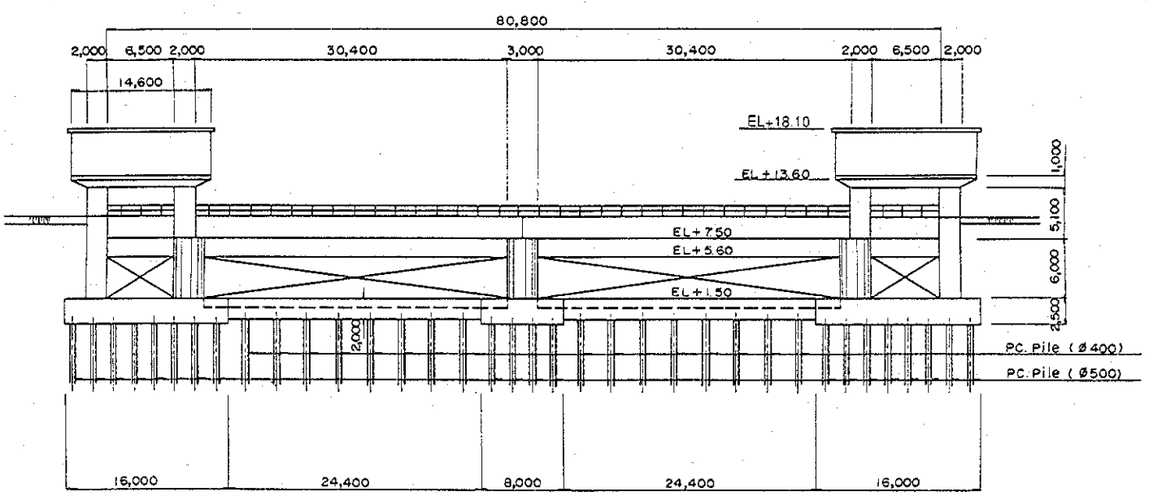
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
JAPAN INTERNATIONAL COOPERATION AGENCY

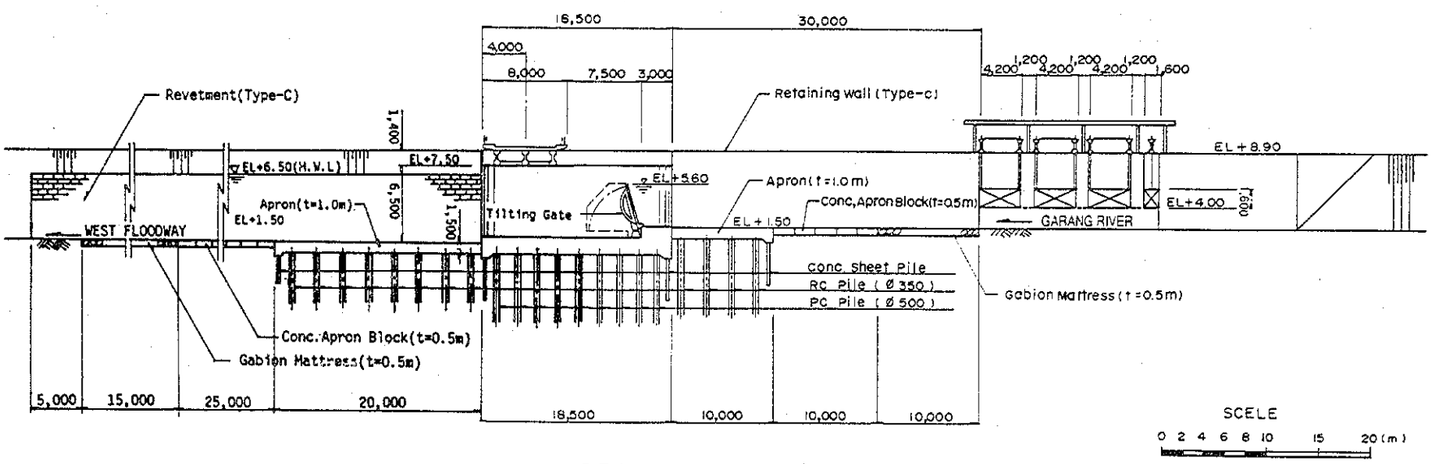
Fig. X.4.4(3/4)
STANDARD DESIGN OF SIMONGAN WEIR
(RUBBER GATE TYPE)



PLAN



SECTION A-A



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MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
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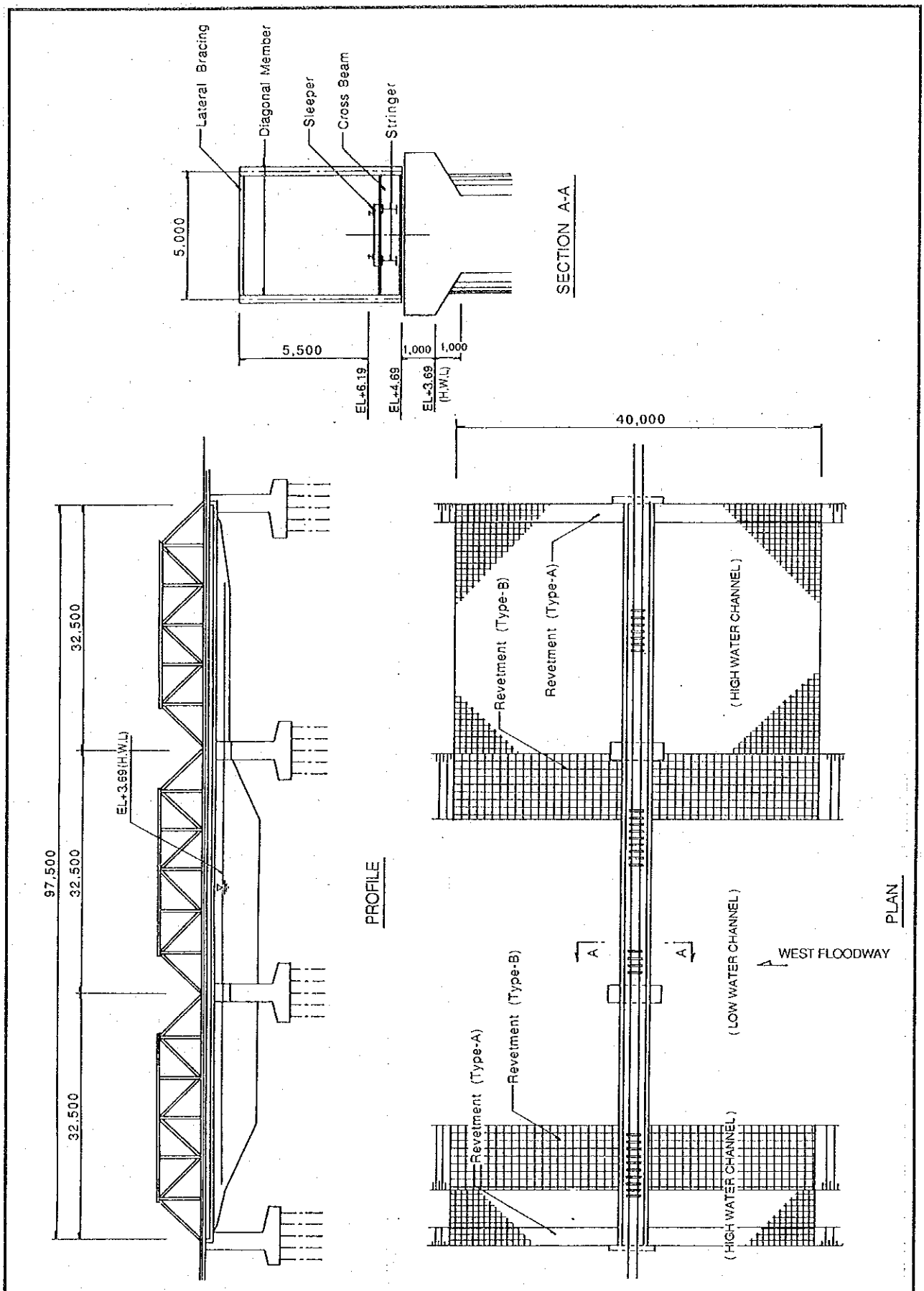
Fig. X.4.4(4/4)
STANDARD DESIGN OF SIMONGAN WEIR
(TILTING GATE TYPE)

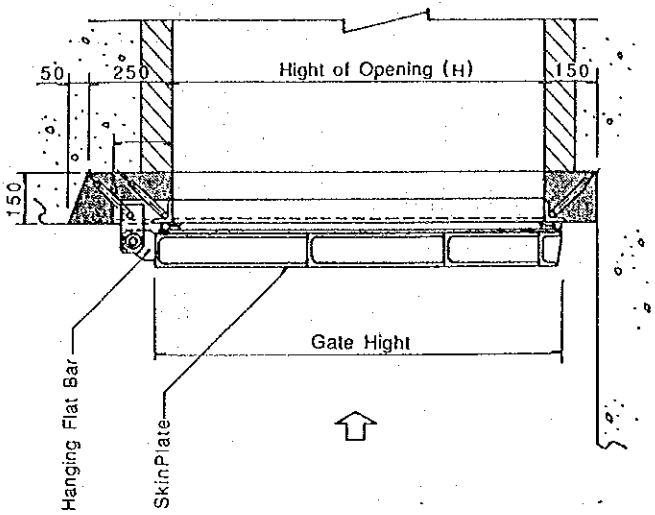


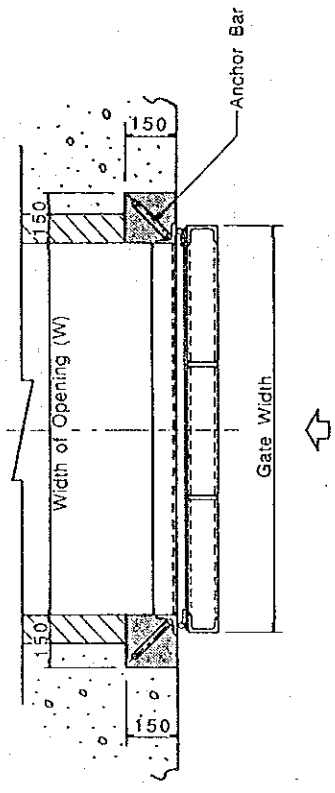
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.4.5 STANDARD DESIGN OF RAILROAD BRIDGE

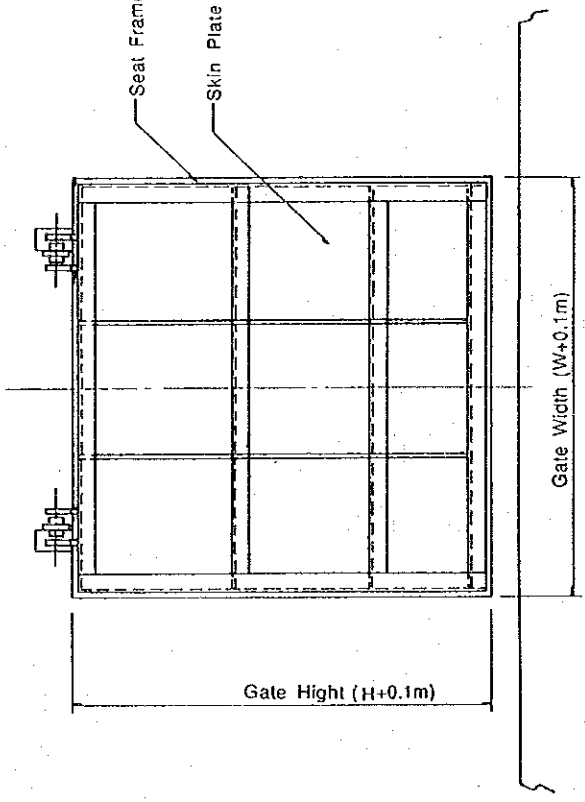
NOTE:

LOCATION AND DIMENTION OF CULVERT

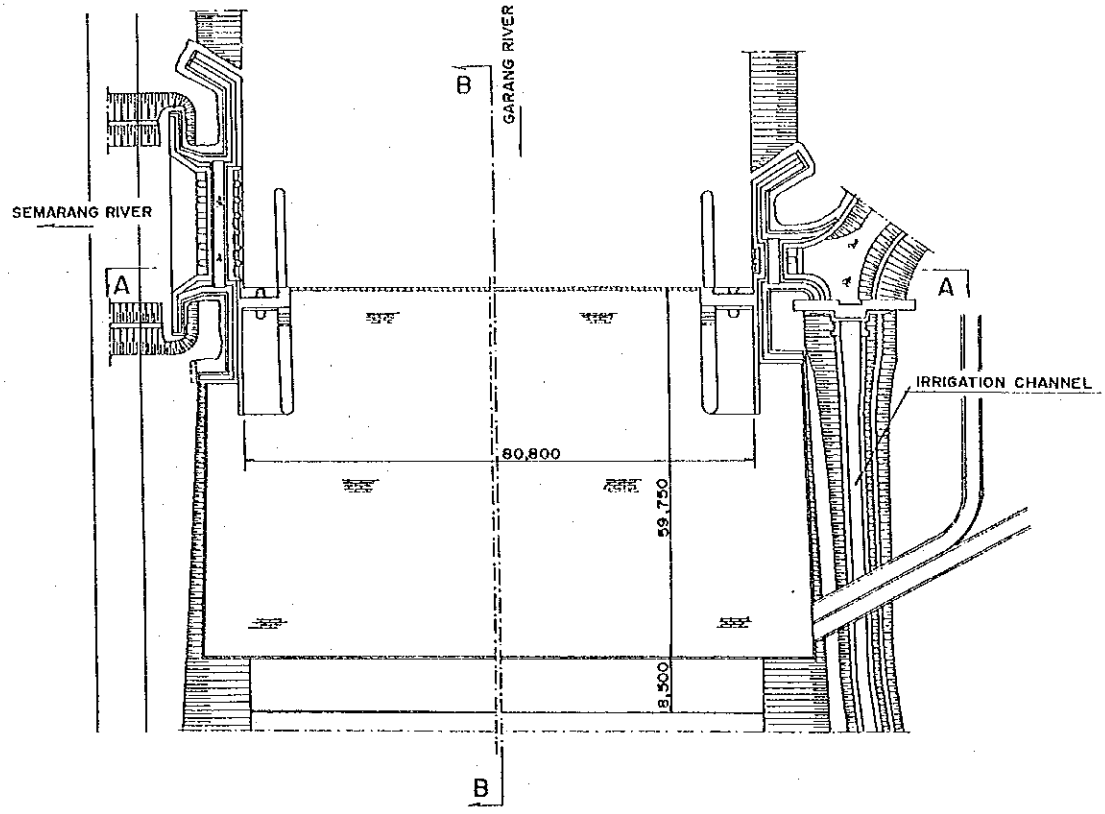
Station No.	W (m)	H (m)
1.81K	2.00	2.00
2.11K	2.20	2.20
3.01K	1.00	1.00



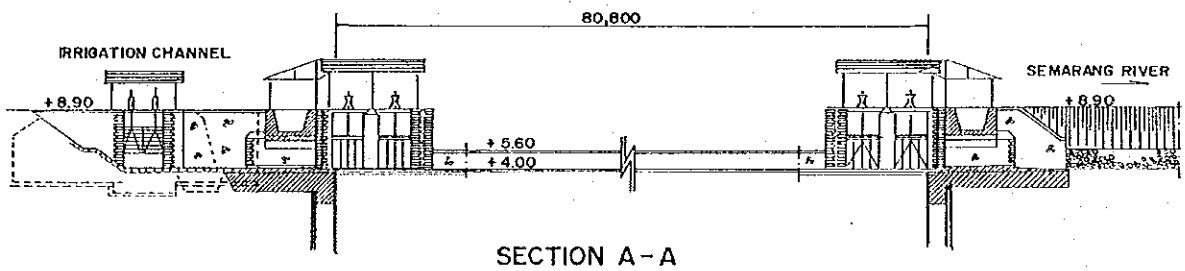




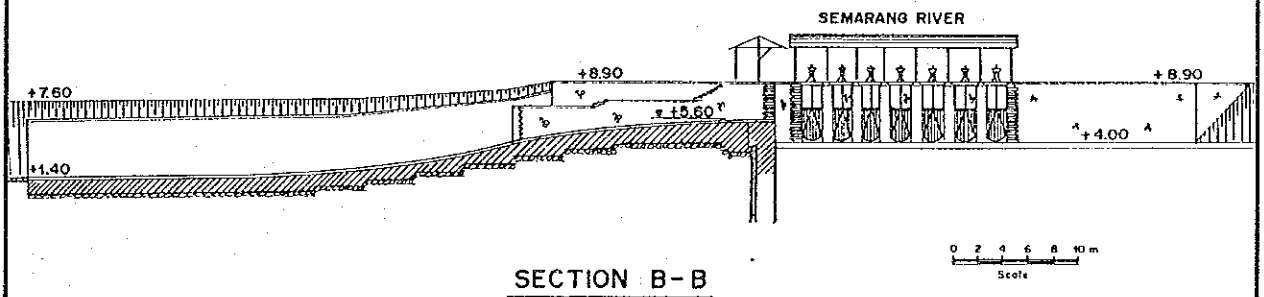
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.4.6 STANDARD DESIGN OF FLAP GATE FOR CULVERT



PLAN



SECTION A-A



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MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. X.4.7 GENERAL VIEW OF EXISTING SIMONGAN WEIR

XI CONSTRUCTION PLAN

XI CONSTRUCTION PLAN

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CHAPTER 1 GENERAL

This sector of the supporting report presents the construction plan of appropriate measures against flood damage and shortage of water supply in Semarang City and suburbs. The construction plan is worked out in consideration of topographic and meteorological conditions in the project area, the results of geological investigation and other factors related to the implementation of the project.

Standard construction methods are planned to be carried out with a combination of feasible equipment available in Indonesia.

CHAPTER 2 CONDITIONS FOR PLANNING

2.1 Topography and Geology

The study area is located in the northern slope of Mt. Ungaran which has an altitude of 2,050 m. The area can be divided into three topographical types: mountainous region, hilly region and alluvial plain. Semarang City is located in alluvial plains with elevation of about EL. 0 to 50 m along shorelines and rivers. Proposed dam sites are on the rivers originating from Mt. Ungaran. These rivers are characterized with steep slope in the hilly area because of the short stream length, large difference in ground level and gentle slope in alluvial plains.

Geology of this area is roughly divided into three categories: volcanic rock, sedimentary rock which is marine in origin, and alluvial deposits which cover these basement rocks. Folds and faults caused by volcanic activity are distributed in the study area. Small-scale folds are developed in the proposed dam sites and reservoir areas.

2.2 Meteorology

The study area is under the influence of northwest and southeast trade winds. Climate is divided into two seasons; namely, rainy season and dry season. The rainy season lasts between November and April with wet northwest winds from Jawa Sea bringing rainfall, while the dry season lasts between May and October with southeast winds. In the rainy season, annual rainfall amounts to 2,460 mm at the Semarang station located in the coastal plain.

Temperature at the Semarang station ranges between 21°C and 35°C, and average annual temperature is 27.4°C. Average annual humidity is 76%.

2.3 Other Conditions

Construction Period and Workable Days

Since construction works are much influenced by rainfall and flooding, the construction period and workable days are estimated based on the rainfall data at the Semarang station (refer to Fig. I.1.1) for 13 years starting from 1979. In addition, national holidays and religious events are considered.

The number of monthly rainy days are presented in Table XI.2.1. The calculation results on workable days are presented in Table XI.2.2 and summarized below.

Construction Period	Annual Workable Days
April to December	180 days

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 overtime work.

Mode of Construction

To implement the project works within the limited construction period, it is proposed to execute the project works by international contract system.

CHAPTER 3 URGENT PROJECT STUDY

3.1 Work Item and Quantities

River improvement is formulated as the Urgent Project for West Floodway/Garang River for the stretch of 9.54 km starting from the river mouth up to the confluence of Garang River and Kreo River. Work item and quantities are given in Table XI.3.1.

3.2 Standard Construction Method

Construction method must be safely and economically established with consideration given to the scale of works and site conditions. The standard construction method for main work items are as follows:

(1) River Improvement Works

Excavation

Excavation works are planned to be carried out by a combination of the following equipment. Regarding excavation of the river mouth, backhoe and pontoon barge are adopted because of the small quantity of excavation and using a dredger is not economical.

Excavation 1 (Excavation for on-land works):

Bulldozer	:	15-ton
Backhoe	:	0.6 m^3
Dump Truck	:	11-ton

Excavation 2 (Excavation for submerged portions lower than the tidal water level EL. 0.0 m):

Backhoe	:	0.6 m^3
Dump Truck	:	11-ton

Excavation 3 (Excavation for submerged portions far from land such as river mouth):

Backhoe	:	0.6 m^3
Pontoon Barge	:	200-ton
Scow	:	150 m^3
Dump Truck	:	11-ton

Embankment

Excavated materials above water level in the project area are mostly usable as embankment material. Embankment works including moisture content control, spreading and compacting of materials are planned to be carried out by a combination of the following major equipment:

Bulldozer	:	15-ton
Tire Roller	:	8-ton
Wheel Loader	:	0.8 m^3

Concrete Works

Cement is procured from suppliers in Semarang and concrete aggregate is procured from an existing crushing plant after confirming that the aggregate is composed essentially of clean, uncoated, properly shaped particles of strong, durable materials.

Concrete works such as backfilling concrete, reinforced concrete for groundsill and

retaining wall are to be carried out by a combination of the following major equipment:

Concrete Plant	:	1.0 m^3
Generator	:	150 KVA
Wheel Loader	:	0.8 m^3
Truck Mixer	:	3.0 m^3
Crawler Crane	:	37-ton
Concrete Bucket	:	1.0 m^3

(2) Reconstruction of Simongan Weir

Preparatory Works

Preparatory works including equipment transportation facilities, electric power facilities, temporary material storage yards and temporary field buildings are prepared near the construction site before starting permanent works.

During the construction period, the existing reservoir water level is maintained and the water is supplied to PDAM, Semarang River and the existing irrigation channel. In case the reservoir water level goes down, water is supplied by submersible pump.

Diversion Works and Dewatering

The construction site must be enclosed by a temporary cofferdam, and the inside of the cofferdam must be dewatered because, in principle, the works must be executed under the dry condition. In this project, the new weir axis is shifted from the existing one to 30 m downstream and the existing weir can be used as

a temporary cofferdam in consideration of the following requirements:

(a) The existing reservoir water level of Simongan Weir must be maintained during the construction period.

(b) Using the existing weir as a temporary cofferdam is more economical than preparing a new temporary cofferdam.

In this method, one side of the existing scouring sluice is closed and the entire river flow is transferred to one-half of the temporary channel. Excavation, piling works and concrete works are carried out first in the closed section. Works at the remaining section are executed later, after the water flow is diverted into another side of the scouring sluice.

Piling Works

All piles as foundation treatment are procured from suppliers in Central Jawa Province. Piling works are to be carried out using the following major equipment:

Diesel Hammer : 2.5-ton

Concrete Works

Concrete placing facilities of the required capacities to suit the construction schedule must be mutually balanced with regard to concrete mixing, transportation and placing. Concrete works are to be carried out using the following major equipment:

Concrete Plant	:	1.0 m^3
Generator	:	150 KVA
Wheel Loader	:	0.8 m^3
Truck Mixer	:	3.0 m^3
Crawler Crane	:	37-ton
Concrete Bucket	:	1.0 m^3

Gate

Gate is shop designed and fabricated, and then transported in sections to the construction site where they are assembled, painted, inspected and tested to confirm their satisfactory functioning.

(3) Spoil Bank

Reclamation of the foreshore area is being executed by P. T. Indo Perkasa Usahatama at the left side of West Floodway to develop a golf course and a commercial area, requiring more than 3,000,000 m^3 of reclamation material. About 1,000,000 m^3 of excavated materials and debris from rivers and foundation of structures are to be disposed in this area. The average hauling distance from West Floodway and Garang River is 2.0 km and 6.5 km, respectively.

3.3 Implementation Schedule

The target year of completion of the Urgent Project is set at the year 2000. The pre-construction stage including detailed design, prequalification, tendering and contracting procedures is to be started in 1994. The implementation schedule is presented in Fig. XI.3.1.

The construction schedule of the Urgent Project planned in consideration of the construction method is presented in Fig. XI.3.2.

CHAPTER 4 MASTER PLAN STUDY

4.1 Flood Control Plan

Work Item and Quantities

The flood control plan is formulated for six (6) major rivers; namely, Blorong River, Bringin River, Silandak River, West Floodway/Garang River, East Floodway, and Babon River. Work item and quantities are given in Table XI.4.1.

Work Plan and Construction Materials

The work plan must be safely and economically established with consideration given to the scale of the works and site conditions. The standard construction method for main work items are described as follows.

Excavation for on-land works are planned to be carried out by a combination of 15-ton bulldozers, 0.6 m^3 backhoe and 11-ton truck. Excavation works for submerged portions lower than the tidal water level EL. 0.0 m are to be carried out by a combination of 0.6 m^3 backhoe and 11-ton truck.

Excavated materials above water level in the project area are mostly usable as embankment materials. Embankment works including moisture control, spreading and compacting of materials are planned to be carried out by a combination of 15-ton bulldozers, 8-ton tire roller and 0.8 m^3 wheel loader.

Cement, steel bars and aggregates for concrete can be procured from suppliers in Central Jawa Province. Concrete works such as backfilling concrete,

reinforced concrete for revetment and other structures are to be carried out by mixing with a 1.0 m^3 concrete plant, hauling with 3 m^3 truck mixer and placing with 37-ton crawler crane.

Implementation Schedule

The target year of completion of the Master Plan is set at the year 2015. The implementation schedule is prepared by placing higher priority on projects that can satisfy the following conditions:

(1) Urgency in implementation to mitigate the flood damage;

(2) Higher economic efficiency and less negative social impact to be expected with the implementation; and

(3) The Urgent Project for West Floodway/Garang River, and Babon Floodway scheduled to be implemented by the Jratunseluna Project.

The implementation schedule is prepared by priority of the EIRR and the above conditions. Fig. XI.4.1 shows the proposed implementation schedule.

4.2 Urban Drainage Plan

Work Item and Quantities

The urban drainage plan is formulated for three (3) drainage areas; namely, Eastern Semarang, Central Semarang and Western Semarang. Work items and quantities are given in Table XI.4.2.

Work Plan and Construction Materials

The major work items of the urban drainage project are channel improvement works composed of excavation, embankment and construction of revetment, and pump station including mechanical and electrical works. Earthworks and concrete works are planned to be carried out in the same manner as the flood control plan.

Implementation Schedule

The target year of the Master Plan is set at the year 2015. The implementation schedule is prepared by placing higher priority on projects that can satisfy the following conditions:

(1) Urgency in implementation to mitigate the flood damage;

(2) Higher economic efficiency and less negative social impact to be expected with the implementation; and

(3) The ongoing project.

Practically, the priority is examined in terms of EIRR considering the project cost including the surveyed and other primary and secondary channel improvements. Accordingly, the implementation schedule consisting of surveyed primary channel improvement is prepared taking into account the proper scheduling of annual expenditures and the above conditions (refer to Fig. XI.4.1).

4.3 Water Resources Development Plan

Objective Facilities

The water resources development plan proposes five (5) facilities; namely, Babon Dam, Jatibarang Dam, Mundingan Dam, Interbasin Transfer, and Kedung Suren Dam. The principal features and work quantities of these facilities are as follows:

Name	Type	Height (m)	Crest Length (m)	Volume (m^3)
Babon Dam	Rockfill	45.0	1,550	5,890,000
Jatibarang Dam	Concrete Gravity	77.0	180	170,000
Mundingan Dam	Concrete Gravity	50.0	480	188,000
Kedung Suren Dam	Rockfill	46.0	1,000	4,120,000
Interbasin Transfer	tunnel	2 m in height; 2 m in width; 1,600 m in length		

Work Plan

Dam construction works consist of diversion and care of river, excavation, foundation treatment, quarrying and borrowing of materials, embanking, placing concrete, construction of other appurtenant structures and water impounding schedule. While the excavation and concrete works will be continuously done all through the year, embankment work will be suspended during the rainy season from January to March, and diversion works will be started avoiding the rainy season.

Construction works will generally be performed by conventional method. Excavation and collection of materials will mainly be carried out by blading and ripping with bulldozers, loading with shovels and hauling with dump trucks. Excavation of hard rocks will be performed by drilling and blasting. Bulldozers will be used for the excavation of soft rocks.

In case of rockfill dam, compaction of core and filter material will be done by tamping rollers and vibratory rollers, respectively. Rock materials will be compacted with heavy vibratory rollers.

In case of concrete gravity dam, concrete is produced by a central mixing plant, and concrete placing will rely on a cable crane or a tower crane.

Basically, all works will be executed by applying the two-shift system everyday to facilitate effective dam construction.

Construction Materials

(1) Concrete Gravity Dam

Riverbed deposits such as sand and gravel cannot be utilized for concrete aggregates because of low quality. Hard rock such as andesite lava or intrusive rock are recommended. Therefore, Mt. Mergi, about 5 km south of the town of Ungaran, and a hilly area near Ungaran are proposed as quarry sites. These sites are composed mainly of andesite and can supply a sufficient amount of aggregates.

Cement can be procured from suppliers in Central Jawa Province. The supply capacity of cement in Semarang market exceeds the demand of dam construction.

(2) Rockfill Dam

Soil materials taken from the weathered portions of rock and topsoil distributed near the sites of Babon Dam and Kedung Suren Dam are mostly usable as core material. Riverbed deposits and flood plain deposits such as sand and gravel distributed near each dam site can be utilized for filter material and random fill.

Rock materials for Babon Dam can be taken from the quarry sites mentioned above located about 10 km south of the dam site. On the other hand, in the vicinity of Kedung Suren Dam, it is difficult to find sufficient volumes of the appropriate rock material such as andesite lava or intrusive rock. Therefore, in addition to rock materials transported from the above quarry sites, gravel taken from the riverbed of Blorong River and tributaries will be used in the rock zone. In this case, it may be necessary to adjust the grain size distribution of gravels.

Implementation Schedule

The implementation schedule of the Master Plan is prepared in the order of priority on components studied in SECTOR VII, WATER RESOURCES DEVELOPMENT PLAN. The construction works are scheduled to be executed as shown in Fig. XI.4.1.

CHAPTER 5 FEASIBILITY STUDY

5.1 General

Objective Priority Projects

The following are identified as the priority projects with appropriate measures proposed in the Master Plan:

(1) Flood Control Plan for Garang River Basin

(a) River Improvement Works for West Floodway/Garang River; and

(b) Construction of Jatibarang Dam.

(2) Urban Drainage Plan for Semarang River Basin

(a) Construction of three pumping stations;

(b) Channel improvement works in the Semarang river basin; and

(c) Construction of gate structure in Baru River.

(3) Water Resources Development Plan

(a) Construction of Jatibarang Dam; and

(b) Hydropower Station.

Work Item and Quantities

River improvement works for West Floodway/Garang River are applied to the Master Plan. Work items and quantities for the Urban Drainage Plan and the Water

Resources Development Plan are presented in Table XI.5.1.

5.2 Standard Construction Method

Flood Control Plan

Standard construction methods, except the construction of Jatibarang Dam, are applied to the Urgent Project described in CHAPTER 3.

Urban Drainage Plan

The major work items of the Urban Drainage Plan are channel improvement works including excavation, embankment and construction of revetment, and pump station including mechanical and electrical works.

Earth works, concrete works and piling works are planned to be carried out by the same equipment and by the same manner as the flood control plan.

The pumping equipment such as pump, main motor, pipe and valve and other facilities are to be imported.

Water Resources Development (Jatibarang Dam)

(1) Diversion Tunnel

Diversion tunnel is planned to divert flows at the dam site. When the dam is completed, the tunnel will be closed permanently by concrete plug. The required construction equipment is as follows:

Leg Hammer	:	40 kg
Tractor Shovel	:	1.4 m^3

Dump Truck	:	8 ton
Agitation Truck	:	4.5 m^3
Concrete Pump Car	:	45 m^3/hr

(2) Excavation

Excavation for the main dam will be executed after the river water is diverted through the completed diversion tunnel. The required construction equipment is as follows:

Bulldozer with Ripper	:	32 ton
Tractor Shoverl	:	3.2 m^3
Dump Truck	:	20 ton
Bulldozer	:	11 ton
Crawler Drill	:	15 m^3/min
Air Compressor	:	17 m^3/min

(3) Concrete Works

Mass concrete and reinforced concrete for the dam body will be placed using a cable crane. Left end of the cableway is made movable in consideration of the topographical conditions. The required construction equipment is as follows:

Concrete Plant	:	3.0 m^3
Cable Crane	:	9.5 ton
Concrete Bucket	:	3.0 m^3

(4) Foundation Treatment

Curtain grouting will be executed from the upstream toe in parallel with the concrete placing. The required construction equipment is as follows:

Leg Drill	:	2.7 m^3/min
Boring Machine	:	5.5 kW
Grout Pump	:	7.5 kW
Grout Mixer	:	200 liter

(5) Penstock

Since the penstock is designed to be lain in the dam body, it will be installed together with the concrete placing of the dam. The cable crane to be used for concrete works of the dam will also be used to carry the pieces of penstock to the designated positions.

(6) Power Station and Power Generating Equipment

Foundation excavation and concrete placing for the power station will be conducted concurrently with the excavation for the energy dissipator. The power generating equipment will be installed using a 37 ton crawler crane.

5.3 Implementation Schedule

The target year of the Feasibility Study is set at the year 2005. However, the completion year of the priority projects of Flood Control Plan and the Water Resources Development Plan is, however, set at the year 2000, as proposed in the Master Plan, due to the following reasons:

(1) Jatibarang Dam has to be completed in the year 2000 to cope with the incremental water demand of Semarang City (refer to SECTOR VII, WATER RESOURCES DEVELOPMENT PLAN).

(2) The river channel improvement of West Floodway/Garang River has to be completed as Urgent Project before the year 2000 so as to relieve the extremely high flood damage potential as agreed in the Minutes of Meeting between DGWRD and JICA in 1991.

Consequently, the target completion year of the Feasibility Study is set as follows:

Flood Control Plan	:	year 2000
Urban Drainage Plan	:	year 2005
Water Resources Development Plan	:	year 2000

The implementation schedule and the construction schedule are presented in Figs. XI.5.1 and XI.5.2, respectively. The construction schedule of the river channel improvement for West Floodway/Garang River is applied to the Urgent Project.

TABLES

Table XI.2.1 MONTHLY RAINY DAYS AT SEMARANG METEOROLOGICAL STATION (BMG)

Unit: day

Year	Rainfall	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1979	0< R < 5 mm	16	24	23	18	22	27	27	27	22	26	18	25	275
	5< R <10 mm	7	1	2	2	0	0	1	1	2	2	6	3	27
	10< R <15 mm	2	1	2	3	0	2	2	2	2	0	2	0	18
	15< R <30 mm	2	1	2	5	6	0	1	0	3	2	2	1	25
	30 mm < R	4	1	2	2	3	1	0	1	1	1	2	2	20
1980	0< R < 5 mm	19	21	25	21	27	29	26	26	28	27	23	19	291
	5< R <10 mm	3	2	0	5	0	0	1	1	1	1	1	3	18
	10< R <15 mm	0	2	2	1	1	0	2	2	0	1	1	4	16
	15< R <30 mm	4	0	2	3	1	1	2	0	0	2	4	2	21
	30 mm < R	5	3	2	0	2	0	0	2	1	0	1	3	19
1981	0< R < 5 mm	9	14	23	18	27	24	26	30	24	26	24	20	265
	5< R <10 mm	2	4	1	3	0	3	0	0	2	2	2	3	22
	10< R <15 mm	4	0	0	0	1	0	1	0	1	0	1	3	11
	15< R <30 mm	7	3	7	3	1	2	2	1	1	3	0	3	33
	30 mm < R	9	7	0	6	2	1	2	0	2	0	3	2	34
1982	0< R < 5 mm	14	18	25	-	-	30	29	-	-	31	-	20	167
	5< R <10 mm	2	2	2	-	-	0	1	-	-	0	-	3	10
	10< R <15 mm	6	1	1	-	-	0	1	-	-	0	-	1	10
	15< R <30 mm	4	1	3	-	-	0	0	-	-	0	-	6	14
	30 mm < R	5	6	0	-	-	0	0	-	-	0	-	1	12
1983	0< R < 5 mm	-	20	26	22	23	30	31	31	30	19	19	26	277
	5< R <10 mm	-	2	3	6	0	0	0	0	0	1	1	1	14
	10< R <15 mm	-	2	0	1	2	0	0	0	0	3	3	0	11
	15< R <30 mm	-	2	2	0	2	0	0	0	0	2	5	1	14
	30 mm < R	-	2	0	1	4	0	0	0	0	6	2	3	18
1984	0< R < 5 mm	22	14	21	20	23	27	24	29	16	25	18	15	254
	5< R <10 mm	2	4	1	3	4	2	2	2	3	1	2	3	29
	10< R <15 mm	0	4	2	1	3	0	0	0	3	2	3	2	20
	15< R <30 mm	3	3	4	3	1	1	5	0	6	0	4	4	34
	30 mm < R	4	3	3	3	0	0	0	0	2	3	3	7	28
1985	0< R < 5 mm	23	16	20	24	23	24	26	28	27	26	22	21	280
	5< R <10 mm	1	2	3	1	1	1	1	0	0	1	3	4	18
	10< R <15 mm	1	2	1	1	2	2	2	1	1	2	1	3	19
	15< R <30 mm	3	3	4	2	2	1	1	1	0	1	3	0	21
	30 mm < R	3	5	3	2	3	2	1	1	2	1	1	3	27
1986	0< R < 5 mm	13	21	22	24	30	23	29	29	26	26	21	20	284
	5< R <10 mm	4	2	1	3	0	1	1	0	3	1	3	5	24
	10< R <15 mm	1	0	2	0	0	2	0	1	0	1	1	1	9
	15< R <30 mm	6	5	5	1	1	1	0	0	0	1	3	4	27
	30 mm < R	7	0	1	2	0	3	1	1	1	2	2	1	21
1987	0< R < 5 mm	17	18	22	26	25	26	30	30	-	29	22	18	263
	5< R <10 mm	4	2	4	2	3	3	0	0	-	0	5	2	25
	10< R <15 mm	1	1	1	1	0	0	0	1	-	0	1	6	12
	15< R <30 mm	5	3	1	0	1	1	1	0	-	2	1	4	19
	30 mm < R	4	4	3	1	2	0	0	0	-	0	1	1	16
1988	0< R < 5 mm	16	14	21	26	25	25	27	29	28	22	23	15	271
	5< R <10 mm	4	3	0	3	0	2	0	0	1	2	1	5	21
	10< R <15 mm	0	5	0	1	0	1	1	0	1	1	1	4	15
	15< R <30 mm	7	4	5	0	2	1	2	1	0	2	3	3	30
	30 mm < R	4	2	5	0	4	1	1	1	0	4	2	4	28
1989	0< R < 5 mm	21	14	21	25	24	24	28	28	28	28	19	19	279
	5< R <10 mm	3	2	2	1	1	1	1	1	1	0	2	3	18
	10< R <15 mm	2	1	4	1	2	1	0	0	0	0	4	1	16
	15< R <30 mm	1	4	4	1	1	1	1	1	1	2	2	4	23
	30 mm < R	4	7	0	2	3	3	1	1	0	1	3	4	29
1990	0< R < 5 mm	14	24	24	23	24	26	26	23	23	-	26	18	251
	5< R <10 mm	5	1	1	3	3	0	0	3	2	-	1	6	25
	10< R <15 mm	1	2	2	0	2	0	0	1	0	-	1	3	12
	15< R <30 mm	3	0	1	4	2	3	2	1	2	-	1	3	22
	30 mm < R	8	1	3	0	0	1	3	3	3	-	1	1	24
1991	0< R < 5 mm	20	13	26	22	-	-	31	-	30	30	20	15	207
	5< R <10 mm	3	0	0	0	-	-	0	-	0	0	3	5	11
	10< R <15 mm	0	4	2	1	-	-	0	-	0	0	1	2	10
	15< R <30 mm	8	3	2	5	-	-	0	-	0	1	4	5	28
	30 mm < R	0	8	1	2	-	-	0	-	0	0	2	4	17
Average	0< R < 5 mm	17.0	17.8	23.0	22.4	24.8	26.3	27.7	28.2	25.6	26.3	21.3	19.3	279.7
	5< R <10 mm	3.3	2.1	1.5	2.7	1.1	1.1	0.6	0.7	1.4	0.9	2.5	3.5	21.4
	10< R <15 mm	1.5	1.9	1.5	0.9	1.2	0.7	0.7	0.7	0.7	0.8	1.7	2.3	14.6
	15< R <30 mm	4.4	2.5	3.2	2.3	1.8	1.0	1.3	0.5	1.2	1.5	2.7	3.1	25.5
	30 mm < R	4.8	3.8	1.8	1.8	2.1	1.0	0.7	0.9	1.1	1.5	1.9	2.8	24.2