2-4-4 Basic Design of Basic Facilities

(1) Dimensions of Design Vessels

Table-2.4.16 shows maximum and average dimensions of inshore vessels at Sekondi Fishing Port. The largest vessel is a trawler with the length of 16.8 m and the maximum draft of 1.8 m. The vessel is currently based in Tema, but in the past has landed fishes at Sekondi. The interview survey revealed that its owner intends to move the vessel from Tema to Sekondi when wharves are built at Sekondi. Average dimensions of inshore vessels are 10 m in length, 2.5 m in breadth and 1.3 m in maximum draft.

Table-2.4.17 shows dimensions of canoes with outboard engine.

Table-2.4.16 Maximum and Average Dimensions of Inshore Vessels

	Maximum	Average
Engine Power	150 HP	89 HP
O. A. Length	16.8 m	10.0 m
Breadth	4.9 m	2.5 m
Max. Draft	1.8 m	1.3 m
Number of Crew	19	14.5

Source: Fisheries Department

Table-2.4.17 Dimensions of Canoes with Outboard Engine

	Large Canoe	Medium Canoe	Small Canoe
Engine Power	40 HP	40 HP	25 HP
O. A. Length	20 m	17 m	13 m
Breadth	1.6 m	1.3 m	1.1 m
Max. Draft	0.7 m	0.5 m	0.3 m
Number of Crew	24	8	4

Source: Fisheries Department

(2) Basic Plan for Breakwater

This project plans to construct a breakwater as a protective facility for the port and to improve calmness of the area in front of the wharf. The design concept for the breakwater and proposed dimensions are given below.

1) Design Concept for Breakwater

The layout, length, structure type and dimensions of the breakwater must satisfy the following conditions.

Layout	:	The port entrance should have a sufficient width for smooth navigation of inshore vessels. The layout and length should be such as would secure sufficient calmness of the basin to allow smooth port operations, reduce shoaling of the navigation channel and basin due to drift sand, and minimize effects on the sandy beach.
Structure type	:	The breakwater should be structurally stable against waves. It should have a sluice of seawater in order to promote exchange of water in and out of the port.
Dimensions	:	The width and height should have the normally required dimensions. Provided, however, the trunk should be built by using the end-on system, and the minimum crown height and width required for engineering should be secured.

2) Width of Port Entrance and Navigation Channel

The width of port entrance should be greater than that of the navigation channel. The channel width is usually defined as 6 to 8 times the breadth of a inshore vessel where the channel connects the fishing port to the open sea. Since the arrival of vessels at Sekondi concentrates in the morning and by considering vessel maneuverability, the entrance width is set at 8 times the vessel width. The largest vessel at Sekondi Fishing Port is used as the design for facility.

Channel width = breadth of the largest vessel x 8
= 4.9 m x 8
= 39.2 m ≒ 40 m

The port entrance is formed by the breakwater and the seawall of the Naval Base and is shielded by the breakwater. It is therefore less likely to be attacked by waves. Therefore, the width of 100 m which is the width of the area used normally by inshore vessels and canoes is selected for the entrance.

3) Channel Depth

The channel depth is obtained by adding an allowance of 1.0 m to the draft of the design inshore vessel, which is the largest vessel.

Channel depth = draft of the largest vessel navigating channel + allowance
= 1.8 m + 1.0 m
= 2.8 m ≒ 3.0 m

The channel depth is thus set at 3.0 m.

4) Cross Section

For efficiency in cost, construction and operation, a rubble mound breakwater is selected. Rubble stones produced from a quarry located at about 6 km north of the project site will be used. The rubble mound breakwater is expected to decrease wave reflection from the breakwater trunk, minimize influences on nearby beaches, assure safe navigation of inshore vessels and canoes, and improve calmness in the port.

a) Calculation of Design Wave

Figure-2.4.12 shows the equivalent deepwater wave height distribution and location of the design object in the case of the most critical wave direction of SE which is obtained from the computing wave deformation. Based on the equivalent deepwater wave height at the design location shown in the figure, the breakwater design waves are obtained as shown in Table-2.4.18.

Provided, however, Figure-2.4.13 was used to obtain the wave height since $h/H_o'=8.82 > 4.0$.

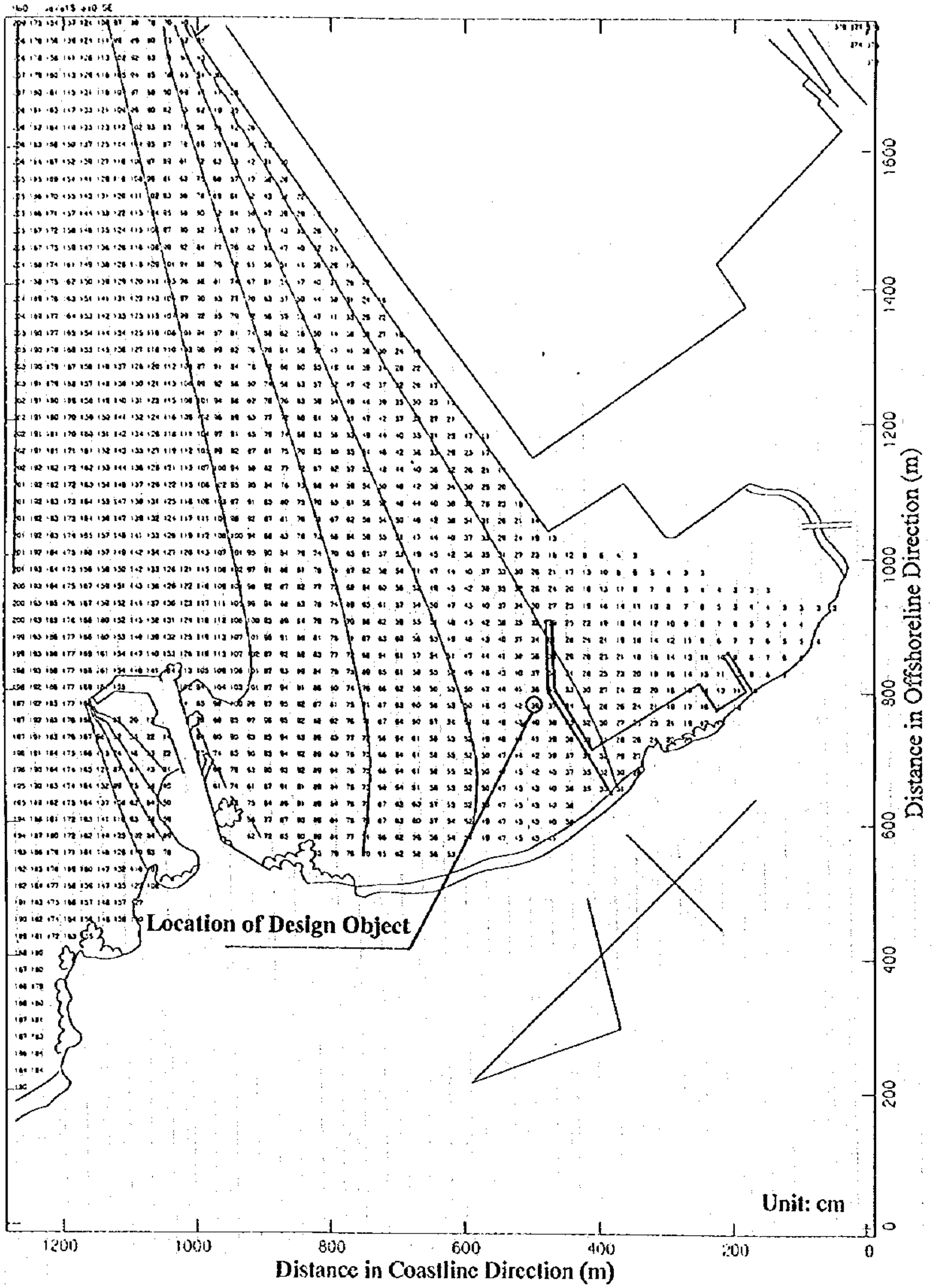


Figure-2.4.12 Equivalent Deepwater Wave Height Distribution and Location of Design Object

Table-2.4.18 Design Wave for Breakwater

Slope of Sea Bottom i	1/50	Depth C. D. L.	-3.1
Wave Direction	S E	Depth including Tide	3.44
Wave Height Ho(m)	3.7	h/Ho'	8.82
Wave Period T(sec)	12.0	h/Lo	0.0017
Wave Length Lo(m)	224.64	H/Ho'	2.50
Equivalent Deepwater Wave Height Ho' (m)	0.39	Design Wave H (m)	1.0
Wave Steepness Ho'/Lo	0.002		

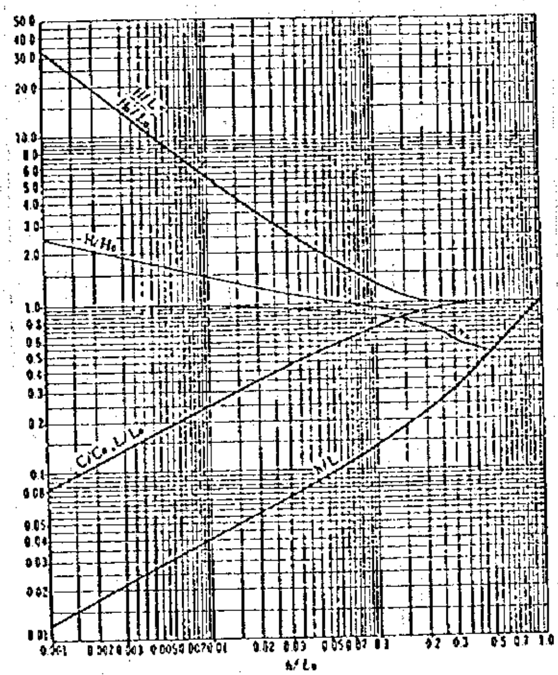


Figure-2.4.13 Wave Characteristic in Shallow Water

b) Sectional Dimensions

The breakwater crown height is selected based on the height of design waves and should be able to prevent overtopping. The height is determined in the following manner by further considering engineering efficiency for the end-on system.

Crown height = design wave height x 1.0 + H.W.L. + allowance in view of construction efficiency
= 1.0 m x 1.0 + 1.62 m + 0.38 m
= +3.00 m

The crown width of 5.0 m should be secured to allow operation of the stone carrying and placing for armor stones.

c) Weight of Armor Stone

The weight of armor stone is obtained from the Hudson's equation as below.

$$W = \frac{\gamma \times w^3 \times H^3}{Kd \times \cot\alpha \times (\gamma - w)^3}$$

W : required weight of armor stone (t)
γ : unit weight of armor stone (2.6 t/m^3)
w : unit weight of seawater (1.03 t/m^3)
α : angle of slope (cot α = 1.5)
H : design wave height (H = 1.0 m)
Kd : stability constant of armor stone (Kd = 1.9)

$$W = \frac{2.6 \times (1.03)^3 \times (1.0)^3}{1.9 \times 1.5 \times (2.6 - 1.03)^3}$$

$$= 0.26\ t$$

Based on the above, the weight of armor stone required for the breakwater is 260 kg. Considering the weight of armor stones used for the existing breakwater in the north of Sekondi Bay is 2 - 4 tons and availability of stones at site, it was decided to use the armor stones weighing about 500 kg/piece.

Figure-2.4.14 shows a typical cross section of the breakwater.

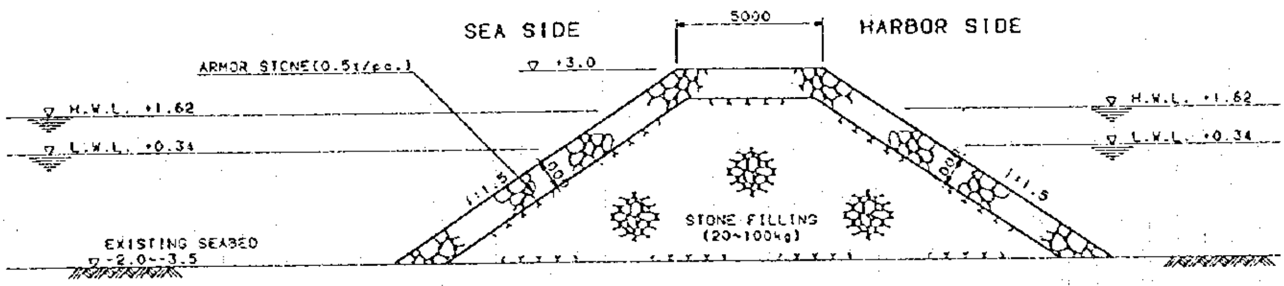


Figure-2.4.14 Typical Section of Breakwater

5) Auxiliary Facilities

Solar type navigation lights will be provided at the tip of the breakwater for safety of inshore vessels arriving and departing the port at night. Their specifications are given below.

Visible distance	:	3 miles
Flashing interval	:	5 seconds (flashing time: 0.5 sec)

There will be provided a sluice of seawater at the centre of the breakwater to promote exchange of seawater.

(3) Basic Plan of Channel and Basin

1) Design Concept for the Channel and Basin

The channel and basin should meet the following requirements.

Channel	:	Sufficient width and calmness should be secured to allow smooth navigation and turning of inshore vessels
Basin	:	Sufficient area and calmness should be secured to allow berthing of inshore vessels

2) Water Depth of the Basin

a) Basin in front of Landing Wharf

The water depth of the basin in front of the landing wharf is obtained by adding an allowance of about 1.0 m to the draft of inshore vessels to berth.

The design inshore vessel is a inshore vessel with maximum dimensions.

Water depth of the basin = maximum draft of a inshore vessel with maximum dimensions + allowance
= 1.8 m + 1.2 m
= 3.0 m

b) **Basin in front of Lay-by Wharf**

The basin depth in front of the lay-by wharf is obtained by adding an allowance of about 1.0 m to the draft of inshore vessels to be moored there.

The design inshore vessel is a inshore vessel with average dimensions.

Water depth of the basin = maximum draft of a inshore vessel with average dimensions + allowance
= 1.3 m + 0.7 m
= 2.0 m

3) **Berthing Width in front of Lay-by Wharf**

As inshore vessels are on 5 abreast berthing in front of the lay-by wharf, the berthing width in front of the wharf is obtained by adding the vessel breadths to the berthing intervals. The average vessel breadth will be employed for calculation and the berthing interval is set at 0.5B (B = breadth).

Berthing width in front of wharf = 5 abreast x (average vessel breadth + 0.5B)
= 5 x (2.5 m + 0.5 x 2.5 m)
= 19 m

4) **Width of Maneuvering Space in front of Wharf**

A maneuvering space is set for turning of vessels in addition to the berthing space in front of the wharf. The maneuvering space is considered to require 2 to 4 times the length of the inshore vessel in calm waters. Deeming the design vessel as the largest vessel, the maneuvering space width is set as twice the ship length.

Width of maneuvering basin = 2 x length of largest inshore vessel + allowance
= 2 x 16.8 m + 1.4 m
= 35 m

(4) Basic Plan for Wharf

1) Concept for Planning Wharf

The landing and lay-by wharves for inshore vessels are planned as follows and the dimensions and structure type of the wharf shall satisfy the following items.

Structural dimensions : The dimensions should be such as would secure stability of the structure under the design conditions. The height and water depth of the wharf are set to suit the use of the wharf. Apron width is set to reflect uses as the landing and lay-by wharves.

Structure type : The structure type is selected by considering work conditions, cost efficiency and advantage in engineering and comparing the sections.

2) Dimensions of Wharf

a) Crown Height of Wharf

The crown height of the landing and lay-by wharves is determined using average dimensions of a inshore vessel as the dimensions of design vessel. The crown height of a wharf is set by gross tonnage of the design vessel and difference in tidal level as shown in Table-2.4.19.

Table-2.4.19 Crown Height of Wharf (above H.W.L.)

Tidal Difference	Fishing Boat (GT)			
(H.W.L. - L.W.L.)	0-20	20-150	150-500	500 more
0 - 1.0 m	0.7 m	1.0 m	1.3 m	1.5 m
1.0 - 1.5 m	0.7 m	1.0 m	1.2 m	1.4 m
1.5 - 2.0 m	0.6 m	0.9 m	1.1 m	1.3 m

Source: Design Standards for Fishing Port Facilities in Japan

The gross tonnage of an average inshore vessel under this plan is about 10 GT, and the tidal difference about 1.3 m.

Crown height of wharf = H.W.L. + 0.70 m
= 1.62 m + 0.70 m
≒ +2.50 m

b) **Water Depth for Wharf**

The water depth for wharf is determined similarly as for the basin.

Landing wharf	: -3.0 m
Lay-by wharf	: -2.0 m

3) Apron Width

A fish handling shed is located behind the landing wharf and all the fish catches are brought to the shed. Since carts are used to transport fish to the shed in Sekondi as in Tema, the apron width is set at 5.0 m allowing the space for transferring catches by manpower and using carts. The apron width for lay-by wharf is set at 10 m by considering preparation for transferring ice, water and fish nets onto the vessels and allowing the space for parking trucks and carts.

Apron width

Landing wharf	: 5.0 m
Lay-by wharf	: 10.0 m

4) Auxiliary Facilities

Fenders will be provided on the front of the wharf and mooring posts and curbs on the crown surface. There will be provided ducts on the apron for water supply and seawater pipes for fire fighting.

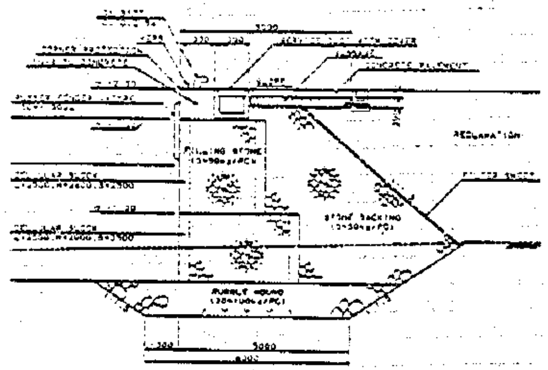
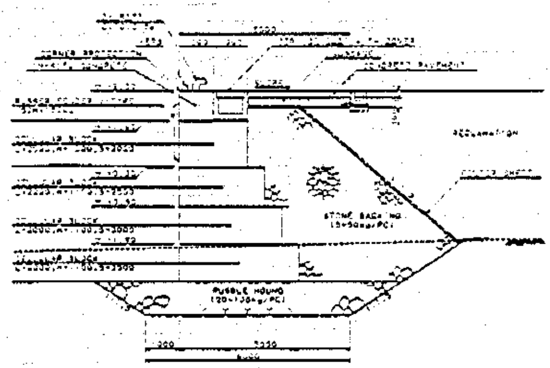
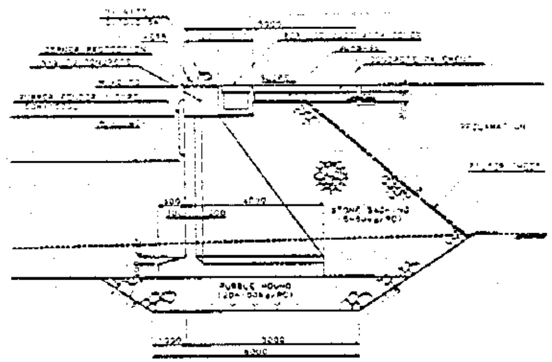
5) Cross Section

Considering that the landing and lay-by wharves are the principal facilities of this project, the design sections were compared for selection of the structure type. As the soil survey revealed a weathered sandstone layer beneath the surface soil (0 - 1 m thickness), it would be difficult to drive in piles or sheet piles. A gravity-type structure was therefore selected.

Efficiency in engineering and cost and work period were compared for three gravity-type structures shown below. The results are presented in Tables-2.4.20 and 2.4.21.

Type 1	:	Concrete block
Type 2	:	Cellular block
Type 3	:	L-shaped block

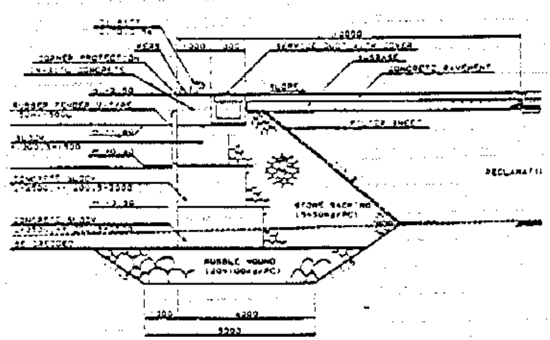
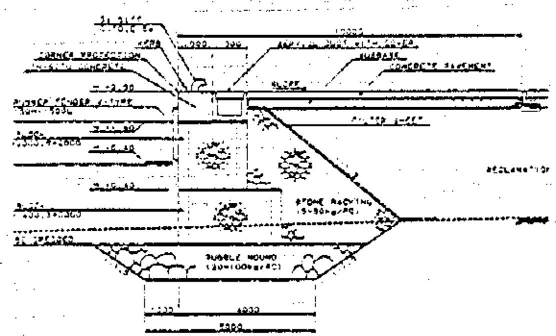
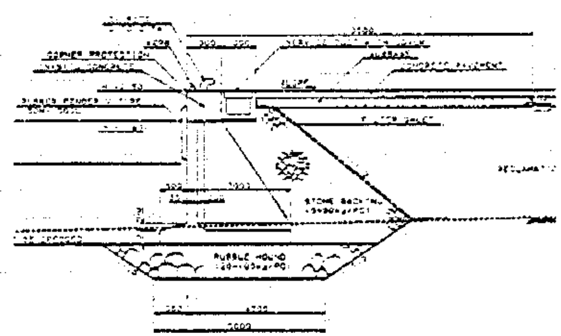
Table-2.4.20 Comparison for Selection of Structure Type (Landing Wharf -3m) (per 100m length)

Item/structure	Cellular block type	Concrete block type	L-shaped block type
Standard section			
Approximate quantities	Concrete, precast(M3) 538 Re-bars(T) 54 No. of blocks made/installed(NO) 81 Standard weight of blocks, MAX(T) 17	1223 0 202 18	438 57 26 50
Engineering performance and major construction machinery	Amount of concrete and number of blocks required are 40% of those for rectangular blocks. 100 T overhead crane is needed.	Amount of concrete and number of blocks required are 2.5 times those for cellular blocks. 100 T overhead crane is needed.	Smallest amount of concrete and number of blocks are required, but the block weight is extremely heavy. 200 T overhead crane is needed.
Approximate construction cost	(Ratio) 1.0	1.1	1.2
Period of construction	(Ratio) 1.0	1.1	1.1
Evaluation	◎	○	△

(Note) As the foundation is rock, plans requiring driving of piles and sheet piles were not considered in view of material procurement, construction cost and period.
The gravity type is selected.

Table-2.4.21 Comparison for Selection of Structure Type (Lay-by Wharf -2m)

(per 100m length)

Item/structure	Concrete block type	Cellular block type	L-shaped block type
Standard section			
Approximate quantities	Concrete, precast(M3) 730 Re-bars(T) 0 No. of blocks made/installed(NO) 123 Standard weight of blocks, MAX(T) 14	436 44 86 12	325 14 21 40
Engineering performance and major construction machinery	Great amount of concrete and number of blocks are required, but structure is simple and engineering easy. 100T overhead crane is needed.	Smaller amount of concrete and number of blocks are required than rectangular blocks, but advantage of the smaller quantify is not appreciable because of smaller depth (70% of the rectangular blocks). Engineering easy. 100 T overhead crane is needed.	Smallest amount of concrete and number of blocks are required, but the block weight is heavy. 150 T or 200 T overhead crane is needed.
Approximate construction cost	(Ratio) 1.0	1.2	1.2
Period of construction	(Ratio) 1.0	1.2	1.2
Evaluation	◎	○	△

(Note) As the foundation is rock, plans requiring driving of piles and sheet piles were not considered in view of material procurement, construction cost and period.
The gravity type is selected.

The following design conditions were employed.

a) Design Conditions

Details of design conditions are described below.

Crown height	:	+2.5 m
Design water depth	:	Landing wharf -3.0 m
		Lay-by wharf -2.0 m
Tidal level	:	H.W.L. + 1.62 m
		L.W.L. + 0.34 m
Waves, currents	:	Effects of waves and currents are not taken into consideration
Surcharge		
Landing wharf	:	1.0 t/m^2 at ordinary
		0.5 t/m^2 at earthquake
Lay-by wharf	:	0.5 t/m^2 at ordinary
		0.25 t/m^2 at earthquake
Design vessel	:	10 GT inshore vessel
		length, 17 m; max. draft, 1.8 m
Berthing velocity	:	V = 0.50 m/sec
Tractive force	:	T = 3.0 t
Design seismic force	:	Kh = 0.1 (in air)
		Kh'= 0.2 (in water)
Subsurface conditions	:	Weathered sandstone layer
Materials Stone backing		
& filling materials	:	internal friction angle ϕ= 30°
		wall friction angle ϕ= 15°
Rubble mound	:	internal friction angle ϕ= 40°
Unit volume weight		
Reinforced concrete	:	2.45t/m^3 (air), 1.42 t/m^3 (water)
Plain concrete	:	2.30t/m^3 (air), 1.27 t/m^3 (water)
Backing material/filling	:	1.80t/m^3 (air), 1.00 t/m^3 (water)
Seawater	:	1.03t/m^3 (air)

b) Selection of Structural Type

As a result of comparison of the cross sections, the following structure with superior engineering, cost efficiency and period of work was selected.

Landing wharf (-3 m)	:	Cellular block type
Lay-by wharf (-2 m)	:	Concrete block type

The typical cross sections of the wharves are shown in Figures-2.4.14 and 2.4.15.

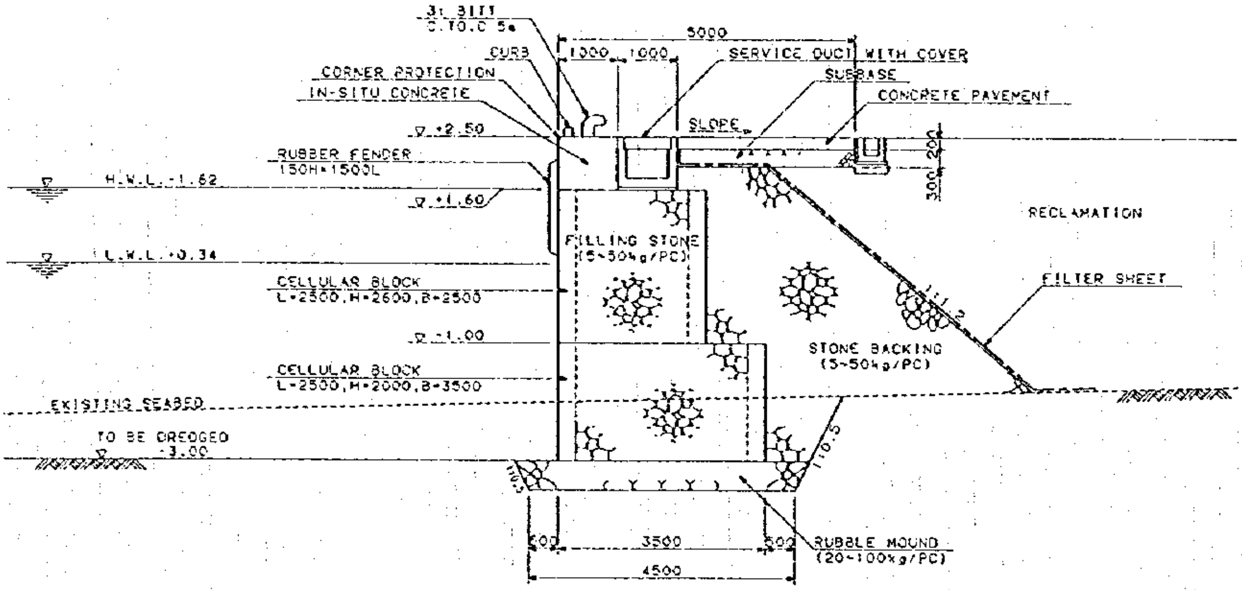


Figure-2.4.15 Cross Section of Landing Wharf (-3m)

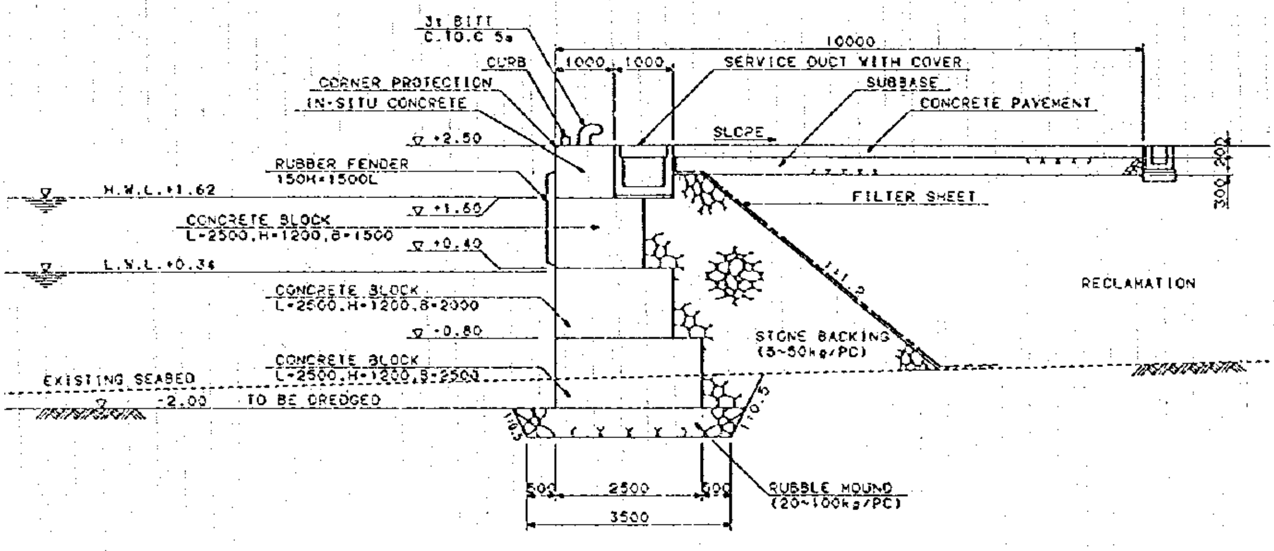


Figure-2.4.16 Cross Section of Lay-by Wharf (-2m)

(5) Basic Plan for Canoe Jetty

1) Design Concept

A canoe jetty is to be used for fish landing and preparations by purse seine and line fishing canoes, which are based in Sekondi. Dimensions and structural type should satisfy the following.

Dimensions : The crown height and water depth for the jetty are selected by considering its objectives of use. The crown width is set by considering that canoes are berthed and moored on both sides.

Structural type : Jetty structure is selected by considering efficiency in cost and engineering, and work conditions. Since the difference in tides is about 1.3 m, a landing step will be provided to facilitate transferring catch from the canoe to the jetty during low tide.

2) Design Water Depth and Crown Height

Design water depth is obtained by adding allowance to the maximum draft of a large sized canoe.

Design water depth = maximum draft of large sized canoe + allowance
= 0.7 m + 0.3 m
= 1.0 m

The crown height shall be +2.50 m which is the same as that of the wharf for inshore vessel, and a landing step will be provided at +1.0 m in view of the difference in tide.

3) Crown Width

The crown width shall be 6.0 m to allow canoes to berth and moor on both sides of the jetty for landing and preparation.

4) Berthing Width in front of the Jetty

As canoes will be on 3 abreast berthing on both sides of the jetty, the berthing width shall be the canoe breadth plus berthing intervals. The canoe breadth shall be that of a large sized canoe and the berthing interval be 0.5 B (B = canoe breadth).

Canoe berthing width = 3 abreast x (canoe width + 0.5 B)

= 3 x (1.6 m + 0.5 x 1.6 m)

≒ 8 m

5) Canoe Maneuvering Width on both sides of the Jetty

Similar to the maneuvering width for the inshore vessels, the maneuvering width for canoes will be twice the length of a large sized canoe used as the design canoe.

Canoe maneuvering width = 2 x canoe length

= 2 x 20 m

= 40 m

6) Cross Section

Comparison of sections for the wharf for inshore vessels revealed that the block type structure is more economical for a jetty structure for shallow design water depth. The gravity-type structure using blocks and filling stones was therefore selected. Typical section of canoe jetty is illustrated in Figure-2.4.17 .

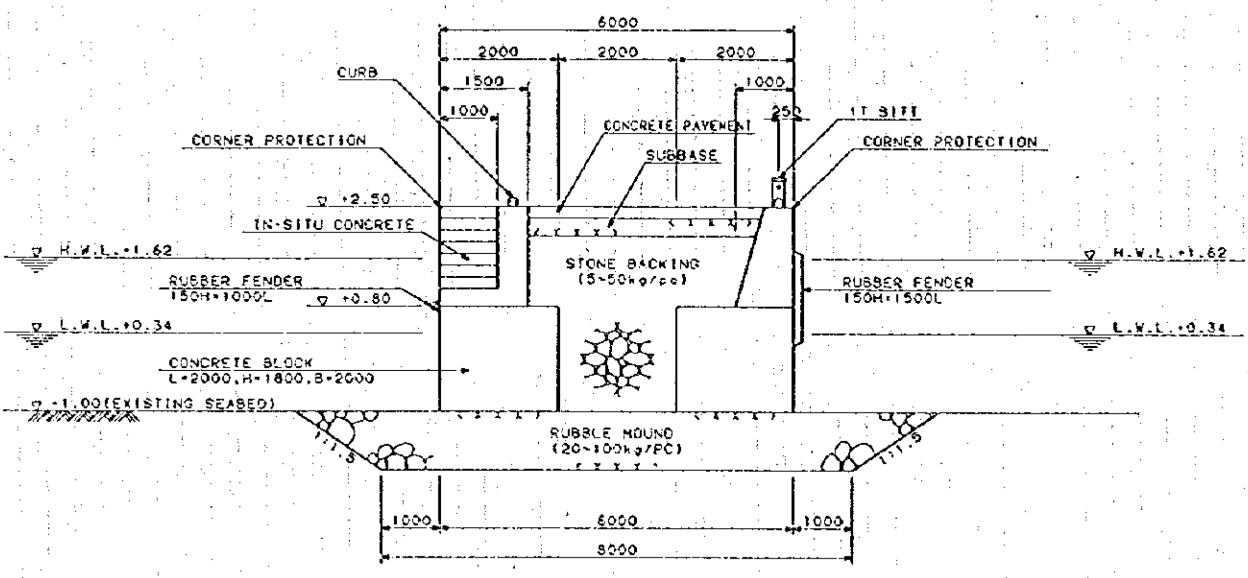


Figure-2.4.17 Typical Section of Canoe Jetty

7) Auxiliary Facilities

Fenders will be provided on both sides of the jetty, and mooring posts and curbs on the crown surface. Navigation lights will be provided at the tip of the jetty, and their specifications are given below.

Visible distance	:	3 miles
Flashing interval	:	5 sec (flashing time: 0.5 sec.)

(6) Basic Plan for North Side Stone Wall

The north side stone wall (115 m in length) leading from the base of the breakwater to the land should not allow overtopping to protect the important hinterland. The stone wall faces the sandy beaches and the changes in littoral drifts which are likely to occur due to the construction of the breakwater and the possible shoreline changes should be taken into consideration.

1) Design Concept for North Side Stone Wall

Dimensions and structural type of the north side stone wall shall satisfy the following.

Dimensions	:	The ground level for the wall shall be set lower than the actual ground, considering future coastal changes and scoring of the toe.
Structural type	:	A rubble mound type is selected, considering cost efficiency and little effect on the beach because of decreased reflected waves.

2) Cross Section

A rubble mound revetment is selected because of ease in procuring materials, cost efficiency, its effect of decreasing reflected waves, and little effects on littoral drift.

The crown height is set at + 3.0 m, the same height as the breakwater, since this wall will also serve as the access road for vehicles during construction of the breakwater. The crown width is set at 2.0 m considering stability of armor stones against waves. Since the overtopping amount for this crown height is less than 1 x 10^{-4} m^3/m sec, effect on the hinterland by the overtopping is negligible. Figure-2.4.18 shows a typical section of north side stone wall.

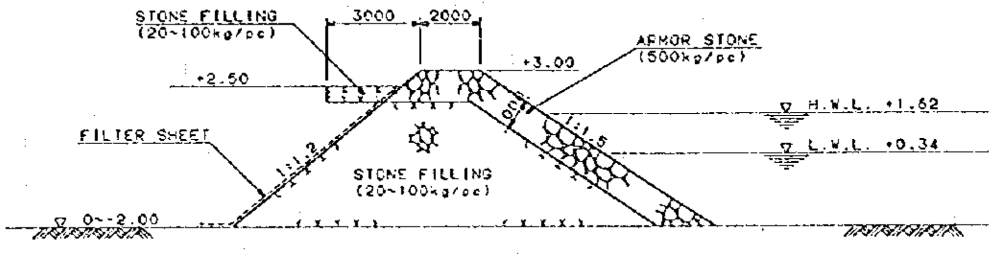


Figure-2.4.18 Typical Section of North Side Stone Wall

(7) Basic Plan for South Side Seawall

The south side seawall (50m in length) provides an area for returns for the lay-by wharf, and functions as a revetment as well as a means to decrease multiple reflections of the waves in the port, particularly in the area north of the canoe jetty to thereby improve calmness of the canoe maneuvering area.

1) Design Concept for Seawall

A rubble mound type with less wave reflections is selected for the south seawall.

2) Cross Section

A rubble mound revetment is selected because of ease in procuring materials, cost efficiency and its effect of decreasing reflected waves, similarly as in the case of north side stone wall.

The crown height for the south side seawall is set at +2.5 m, the same as for the lay-by wharf, considering its use.

Figure-2.4.19 shows a typical section of the south seawall.

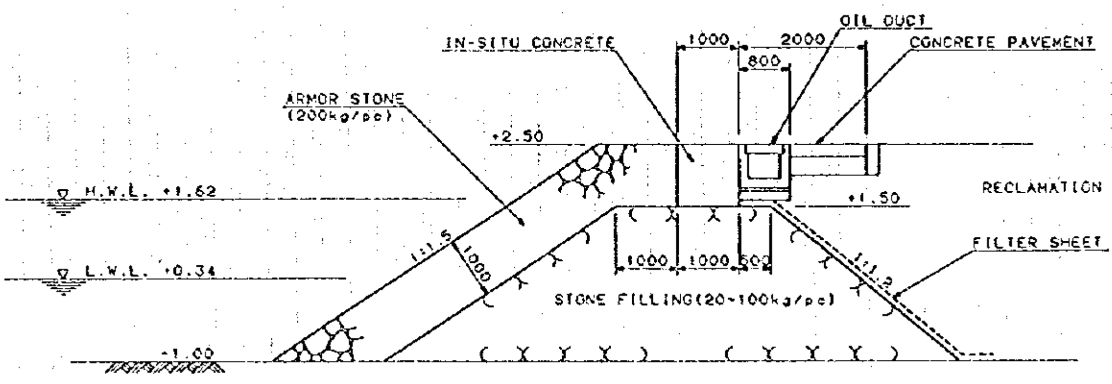


Figure-2.4.19 Typical Section of South Side Seawall

(8) Basic Plan for In-port Road

The in-port road (370m in length) is planned behind the wharf apron.

1) Design Concept for In-port Road

Dimensions : The road will have two lanes.

Structure type : Interlocking block pavement will be selected because of ease in material procurement and maintenance.

2) Lane Width

The width of a lane is 3.0 m, and the road is used for two-way traffic. The apron or the adjacent vacant lot is allocated for pedestrian walk and truck parking.

Road width = lane width x 2 lanes
= 3.0 m x 2
= 6.0 m

3) Cross Section

All the roads in Takoradi Port are paved with interlocking blocks and a maintenance team is stationed in the port at all times. Thus, the interlocking block paving is selected for its ease in procuring raw materials and maintenance. The pavement structure of the in-port roads is shown in Figure- 2.4.20.

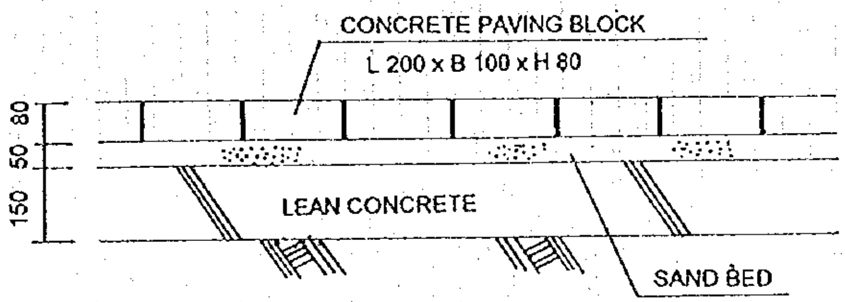


Figure-2.4.20 Pavement Structure of In-port Road

(9) Design Concept for Walkway

The walkway connecting the project site and the existing canoe landing beach is planned in front of the existing vertical seawall for the fish smoking sheds located to the south of the project site.

1) **Design Concept for Walkway**

Dimensions : The walkway will have the width which allows two way traffic for carts (four wheeled cart without motor).

Structure : The walkway will be paved with interlocking blocks because of ease in material procurement and maintenance.

2) **Width of Walkway**

The width is set at 3.5 m considering the above mentioned dimensions.

3) **Cross Section**

The walk will be paved with interlocking blocks similarly as the in-port roads. Typical section of the walkway is presented in Figure-2.4.21.

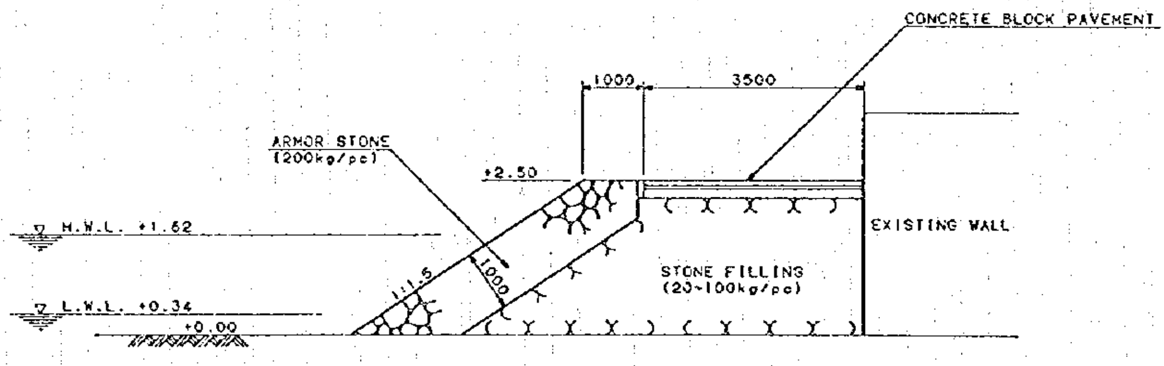


Figure-2.4.21 Typical Section of Walkway

(10) Basic Plan for Access Road

The north road from the project site to the existing breakwater (490m in length) is divided into the section on the sandy beach (325 m) and the section on the reef (165 m). The first section shall be built near the cliff behind the sandy beach in order to preserve the wave dissipating effect and to conserve the sandy beach environment as much as possible. As for the section on the reef, since there is no space for roads in the hinterland, a rubble mound revetment type wall will be built on the sea side.

The section of the access road shall be similar to that of the in-port road, and be paved with interlocking blocks similar to the in-port road.

(11) Basic Plan for Revetment of Access Road

In order to secure the safety against waves of the reef section extending for 165 m, the side facing the sea will be built as the revetment.

1) Design Concept for Revetment

Dimensions and structural type of the revetment shall satisfy the following.

Dimensions	:	The crown height shall be such as would be required for preventing overtopping waves.
Structure	:	A rubble mound type is selected, considering cost efficiency and little effect on the beach because of decreased reflected waves.

2) Cross Section

The rubble mound revetment is selected because of ease in material procurement, excellent cost efficiency, less wave reflection and minimal effect on littoral drift.

The crown height is set at +3.5 m to protect roads behind the revetment from overtopping waves. The overtopping amount for this crown height is less than 1 x 10^{-4} m^3/m sec and its effect of overtopping on the road behind the revetment is negligible. The weight of armor stones is about 500 kg/piece. Typical section of revetment is presented in Figure-2.4.22.

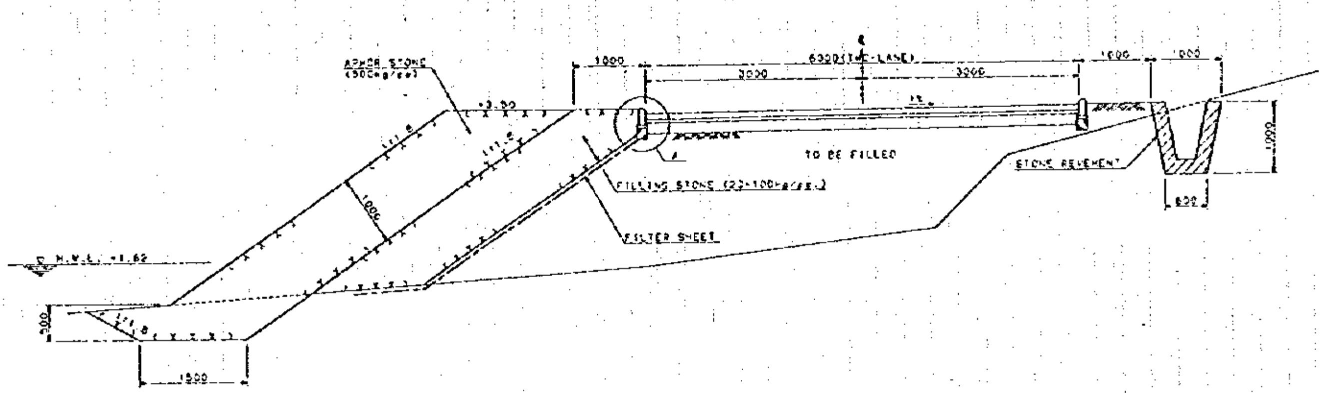


Figure-2.4.22 Typical Section of Revetment of Access Road

2-4-5 Basic Design of Functional Facilities

(1) Ice Making Facility

1) Ice Making Machine

Ice produced under this project is used by inshore vessels, canoes (purse seine, hand liner) and middlewomen for preserving freshness and quality control of marine products.

Block ice, plate ice and flake ice are normally used in marine industry, but only block and flake ice are used in Ghana. As the ice supply is currently limited in Sekondi, the hand liners, not the inshore vessels, use ice when they operate for a long period of time. On the other hand, inshore vessels in Tema procure flake ice or block ice in crushed form from ice making plants in the port.

There are currently three plants in Tema. Their ice making capacities and types of ice produced are given below. Pionur and Nova supply block ice to canoes and crushed ice to inshore vessels.

Name of plant	Type of ice	Daily production
Kaleawo Co., Ltd.	Flake ice	30 tons
Pionur Co-op. Cold Store	Block ice	7.5 tons
Nova Complex Limited	Block ice	35 tons

2) Type of Ice Making Machine

Time to dissolve for ice is proportionate to the ice surface area, and the duration of ice remains solid is in the order of block ice > plate ice > flake ice. Block ice keeps the longest. People in Ghana are not familiar with operation and control of plate ice making. The ice making cycle for plate ice is about 30 minutes, during which time ice making and removing are performed and coolant and high temperature gases flow to increase the temperature difference. This often causes breakdown to the joints between the coolant pipes and the ice making plate. Since two different types of metals are joined, a special method called explosive forming, a sophisticated technique, is necessary. Plate ice is excluded from this project because of such problems in maintenance, etc. at the site and because the technology is not well known in Ghana.

Operation, maintenance and control of a flake ice making machine is more complicated than other types of machines and there are higher risks of machines breaking down and remaining unrepaired after construction is made. In Tema, inshore vessels alone use flake ice, not canoes.

Hand liners use block ice, and inshore vessels can also use it in crushed form. Operation and control of a block ice making machine is relatively easy, and considering the current use of ice by fishing boats (inshore vessels and canoes) using at Tema, block ice (including crushed ice), which may be loaded on both types of boats, is judged most appropriate.

3) Type of Coolant

Coolants used for freezer are roughly divided into Furon (fluorocarbon) and ammonia. The former is subject to restrictions for protection of the ozone layer.

In view of these restrictions, current use conditions and availability in Ghana, ammonia is selected as the most appropriate coolant for this project. Salt which is available in abundance is selected as the secondary coolant. As for possible corrosion by salt, there is no problems in maintenance and inspection of facilities, particularly of ice cans and brine tanks, since materials are available locally.

4) Characteristic Features of Ice

Table-2.4.22 lists features of each type of ice.

Table -2.4.22 Features of Each Type of Ice.

	Flake ice	Plate ice	Block ice
Approximate shape(m/m)	10x15x1.2	30x40x15	600x200x800
Ice making cycle	Continuous	30 min	24 - 48 hr
Ice dissolving speed	Rapid	Gradual	Most gradual
Plant size	Small	Small	Large
Maintenance/inspect.	Highly technical	Easy	Easy
Work force	Automatic	Automatic	Required for ice removal

Adequacy for fish type

Flake ice	:	not suitable for large and medium size fishes because voids are formed when packed.
Plate ice	:	suitable for all types of fish as they fit well with fishes when packed.
Block ice	:	suitable for all types of fish if ice is crushed.

5) Capacity of Ice Making Machine

Capacity of the ice making machine is determined by considering the following conditions.

* Ice is most often used by inshore vessels departing the port, followed by use for preserving freshness of catches landed and transported.
* Both inshore vessels and canoes use ice for fishing.
* In Sekondi Port, only hand liners use ice. Inshore vessels do not use ice at all.
* In Tema, inshore trawlers (gross tonnage: about 60 tons) use about 10 tons of flaked ice or crushed ice per voyage.
* In Sekondi, about 6 tons per day of block ice is supplied from Takoradi for use by hand liners (about 1 ton per canoe).
* At the time of present investigation, an interview survey with boats owners of 22 inshore vessels revealed that they intended to purchase about 20 to 40 blocks (converted to 25 kg/block ice) per voyage (about 3 days) if an ice making machine was built in Sekondi.

The capacity of an ice making machine is determined by calculating per day consumption as the sum of amounts used by inshore vessels and canoes engaged in hand lining and purse seine, and the amount used for preserving freshness of fish catch after landing.

a) Ice Consumption by Inshore Vessels (Design Value)

Number of boats	:	46 (number of vessels using per on a standard day)
Number of days/voyage	:	1 day (currently), but with use of ice, 3 days
Number of voyages/month	:	7 voyages
Number of operation days/month	:	7 voyages/month x 3 days/voyage =21 days/month

Ice consumed/month	:	(25 kg/block x 30 blocks/boat) x 0.8 x 46 boats x 7 voyages/month = 193 tons/month Ice loaded on canoe is assumed to be 80% of the amount indicated in the interview survey
Ice consumed/day	:	193 tons/month ÷ 25 days/month = 7.7 tons/day ....a

b) **Ice Consumed by Line Fishing Canoe(Actual Value)**

Number of canoes	:	6 (number of canoes using per on a standard day)
Ice loaded/day	:	25 kg/block x 40 block /canoe = 1.0 tons/canoe
Ice consumed/day	:	1.0 ton/canoe x 6 canoes/day = 6.0 tons/day ....b

c) **Ice Consumption by Canoes Engaged in Purse Seine (Design Value)**

Number of canoes	:	13 (number of canoes using on a standard day)
Number of days/voyage	:	1 day (currently), but with use of ice, 3 days
Number of voyages/month	:	7 voyages
Number of operation days/month	:	7 voyages/month x 3 days/voyage = 21 days
Ice consumed/month	:	(25 kg/blocks x 25 blocks/canoe) x 0.8 x 13 canoes x 7 voyages/month = 46 tons/month Ice loaded on canoe is assumed to be 80% of the amount indicated in the interview survey
Ice consumed/day	:	46 tons/month ÷ 25 days/month =1.8 tons/day............................c

d) Ice Consumed for Preserving Fish Catch after Landing (Design Value)

Ice consumed for preserving freshness of catch in Japan is usually deemed equal in volume to the catch. Under this project, as large catches landed during the peak season are sardines and the smoking sheds are located next to the fishing port, which means only a short time is needed for transport, and ice consumption for the preservation is insignificant.

Ice is assumed to be used only for expensive fishes, and thus ice equivalent to about 30% of fish catch is required.

Ice consumed/day : 3.4 t/day x 30% = 1.0 t/day ....d
wherein 3.4 tons is the catch by a hand liner on a standard day.

Based on the foregoing, ice production per day is calculated as follows.
Ice production per day = a + b + c + d = 16.5 tons/day

The production capacity of ice making machine in Takoradi is given below.

* State Fishing Co. Block ice 7.5 tons/day
* Ansa Cold Store Ltd. Block ice 12.5 tons/day

Of 20 tons produced daily, an average of 6 tons is supplied to Sekondi. If a new port is constructed and good quality ice can be supplied directly and hand liners will purchase their daily requirement (6 tons) directly from the ice making machine in the port instead of from Takoradi. Inshore vessels at Axim, Elmina and Manford are also expected to purchase ice from the new port.

Accordingly, the project will not consider 6 tons of ice currently supplied from Takoradi. The ice production will be as follows.

Ice required per day = 16.5 tons/day ≒ 15.0 tons/day

An ice making machine with a 15 ton/day ice making capacity is deemed appropriate by considering fluctuation in fish catches.

6) Specifications for Ice Making Machine

Design conditions and specifications of the ice making machine are given below.

a) Design Conditions

Ambient temperature	:	+ 32° C (humidity 95%)
Power source	:	Commercial power (3 ϕ,4W, 50Hz, 415 V/240V, ACV)
Primary coolant	:	Ammonia
Secondary coolant	:	Salt
Raw water	:	City water (clean water)
Ice production	:	15 tons/day
Ice making method	:	Block ice making
Machinery	:	For use in tropics, salt-resistant

b) Specifications for Ice Making Machine

No. of units installed	:	one unit with 15 tons/day capacity
Model	:	25 kg can type block ice maker
Freezer	:	Open type
Cooling method	:	Water cooling type
Accessories	:	Crane, ice crusher, Air discharger

(2) Ice Storage Facilities

1) Ice Storage

It takes 24 hours for the proposed ice making machine to produce ice. Flake and plate ice making units can operate continuously and supply ice as needed where as block ice making unit cannot do so. As the inshore vessels depart the port at about the same time within a short interval, stable supply of ice is a requisite in meeting their demand. For regular maintenance checks of the plant, ice supply should be continued in order not to hamper fishing operations. As Tuesday is a holiday for fishing in Ghana, all the inshore vessels depart the port on Wednesday, thereby requiring a large supply of ice at once. Ice storage is therefore planned to secure stable supply of ice.

The ice making plant in Tema is currently equipped with a storage space which is 2 - 3 times its daily ice producing capacity to enable a stable supply despite fluctuations in the number of boats served. An ice making plant in a Japanese fishing port typically has a storage which is 7 to 10 times the daily ice production.

The volume of ice storage for this project is therefore set at 45 tons as three times the maximum daily ice production capacity.

15 tons x 3.0 = 45 tons

2) Specifications for Ice Storage

Specifications for ice storage are given below.

Number of units	:	45 ton type- 3 rooms
Model	:	Prefabricated assembly type
Heat insulation	:	Hard polyurethane foam
Heat insulation thickness	:	100 mm
Freezer	:	Open/reciprocal type
Cooling method	:	Water cooling
Cooling unit	:	Suspended/forced ventilation type
Inside temperature	:	-10℃

3) Ice Crusher and Air Discharger

a) Ice Crusher

Block ice will be supplied by this project. In Tema, blocks are placed in boxes and loaded in hand liners. Before loading block ice onto the inshore vessels, ice is crushed using a crusher.

As inshore vessels using at Sekondi will also require crushed ice, an ice crusher will be installed.

b) Crushing Capacity

The inshore vessels requires about 7.7 tons/day and the large canoes (purse seine) about 1.8 tons/day of crushed ice. The total daily requirement is therefore about 9.5 tons. As all the inshore vessels prepare and depart the port within the same time zone, it is necessary to supply crushed ice at the rate of 9.5 tons ÷ 2 hours = 4.8 tons/hour when supplying within 2 hours. Therefore, an ice crusher having a capacity of at least 4.8 tons/hour is necessary.

c) Specifications for Crusher

Specifications for the crusher are given below.

Crushing capacity	: 5 tons/hour
Size of block ice	: 35 kg or less
Size of crushed ice	: 10 – 50 mm
Motor output	: 2.2 kw

d) Air discharger

When loading crushed ice onto the storage in the inshore vessel berthed at the wharf, about 5 tons of crushed ice must be loaded within an hour. This requires mechanical loading. An air discharger with a capacity of at least 5 tons/hour is therefore required.

e) **Specifications for the Discharger**

Specifications for the discharger are given below.

Amount discharged	:	8.2 - 10.8 tons/hour
Lift	:	0 - 3 m
Horizontal discharger distance	:	30 - 100 m

3) **System for Ice Making/Storage**

Figure-2.4.23 shows a flow chart for the ice making/ storage system.

(3) **Water Supply System**

1) **Amount of Water Supply**

a) **Ice Making Plant**

The facility which consumes a large quantity of water under this project is the ice making plant. In Japan, the quantity is usually 1.5 times the amount of ice produced. The ice making plant which used to be in operation in Sekondi has a water tank capable of storing about 3 times more water than ice produced. The plant in Tema has a tank capable of storing water about 2 times the ice making capacity.

Quantity of water supply required for the ice making plant shall be twice the ice making capacity.

Ice making plant : 15 tons x 2.0 = 30 tons

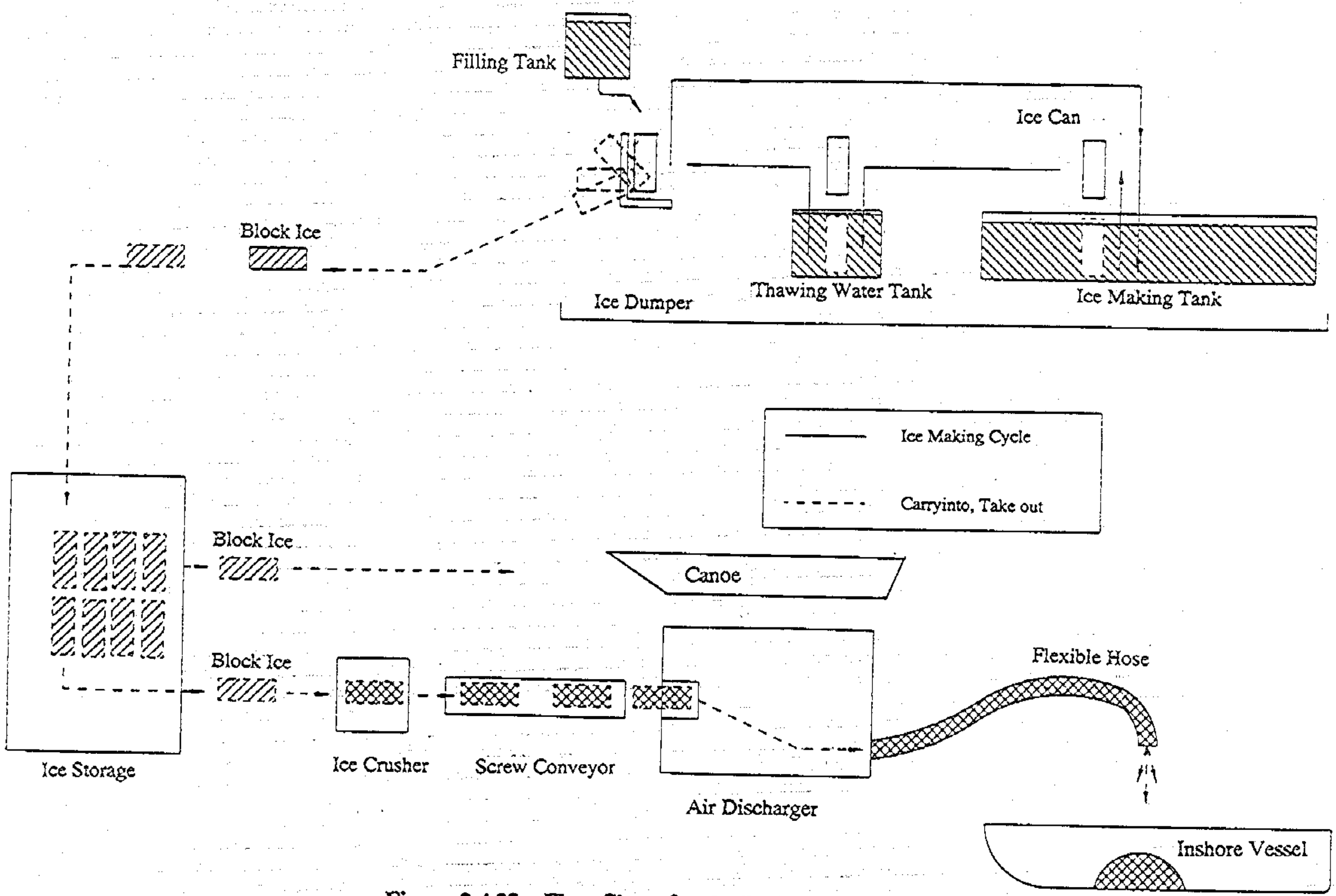


Figure-2.4.23 Flow Chart for the Ice Making / Storage System

b) Administration Office

The administration office under this project will house GPHA, Fisheries Department and Inshore Fisheries Association.

According to FAO's "Fish Market Facilities", the amount of clean water required for personal hygiene, drinking, etc. is 100 ltr/person/day. The water requirements for the offices are given in Table-2.4.23.

Water to be supplied to the office is 3.5 tons.

Table-2.3.23 Water Supply for the Office

User	Num. of Person	Water per Person (ltr/person)	Amount of Water (ltr)
G P H A	18	100	1,800
Engineer & Worker for Ice Making machine	12	100	1,200
Fisheries Department	3	100	300
Inshore Fisheries Asso.	2	100	200
Total	35		3,500

c) Inshore Vessels

Table-2.4.24 shows the supply to inshore vessels and canoes.

Water supplied to the inshore vessels and canoes is about 32 tons .

Table-2.4.24 Water Supply to Inshore Vessels and Canoes

Fishing Boats	Num. of Days / Voyage	Num. of Crew	Water Supply per Boat (ltr)	Num. of In-coming Boats	Total (ltr)
Inshore Vessels	3	15	450	46	20,700
P. Seine Canoe	3	24	720	13	9,360
Line Canoe	4	8	320	6	1,920
Total					31,980

2) Water Tank

a) Tank Capacity

Water required per day is described below.

Ice making plant	:	30 tons ....a
Office	:	3.5 tons ....b
Fishing boats	:	32 tons c
Water requirement	:	= a + b + c = 30 + 3.5 + 32
		= 65.5 tons ≒ 60 tons

City water supplied to the project site is taken by a branch from the main (300 mm) buried along the road about 400 m from the site. The diameter of the branch is very small (150 mm).

In order to improve ice making efficiency, removing ice and supplying water should be performed smoothly and quickly, and ordinary piping for city water alone is not sufficient. If power failure lasts, water supply may also stop. Therefore, a 60-ton water tank will be installed.

b) Specifications for Water Tank

Specifications for tank are given below.

Capacity	:	60 tons clean water
Number of unit	:	one
Model	:	FRP, externally reinforced type
Dimensions	:	6.1 L x 5.6 W x 2.0 H (m)
Accessories	:	Inside/outside ladders, etc.

3) Elevated Tank

By providing an elevated tank, water will be supplied by gravity at the head pressure of 8 m to the office building, inshore vessels and canoes.

a) Tank Capacity

Capacity of the elevated tank is calculated as follows by an amount equivalent to that used in one hour of the design amount for a day for the office building and the inshore vessels and canoes.

i) **Administration Office**

Table-2.4.23. shows that the design water requirement per day for the office building is 3,500 litters. Assuming that the working hour is 8 hours a day at the port, the amount used per unit hour is calculated as below.

3,500 ltr ÷ 8 hours = 438 ltr/hour ....a

ii) **Water Supply to Inshore Vessels and Canoes**

Table-2.4.24. shows that design water requirement per day for vessels and canoes is 31,980 litters. Assuming that the time spent for preparation is 6 hours at maximum, the amount supplied per unit hour is calculated as below.

31,980 ltr ÷ 6 hours = 5,330 ltr/hour ....b

The amount supplied to the office building, inshore vessels and canoes is calculated as follows.

a + b = 438 ltr + 5,330 ltr
= 5,768 ltr/hour
≒ 5,000 ltr/hour

Therefore, the capacity of the elevated tank is 5 tons for one hour supply.

b) **Specifications**

Specifications for the elevated tank are given below.

Capacity	:	5 tons clean water (2 pumps)
Number of unit	:	one
Model	:	FRP, externally reinforced type
Dimensions	:	2.0 L x 2.0 W x 1.5 H (m)
Height	:	8.0 m

c) **Flow of Water Supply**

Figure-2.4.24 shows the flow diagram for the water supply.

d) **Faucets**

There will be provided service faucets at 4 places along the wharf in order to facilitate quick water supply to vessels and canoes preparing for preparation work for fishing.

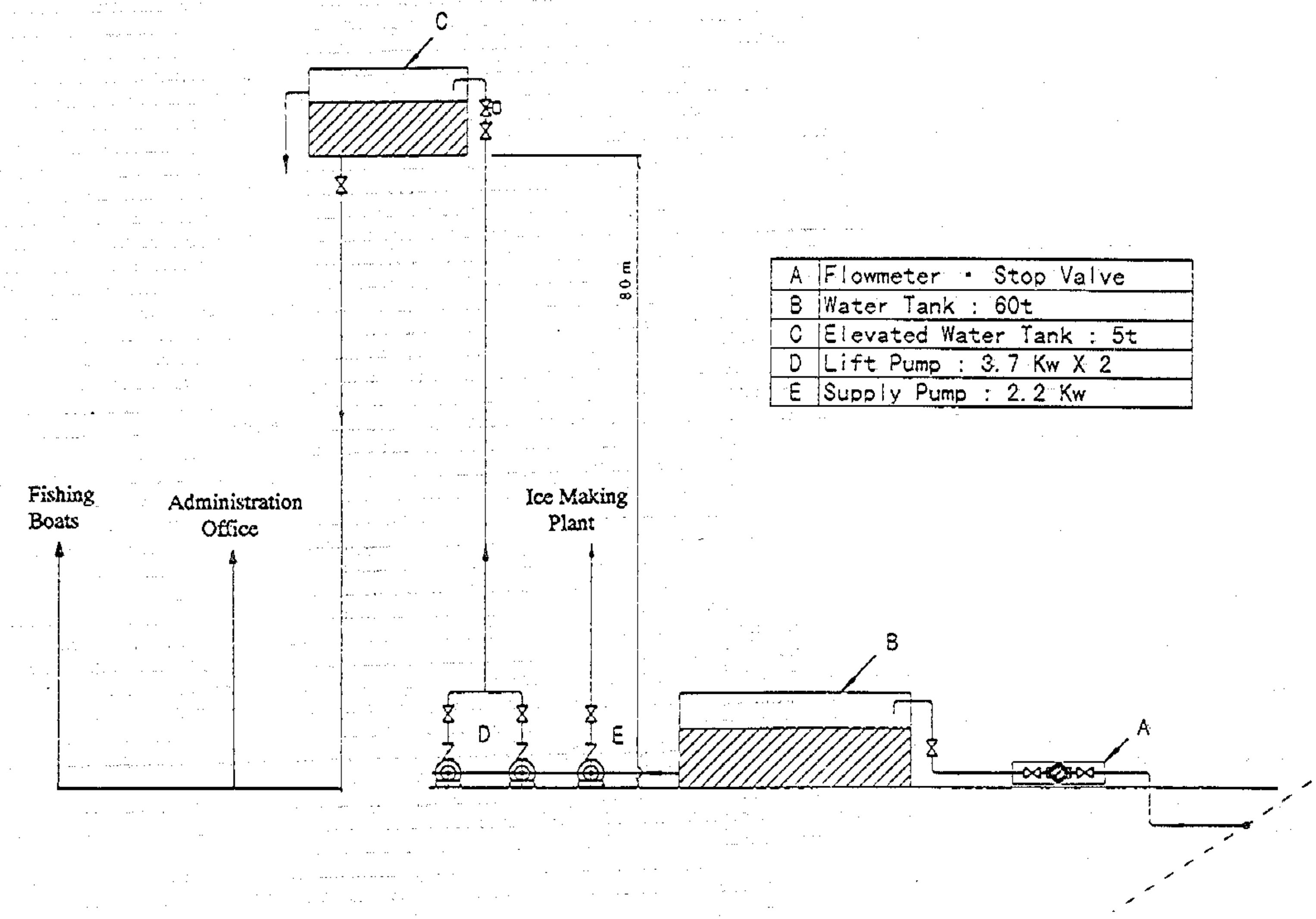


Figure-2.4.24 Flow Diagram for Water Supply

(4) Water Discharge System

As there is no sewage system near the project site, waste water must be treated within the site. Discharge is planned as follows in view of environmental conservation in the port basin.

a) Rainwater and waste water from the administration building will be discharged to the area in front of the wharf through U-shaped ditches and underground drain pipes.

b) As waste water from floor washing at the fish handling shed contains fish guts, fishing tackles and garbage, the water will be passed through a garbage screening pit and discharged to the sea via a settling tank.

(5) Electrical Installation

1) Main Feeder Wiring

Main feeder wiring is located underground between the distribution board at the substation and each distribution board at each of the facilities. Electricity supplied is 3 phase, 4 wires, 415V/240V, and 50Hz. Incoming cable to conform to power consumption required by the fishing port is connected to the breaker in the substation at the site. This incoming cabling and connection shall be the responsibility of the Government of Ghana.

2) Lighting Fixture

In order to assure safe and smooth arrival/departure and preparation at night and to ensure security by preventing thefts, etc., 10 street lamps (400 W) will be placed at 30 meter interval along the apron, the walkway and the canoe jetty.

For lighting the work space in front of the ice making plant, four projectors (400 W) will be installed. Another four projectors (400 W) will also be installed on the fish handling shed for landing operations at night.

(6) Other Facilities

1) Fire Fighting Facility and Seawater Pumps

There will be provided two hydrants at the site to combat fire on the inshore vessels. Seawater will be pumped to extinguish fire. The pump will also be used for cleaning the fish handling shed and wharves.

2) Oil Supply Facilities

Oil supply facilities will not be included in the project as oil is being sold commercially. There will, however, be provided oil supply ducts to the lay-by wharf in the event oil supply to the inshore vessels may be needed after completion of the facilities.

3) Plumbing and Garbage Facilities

Takoradi Port under GPHA's management has toilet and garbage containers, and GPHA has a section in charge of periodical collections of excretes and wastes by vehicles. In case of the Sekondi Fishing Port, garbage containers will be installed in the site and collected by GPHA vehicles.

2-4-6 Basic Design of Buildings

(1) Design Conditions

Design conditions including natural conditions shall be the same as those employed for Tema Outer Fishing Harbour Rehabilitation Project.

Outside temperature	:	24 - 33℃
Humidity	:	95% or higher
Wind force and velocity	:	Prevailing direction SE (annual) Average wind velocity 10 - 14 knots Maximum wind velocity 50 knots
Rainfall	:	1,200 mm/year
Power supply	:	415 V, 3 phase, 50 Hz
	:	240 V, single phase, 50 Hz
Applicable standard	:	Design conditions for this project will follow Ghana's standard, but structural computation, etc. will be conducted based on Japanese standard.

(2) Administration Building

1) Layout Plan

The administration office building will house a total of 23 persons; 18 from GPHA in charge of management of Sekondi Fishing Port, 3 from Fisheries Department and 2 from Inshore Fisheries Association.

The floor area is about 320 m^2 according to the management plan. Calculation of the floor areas are presented in Table-2.4.25. The space for desks, chairs, cabinets, etc. are included in the office space.

Table-2.4.25 Required Area for Administration Office

Room Name	Number of Persons	Number of Rooms	Floor Area per Person (m^2/person)	Required Floor Area (m^2)	Planned Floor Area (m^2)
Supervisor	1	1	16.0	16.0	12.0
Administrator	7	7	13.0	91.0	84.0
Clerk	15	5	5.0	75.0	88.0
Sub-total				(182.0)	(184.0)
Reception	-	1		24.0	16.0
Conference	-	1	32.0	32.0	24.0
Kitchen	-	1	8.0	8.0	8.0
Toilet (M)	-	1	12.0	12.0	16.0
Toilet (W)	-	1	8.0	8.0	8.0
Corridor	-			60.0	64.0
Sub-total				(144.0)	(136.0)
Total	23			326.0	320.0

2) Structural Plan

a) Frame System

Reinforced concrete (RC) structure will be used for the one-story building with RC flat roof.

b) Structural Design

The design is based on the Japanese standard by referring to British Standard (B.S. code).

c) **Foundation**

As the building is built on the reclaimed land, RC continuous footing which withstands the weight of the building will be used to prepare for differential settlement.

3) Detailed Plans

a) **Roof**

RC asphalt is coated for waterproofing and protective plaster is finished with trowel.

b) **Exterior Wall**

Concrete block wall is coated with plaster and finished with paint.

c) **Opening**

Doors, windows' frames, etc. are of anticorrosive materials considering the site conditions near the sea. Jalousie windows that have most opening rate are adopted considering ventilation in dry season. All the windows are equipped with lattice outside for burglar-proof.

d) **Interior Finish**

Wall is of concrete blocks coated with plaster and finished with paint or of a plasterboard and wood base.

e) **Floor**

A Vinyl flooring tile is installed after a mortar steel trowel finish.

4) Utilities Plan

a) **Water supply facilities**

Water supplying pipe to a building is laid being extended from elevated tank in the site.

b) **Sanitary ware**

The wares are arranged as follows.

Toilet for males	: 2 water closet, 2 urinal, 1 wash fountain, 1 room for sweeping tools, 1 sink and 1 ventilator are installed.
Toilet for females	: 2 water closet, 2 wash fountain and 1 ventilator are installed.

c) **Kitchenette**

1 sink, 1 faucet and 1 water heater are stalled.

d) **Lighting and outlet**

Fluorescent lamps are used, and intensity of illumination at various places are as follows :

Office room, conference room, waiting area	: 400 Lux
Kitchenette, toilet room, stair, corridor	: 60 Lux

As for the outlets, one more outlet is provided for each office room and 2 more outlets are for each conference room and waiting area in addition to the outlets for air-conditioners etc..

e) **Telephone facilities**

Telephone main lines to the Administration Office are planned. Extension lines are installed to each office in the Administration Building . The main lines wiring to the telephone exchanger at the Administration Building is the responsibility of the Government of Ghana.

f) **Air-conditioning facilities**

A window type cooler for each office room is installed.

(3) Fish Handling Shed

There will be built a fish handling shed for auction of catches landed from inshore vessels (fish boxes will be used as in the case of Tema).

The area for the shed is calculated based on the fish catch handled per day.

a) **Amount Handled per Day (N)**

Fish catch on a standard day during the peak season is as follows.

Inshore vessel : 46 vessels x 284 kg/vessel = 13.1 tons .... a

Canoe : 13 canoes x 885 kg + 6 canoes x 556 kg = 15.3 tons ... b

N = a + b = 13.1 tons + 15.3 tons = 28.4 tons

b) **Amount Handled per Unit Area (P)**

Size of fish box	=	650 L x 420 W x 200 H (mm)
Stack of boxes	=	1 - 2 stacks
Area per 1.5 stack	=	0.65 m x 0.42 m = 0.273 m^2 Weight 45 kg
Amount handled per unit area	=	45 ÷0.273 = 165 kg/m^2

c) **Area Required for Shed (S)**

$$S = \frac{N}{R \times \alpha \times P} = \frac{28{,}400}{1 \times 0.24 \times 165} = 717 \text{ m}^2$$

R : Number of rotation for shed use = 1

α : Occupancy ratio of fish catch

The occupancy ratio α is 0.3 if estimated based on the ratio for sardines and mackerels in Japan. However, as there are about 400 middlewomen working in Sekondi, congestion in the shed is expected to be considerable. Therefore, the occupancy ratio is estimated to be lower at α = 0.3 x 80% = 0.24 to facilitate smooth auction as follows.

Accordingly, the shed should be 45 m long and 16 m wide (720 m^2 in area).

d) **Structural Specifications**

Columns	:	RC
Roof	:	Steel beam and bent bars
Floor	:	RC finished with plaster
Foundation	:	RC isolated footing

(4) Specification for Ice Making Plant

The ice making plant (450 m^2) is built behind the lay-by wharf to house ice making machine and ice storage space. There will be a anteroom for engineers and workers. The structural specifications are outlined below.

Columns	:	RC
Roof	:	Steel beam and folded - plate
Wall	:	Block finished with plaster, and painted
Floor	:	RC finished with plaster
Foundation	:	RC isolated footing

(5) Toilet

Toilet (11 m x 3.4 m) for vessel crews and middlewomen is planned. Sanitary fixture are the following.

For males	:	2 water closet, 2 urinal, 2 wash fountain, 1 sink
For females	:	4 water closet, 2 wash fountain, 1 sink

The structural specifications are outlined below.

Columns	:	RC
Roof	:	RC mortar with waterproof
Wall	:	Block finished with plaster, and paint
Floor	:	RC finished with plaster
Foundation	:	RC continuous footing

There will be provided a septic tank for the toilet and administration office.

(6) Pump and Electrical House

There will be provided a house for electrical installations and a pump house for seawater pump. Both building will have an identical space (30m^2 : 5m x 6m) and structure. Specifications are outlined below.

Columns	:	RC
Roof	:	RC mortar with waterproof
Wall	:	Block finished with plaster, and paint
Floor	:	RC
Foundation	:	RC continuous footing

(7) Open Storage Yard

A space of about 700m^2 (20m x 35 m) behind the lay-by wharf will be used as the open storage.

2-4-7 Basic Design Drawings

(1) Outline of Basic Facilities

Outline of the basic facilities planned for Sekondi Fishing Port is shown in Table-2.4.26.

Table-2.4.26 Contents of Basic Facilities

No.	Name of Facilities	Scale	Outline
1.	Breakwater	200m	Rubble Mound Type
2.	Wharves		
	2.1 Landing Wharf (-3m)	50 m	Cellular Block Type
	2.2 Lay-by Wharf (-2m)	115 m	Concrete Block Type
	2.3 Junction	15 m	
3.	Canoe Jetty	76 m	Concrete Block Type
4.	Revetment		
	4.1 North Side Stone Wall	115 m	Rubble Mound Type
	4.2 South Side Seawall	50 m	Rubble Mound Type
5.	Roads in and around the Port		
	5.1 In-Port Road	370 m	Pavement Width : 6 m
	5.2 Access Road	490 m	Pavement Width : 6 m
	5.3 Walkway	66 m	Pavement Width : 3.5 m
6.	Pavement in and around the Port		
	6.1 Pavement of Apron	1,435 m^2	Concrete Pavement
	6.2 Pavement of Roads	3,576 m^2	Interlocking Block Pavement

(2) Outline of Functional Facilities

Outline of the functional facilities planned for Sekondi Fishing Port is shown in Table-2.4.27.

Table-2.4.27 Contents of Functional Facilities

No.	Number Of Facilities	Scale	Outline
1.	Ice Making Plant		
	1.1 Ice Making Machine	15 ton/day	
	1.2 Ice Storage	45 ton	
2.	Fish Handling Shed	720 m^2	45 m x 16 m
3.	Administration Office	320 m^2	32 m x 10 m one-story building
4.	Water Supply Facilities		
	4.1 Elevated Water Tank	5 ton	
	4.2 Water Tank	60 ton	
5.	Fire Fighting Facilities & Seawater Pump		
	5.1 Fire Fighting Facilities	1 Ls	
	5.2 Seawater Pump	1 Ls	
6.	Lighting System	1 Ls	
7.	Toilets & Water Discharge System	1 Ls	
8.	Open Storage Yard	1 Ls	

(3) Basic Design Drawings

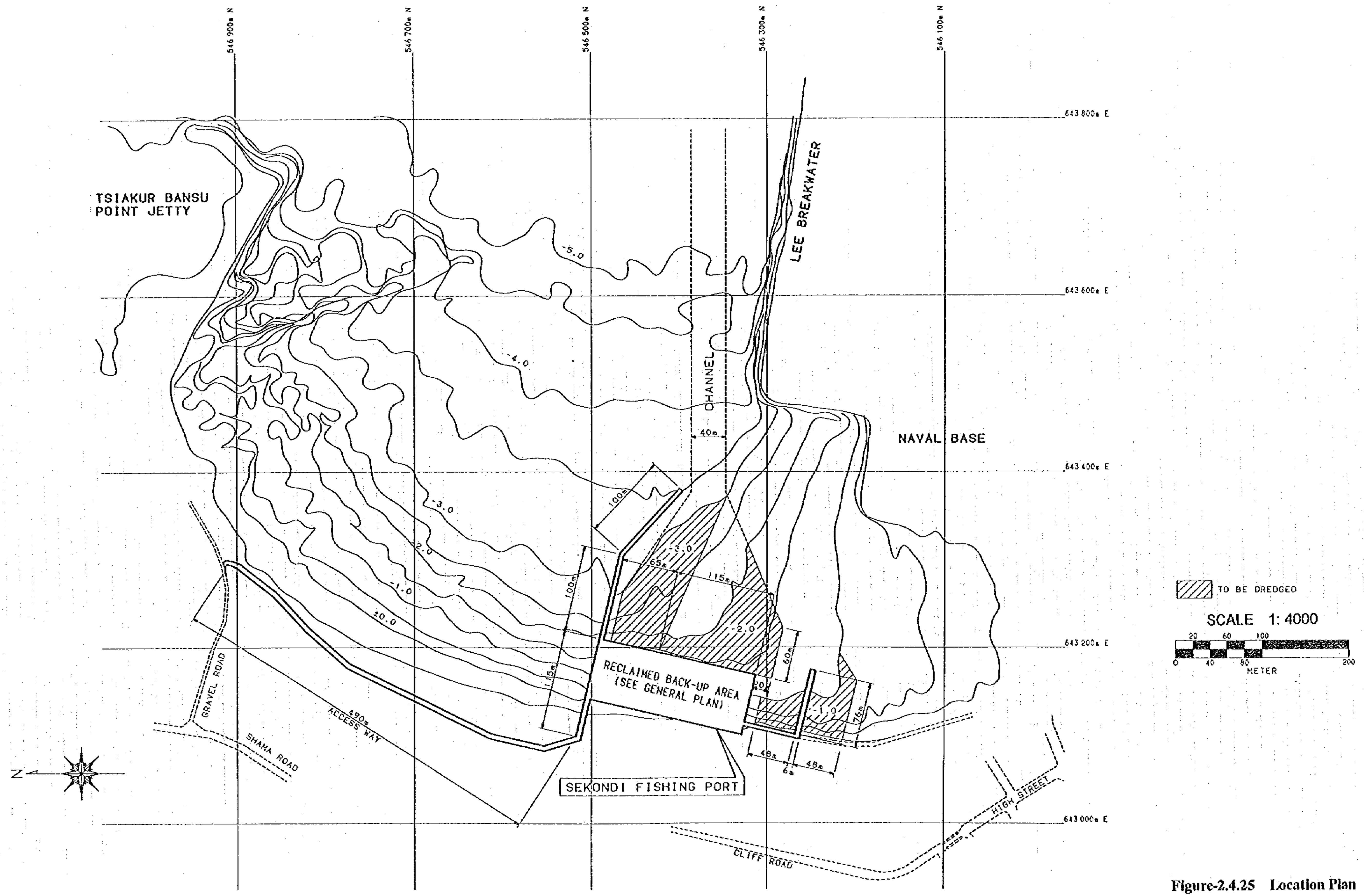


Figure-2.4.25 Location Plan

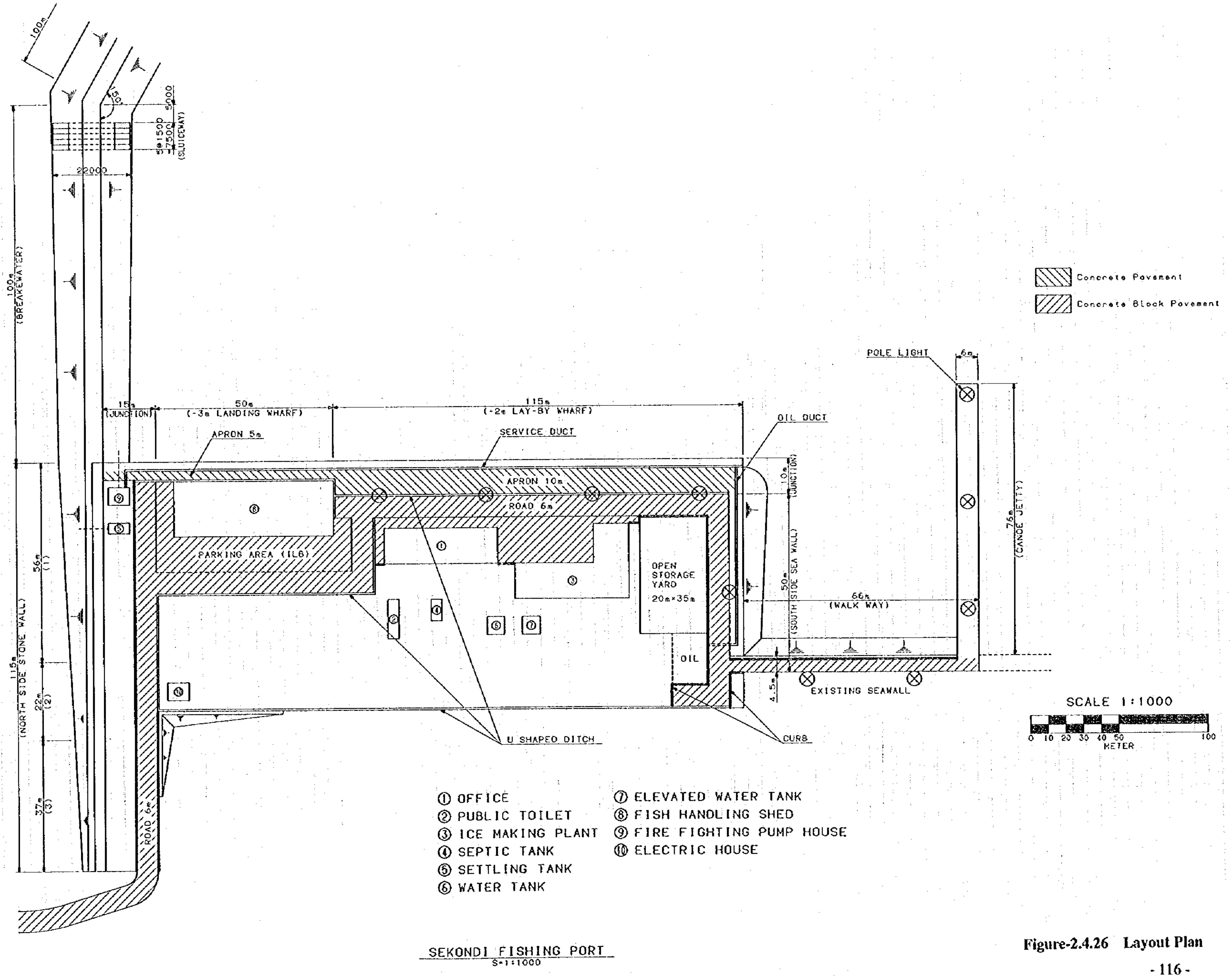


Figure-2.4.26 Layout Plan

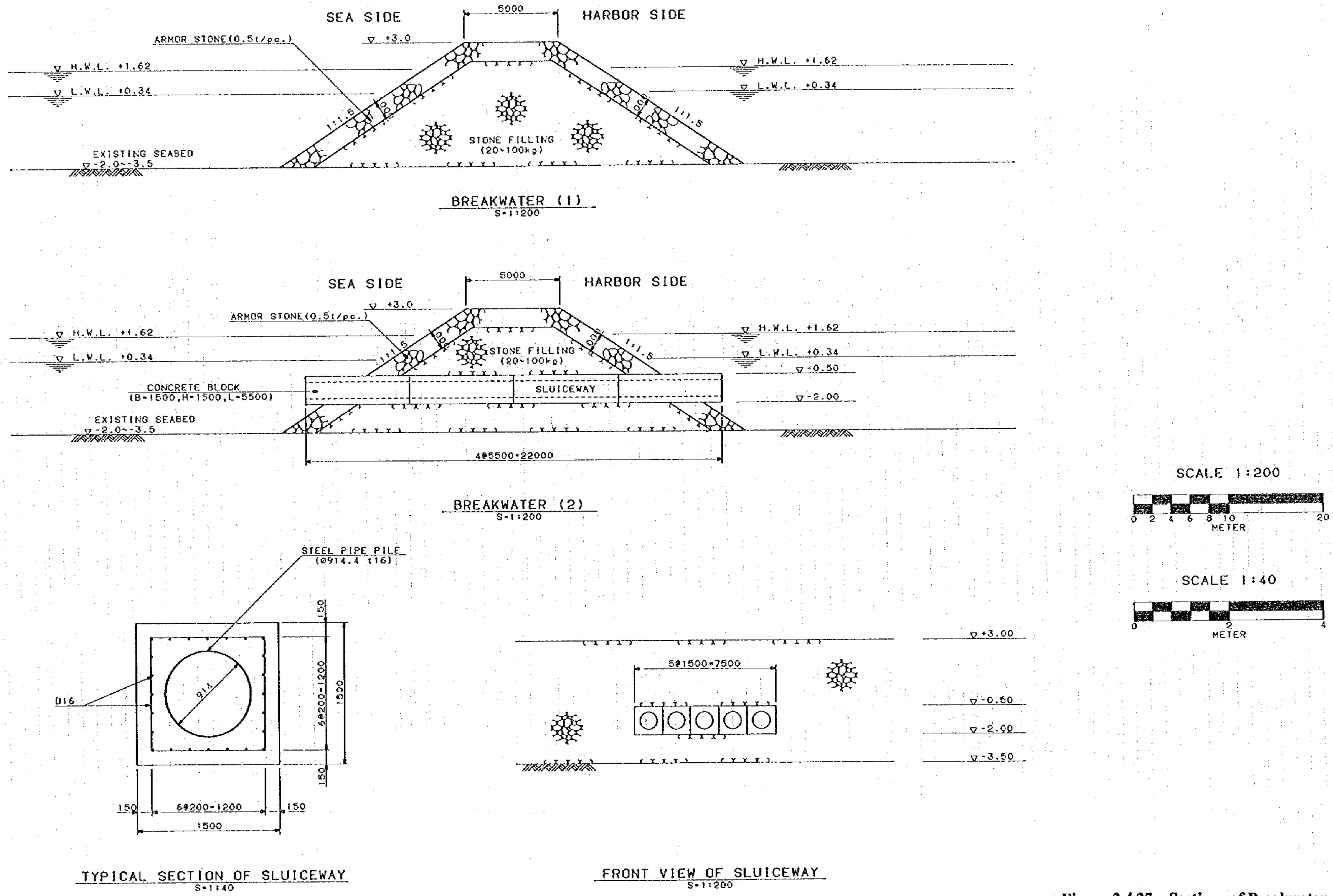
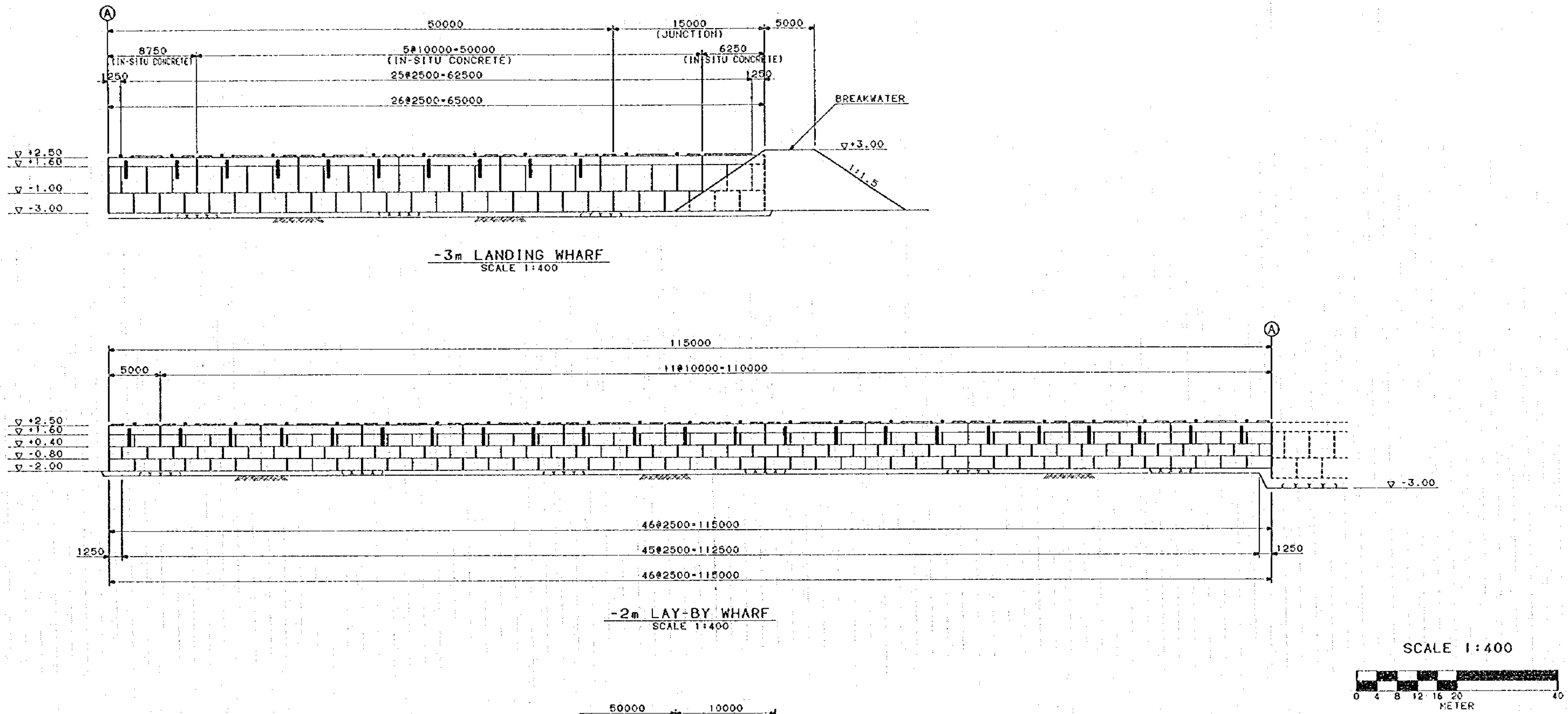


Figure-2.4.27 Sections of Breakwater



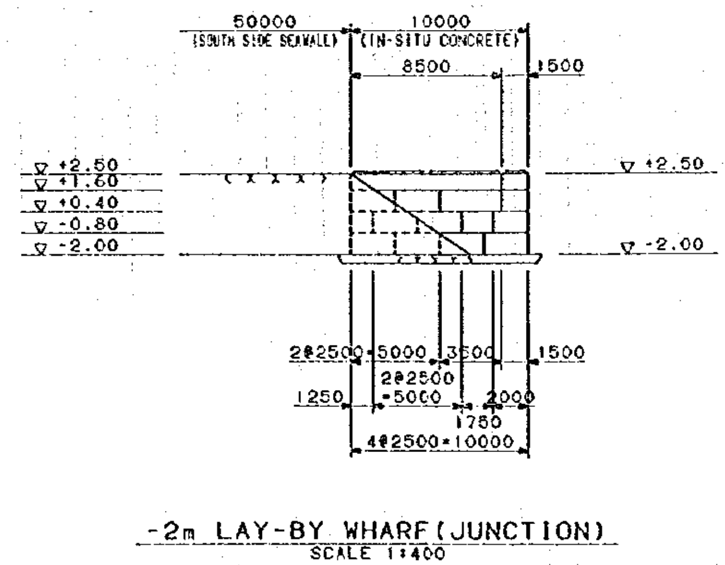
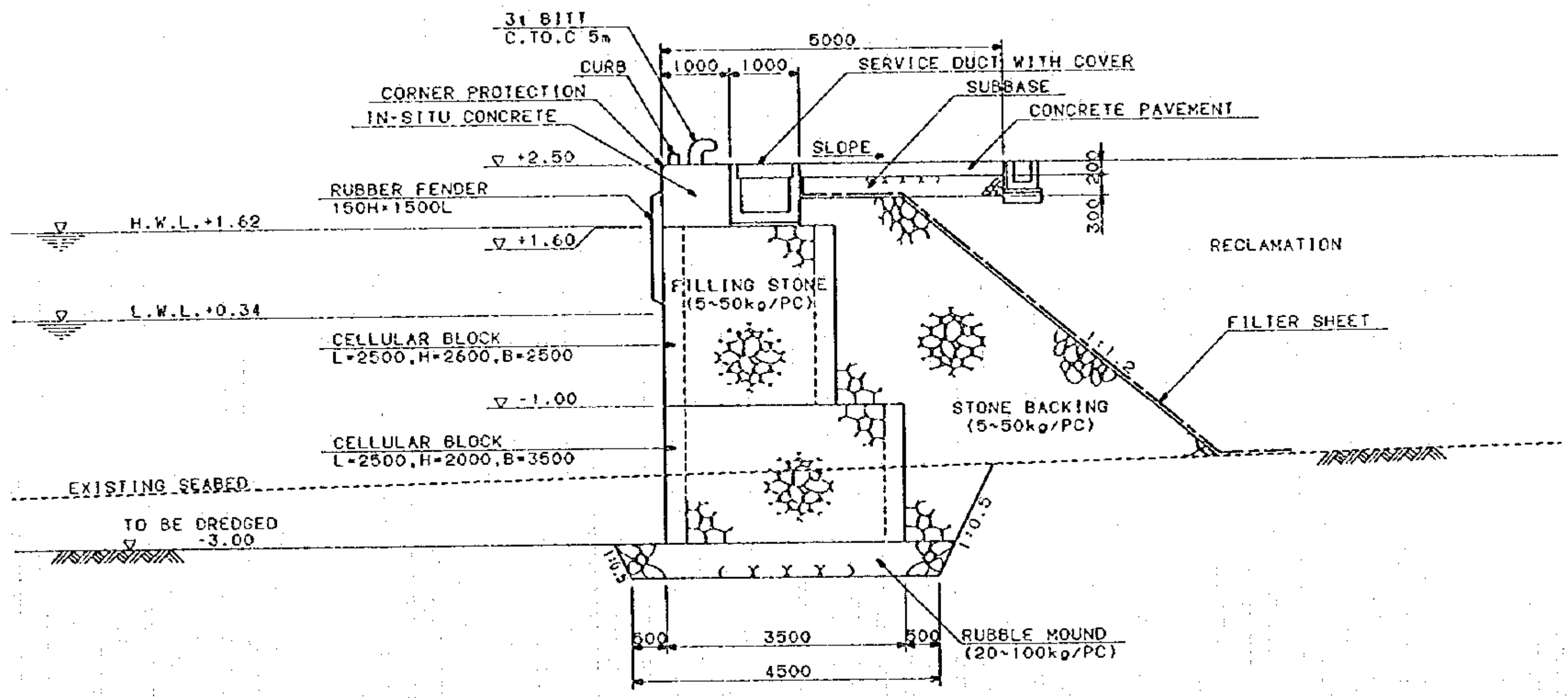
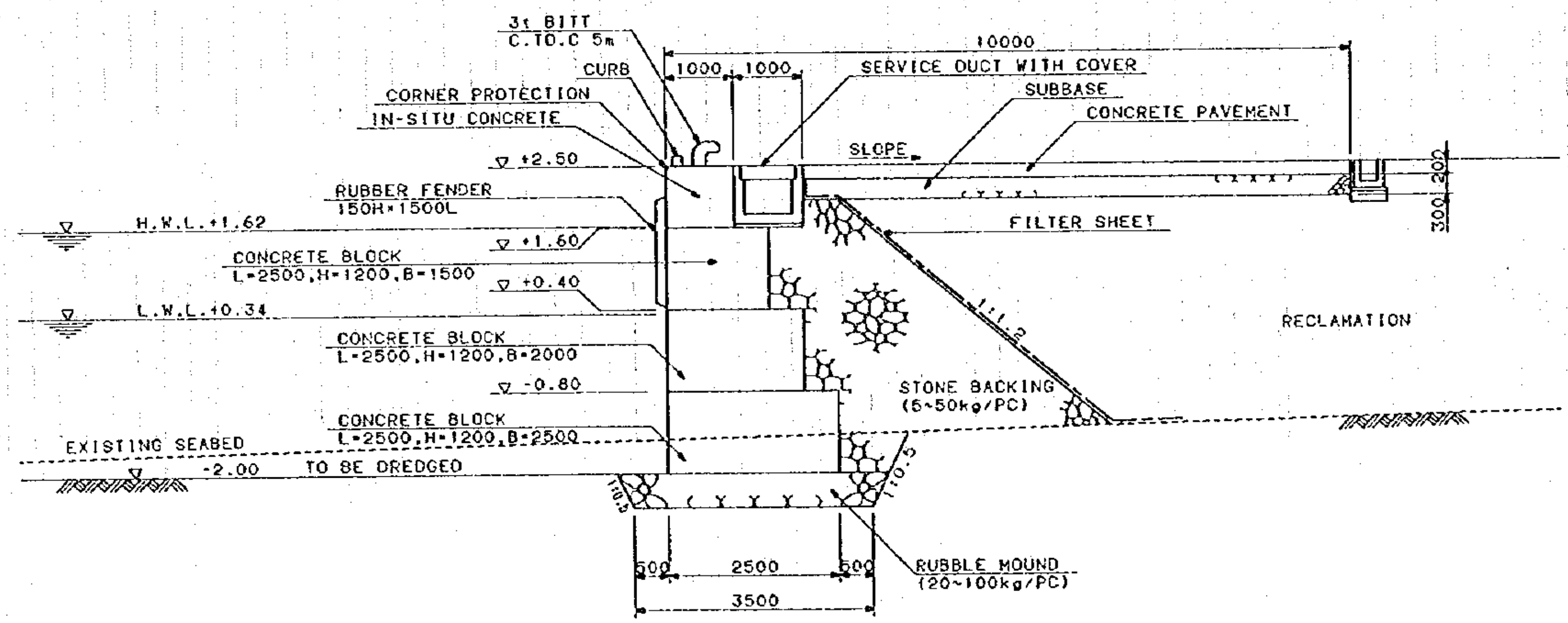


Figure-2.4.28 Front View of Wharves



LANDING WHARF
SCALE 1:100



LAY-BY WHARF
SCALE 1:100

SCALE 1:100

Figure-2.4.29 Sections of Wharves

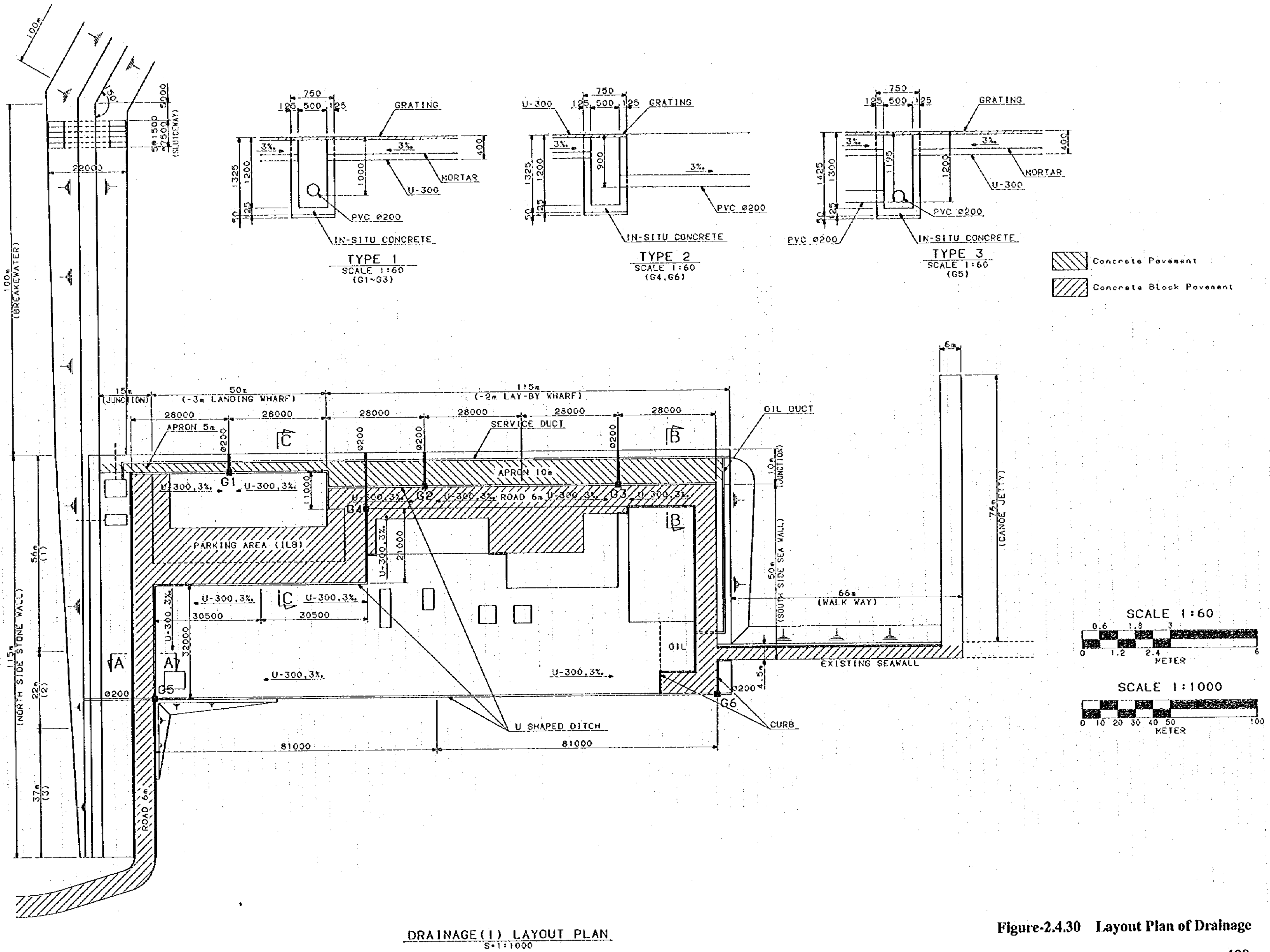


Figure-2.4.30 Layout Plan of Drainage

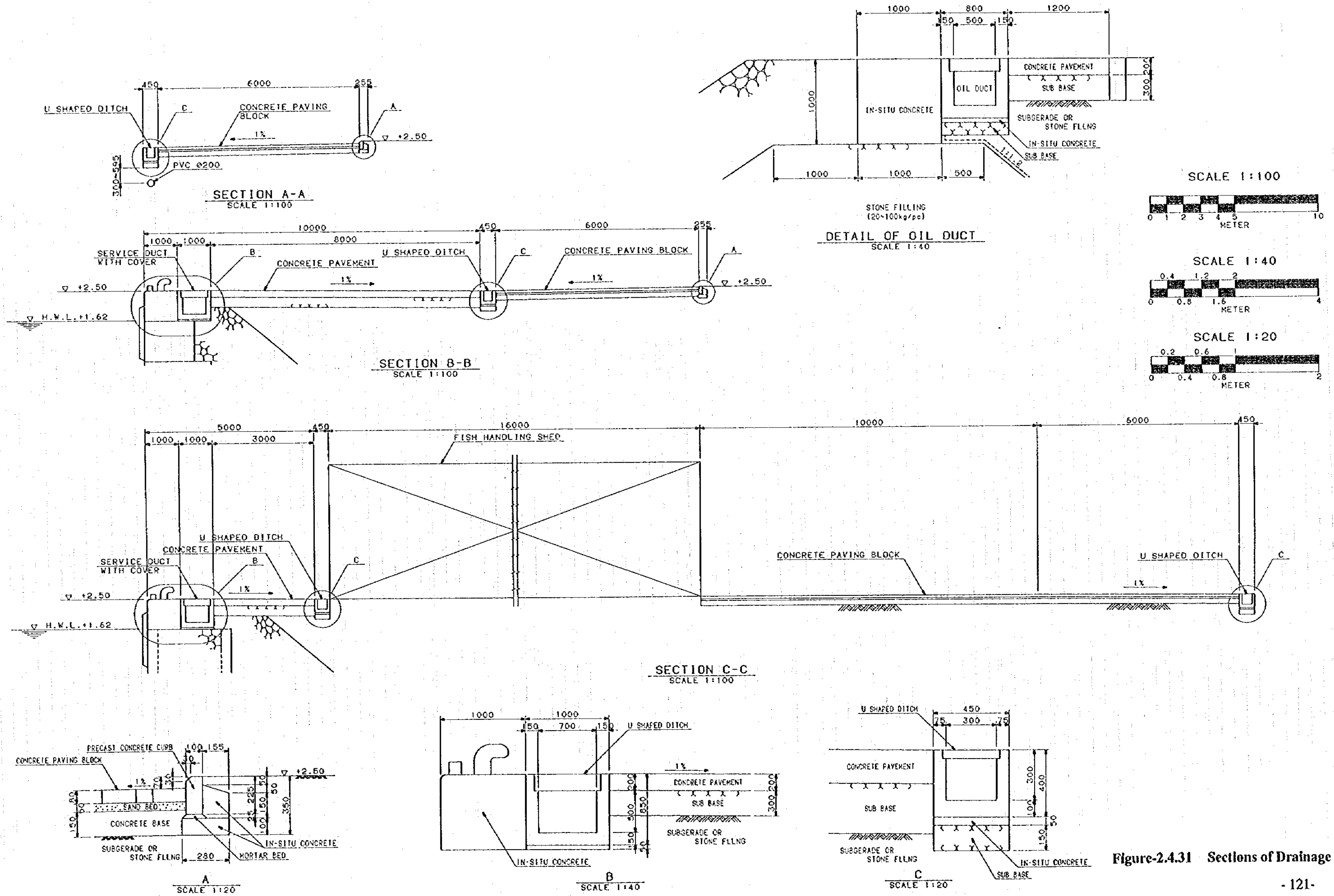
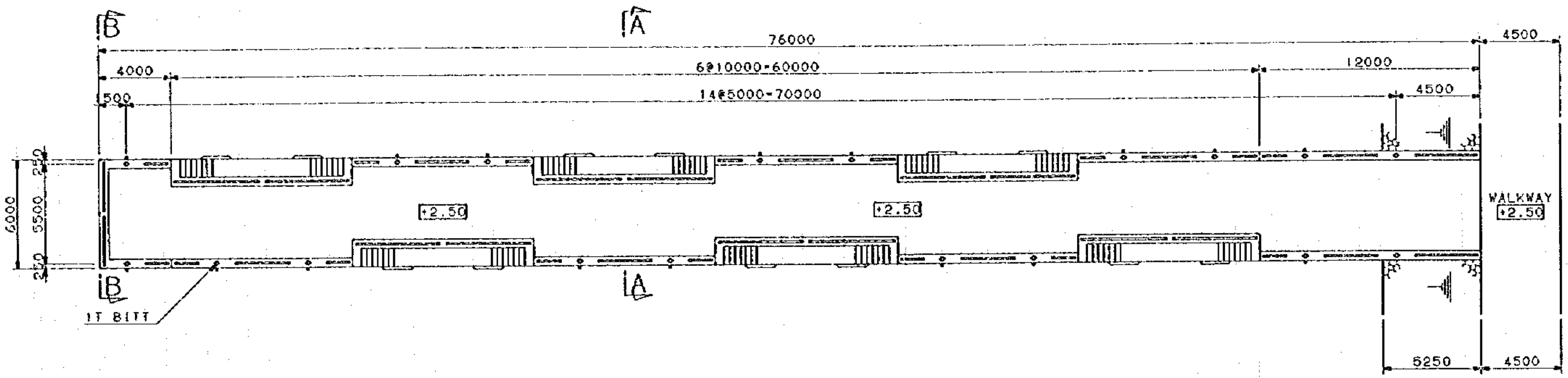
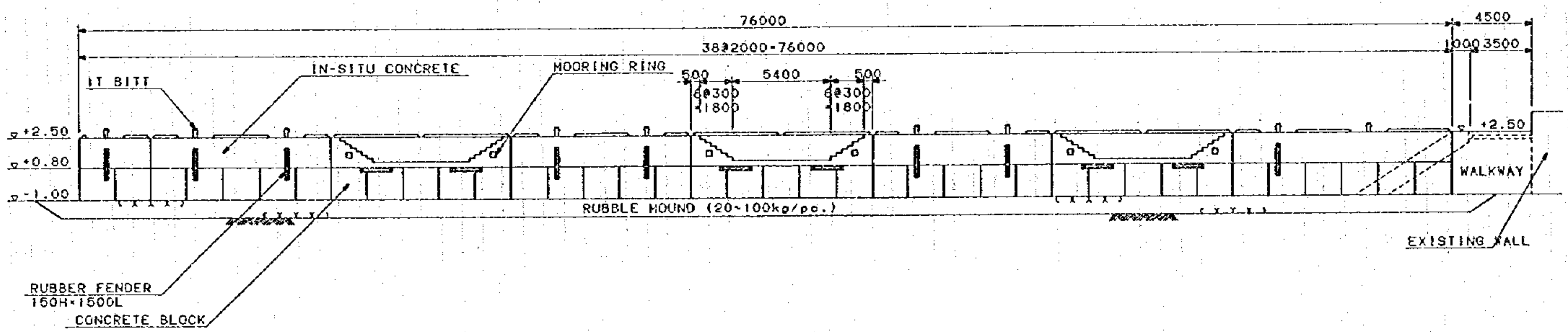


Figure-2.4.31 Sections of Drainage



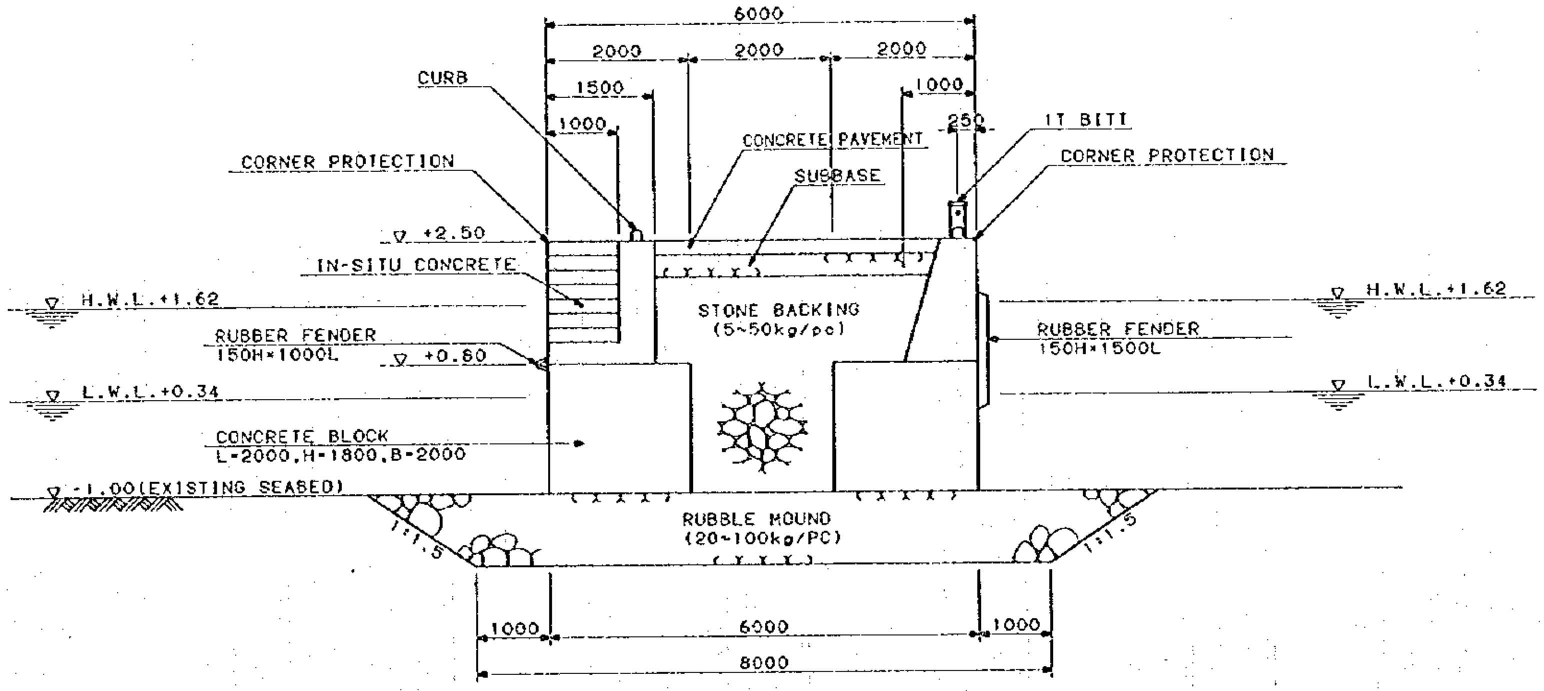
PLAN
SCALE 1:300



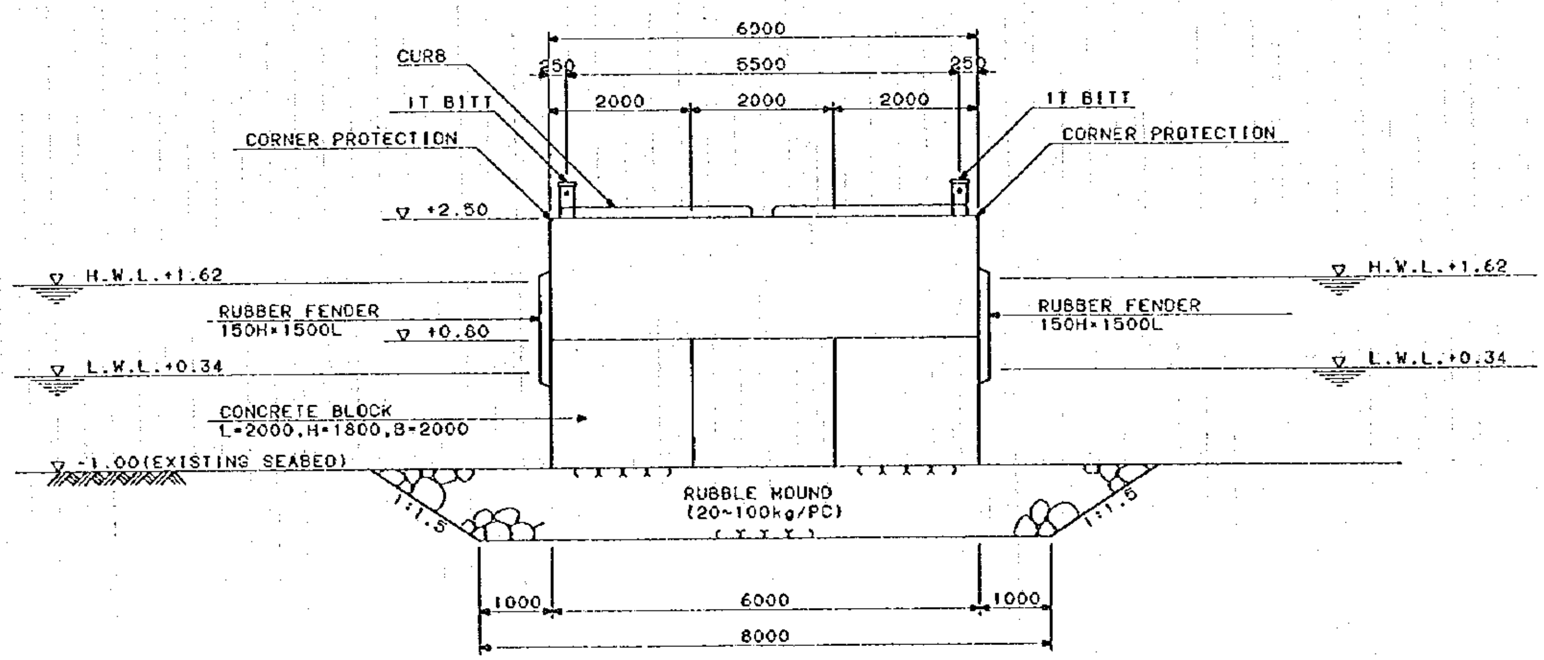
FRONT VIEW
SCALE 1:300

SCALE 1:300

Figure-2.4.32 Plan and Front View of Canoe Jetty



SECTION A-A
SCALE 1:100



SECTION B-B
SCALE 1:100

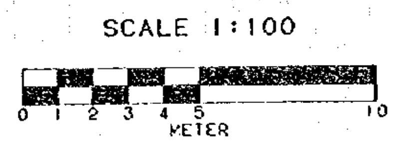


Figure-2.4.33 Sections of Canoe Jetty

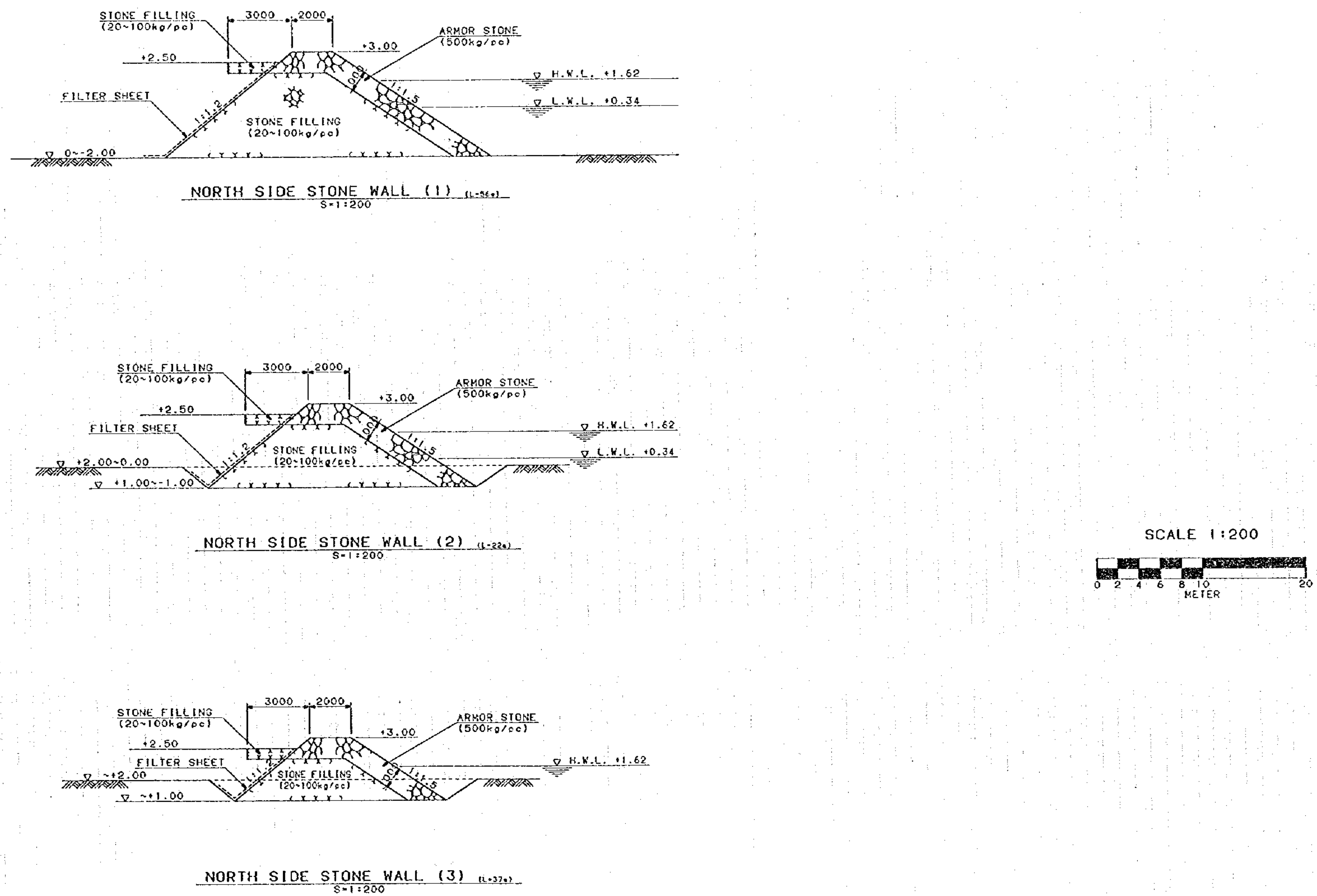
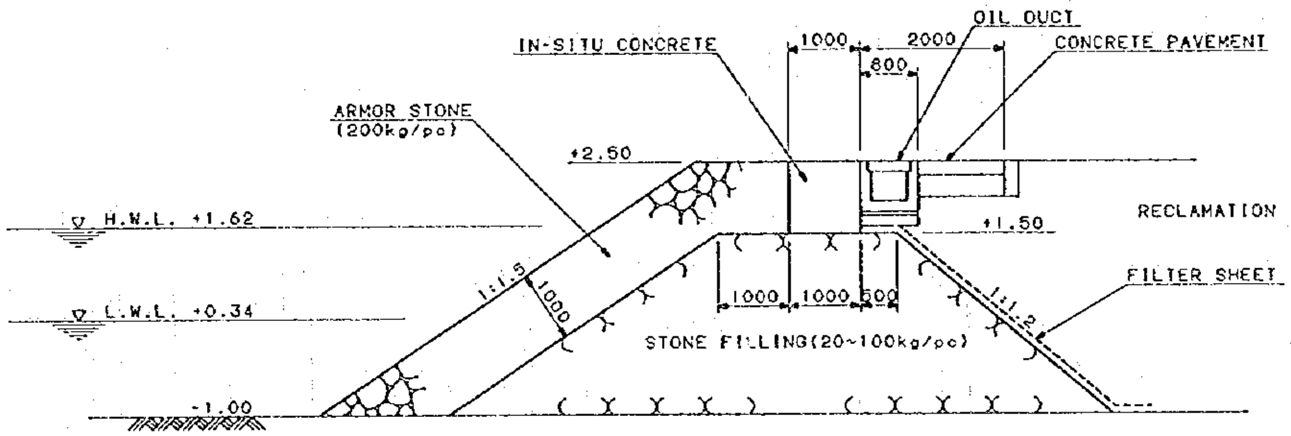
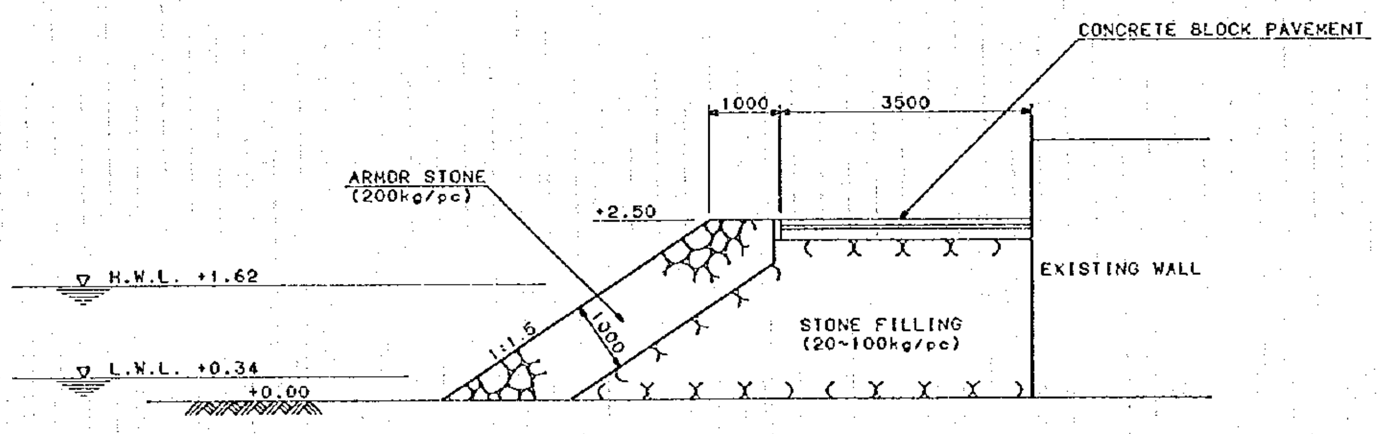


Figure-2.4.34 Sections of North Side Stone Wall



SOUTH SIDE SEAWALL (L-50m)
S=1:100



WALK WAY (L=66m)
S=1:100

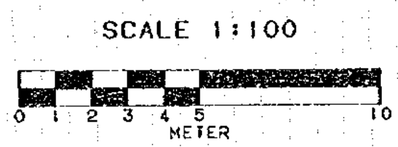


Figure-2.4.35 Sections of South Seawall and Walkway

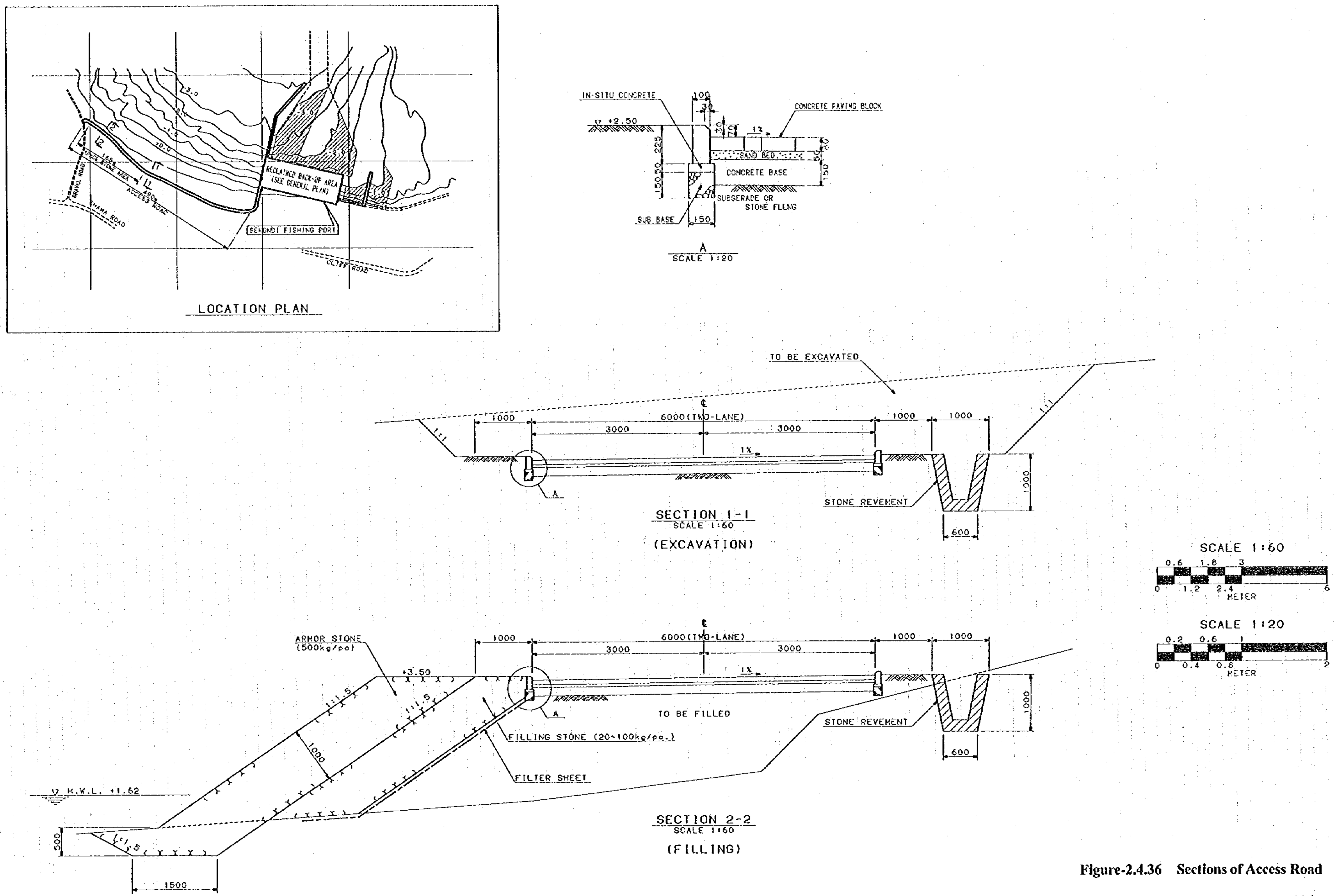
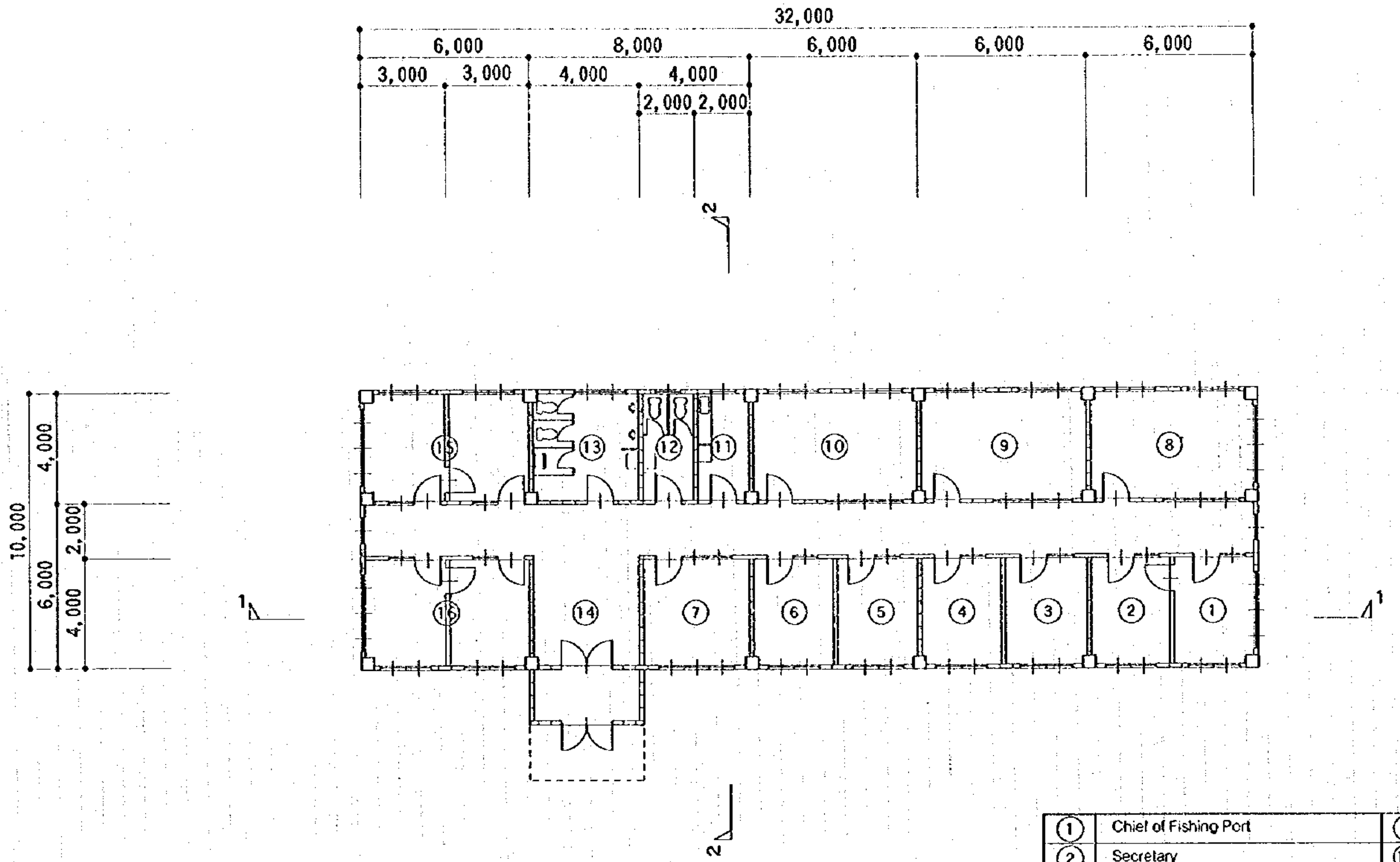


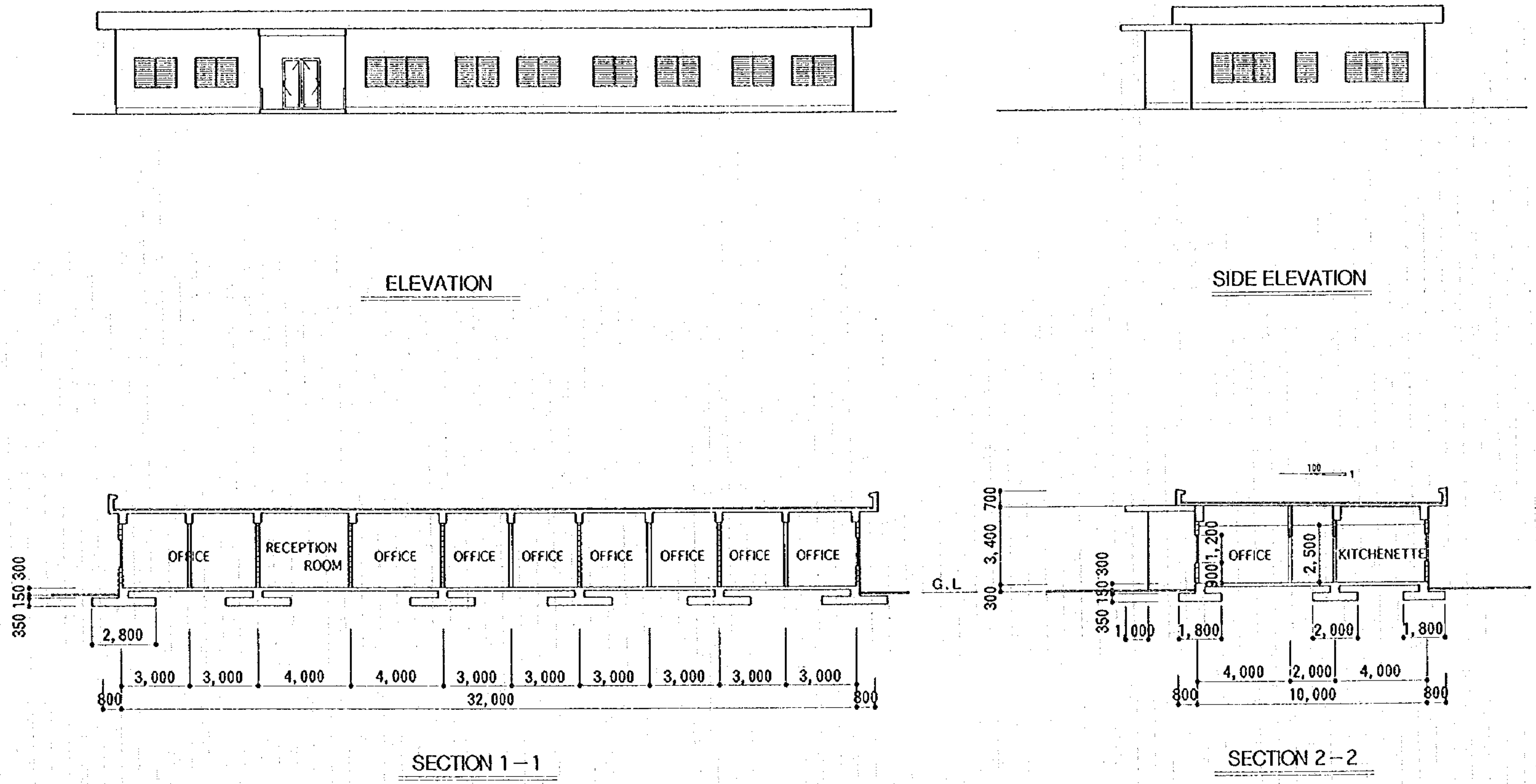
Figure-2.4.36 Sections of Access Road



①	Chief of Fishing Port	⑨	Clerks (2)
②	Secretary	⑩	Conference Room
③	Chief of Operation Service	⑪	Kitchenette
④	Chief of Auditor	⑫	Women's Lavatory
⑤	Chief of Accountant	⑬	Men's Lavatory
⑥	Chief of Engineering Service	⑭	Reception Room
⑦	Operation Service	⑮	Inshore Fisheries Association
⑧	Clerks (1)	⑯	Fisheries Department

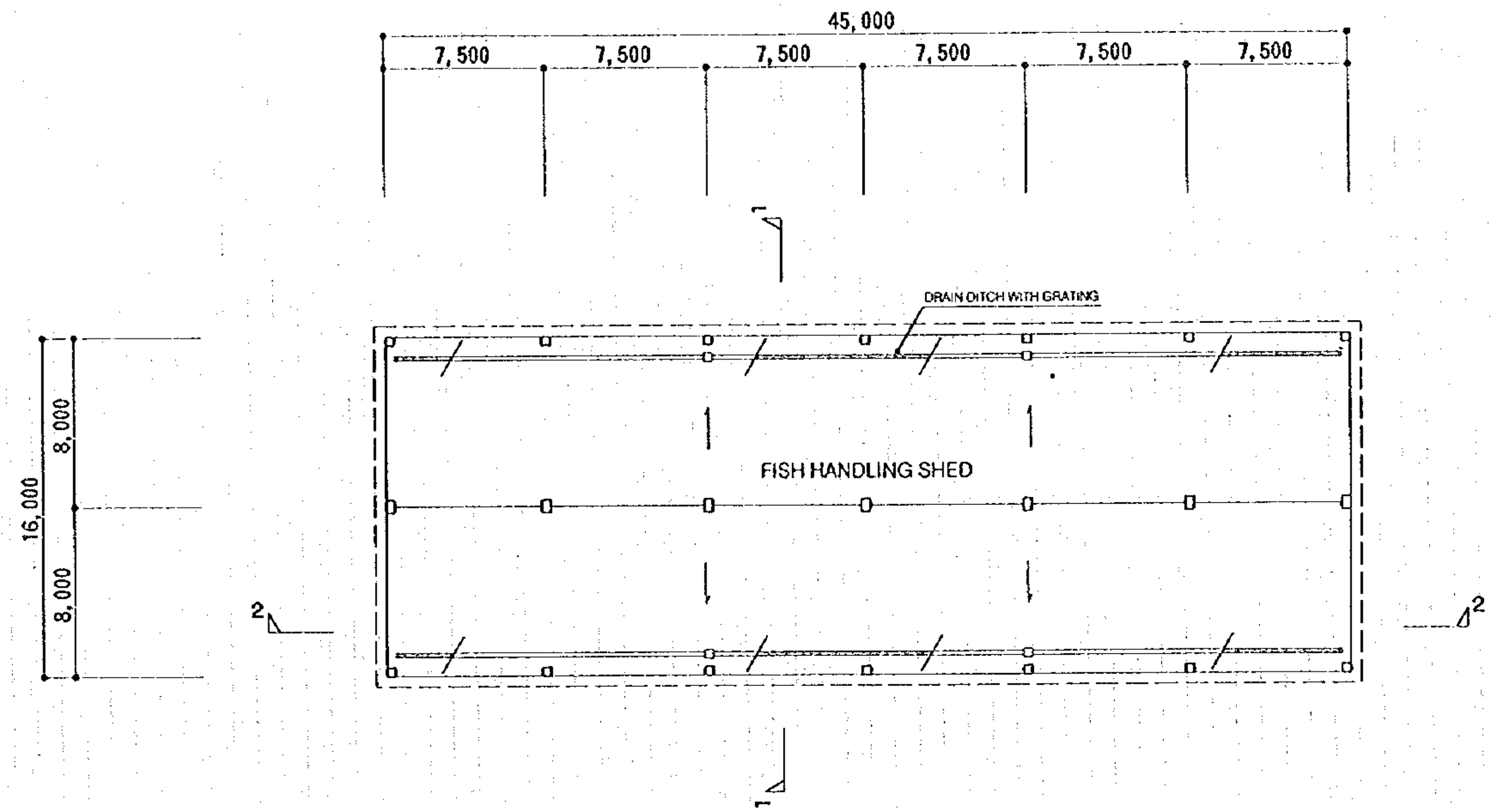
Layout Plan of Administration Office Building S＝1／200

Figure-2.4.37 Layout plan of Administration Office Building



Elevation and Sections of Administration Office Building S＝1／200

Figure-2.4.38 Elevation and Sections of Administration Office Building



Layout Plan of Fish Handling Shed S＝1／300

Figure-2.4.39 Layout Plan of Fish Handling Shed

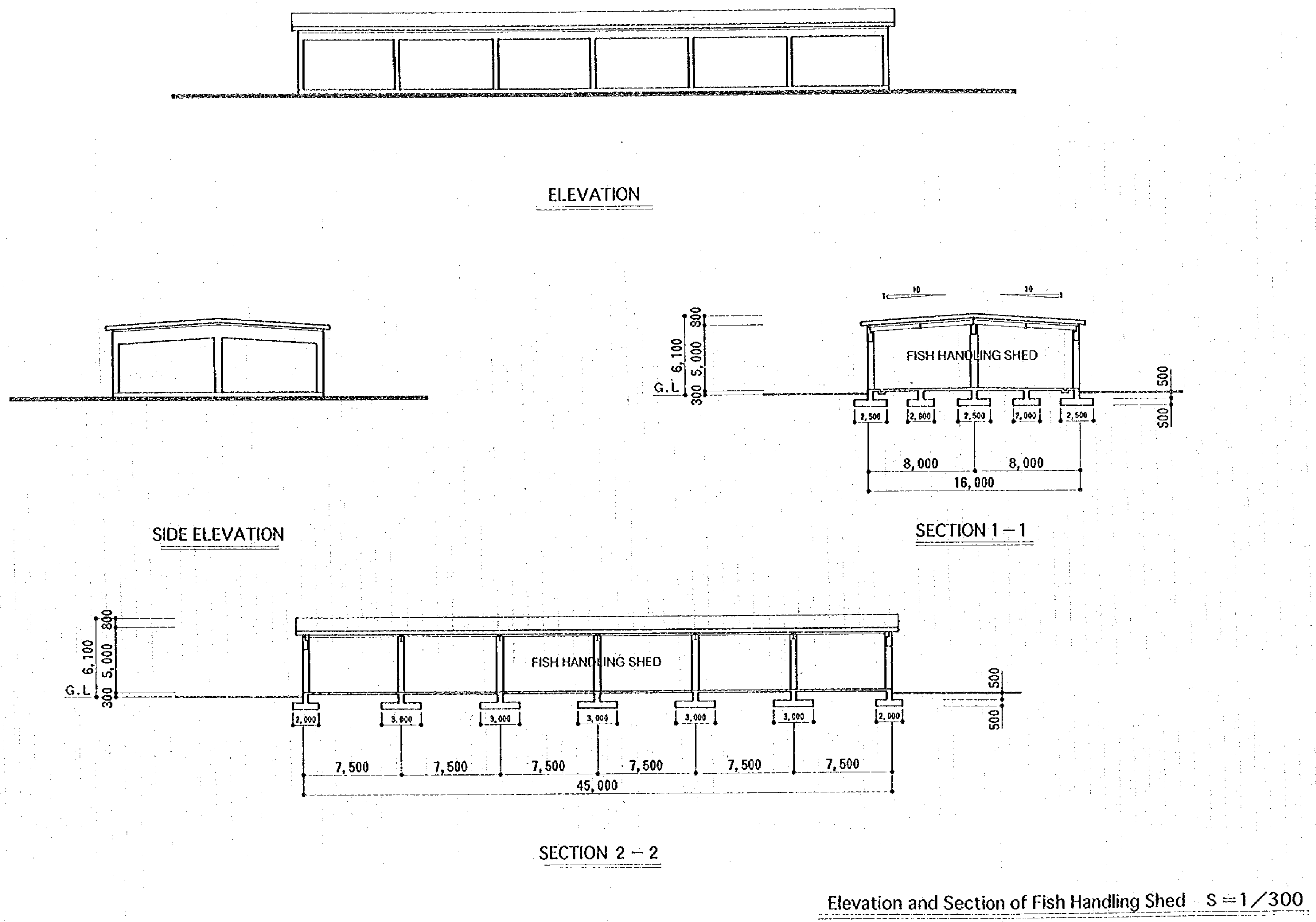


Figure-2.4.40 Elevation and Sections of Fish Handling Shed

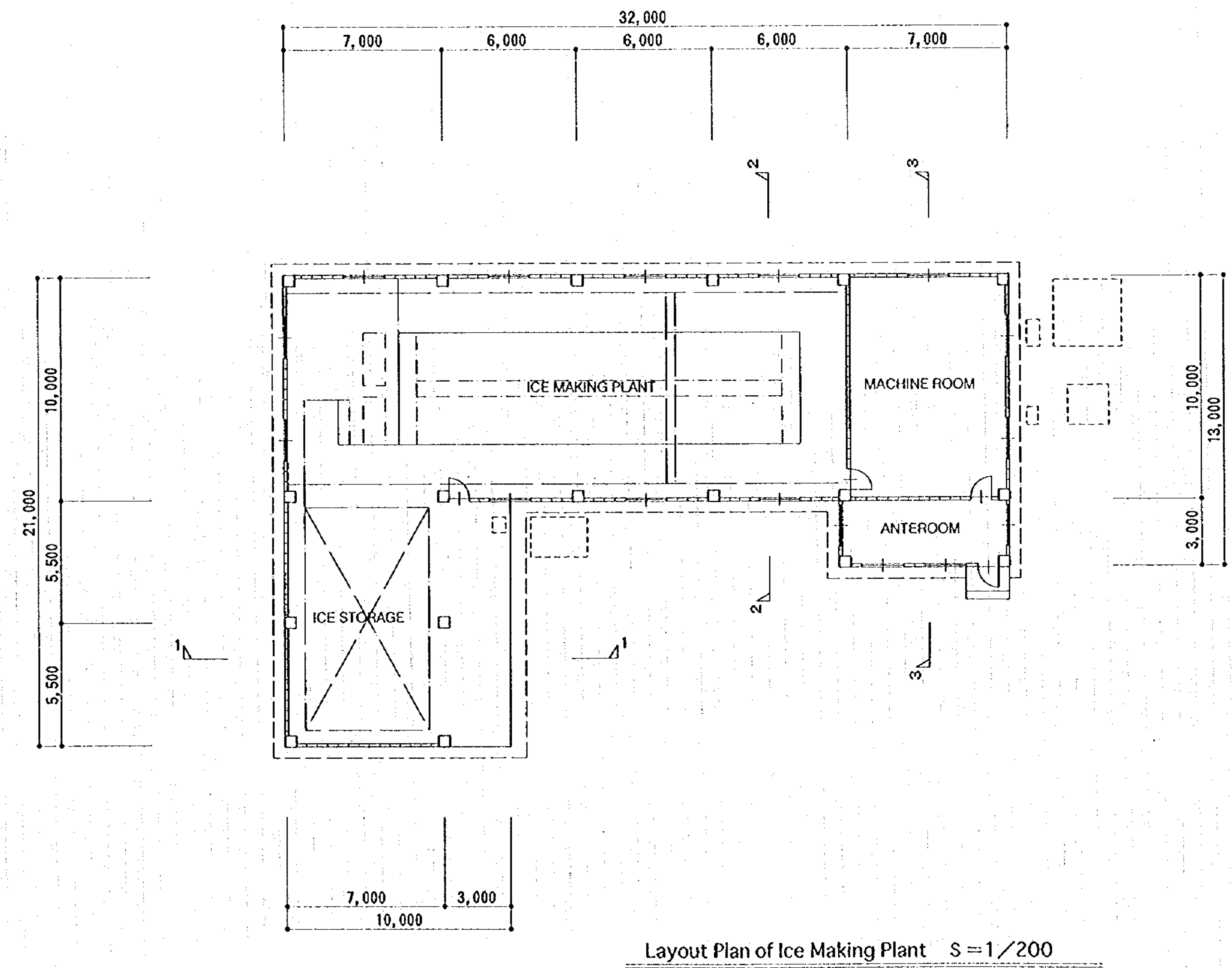


Figure-2.4.41 Layout Plan of Ice Making Plant

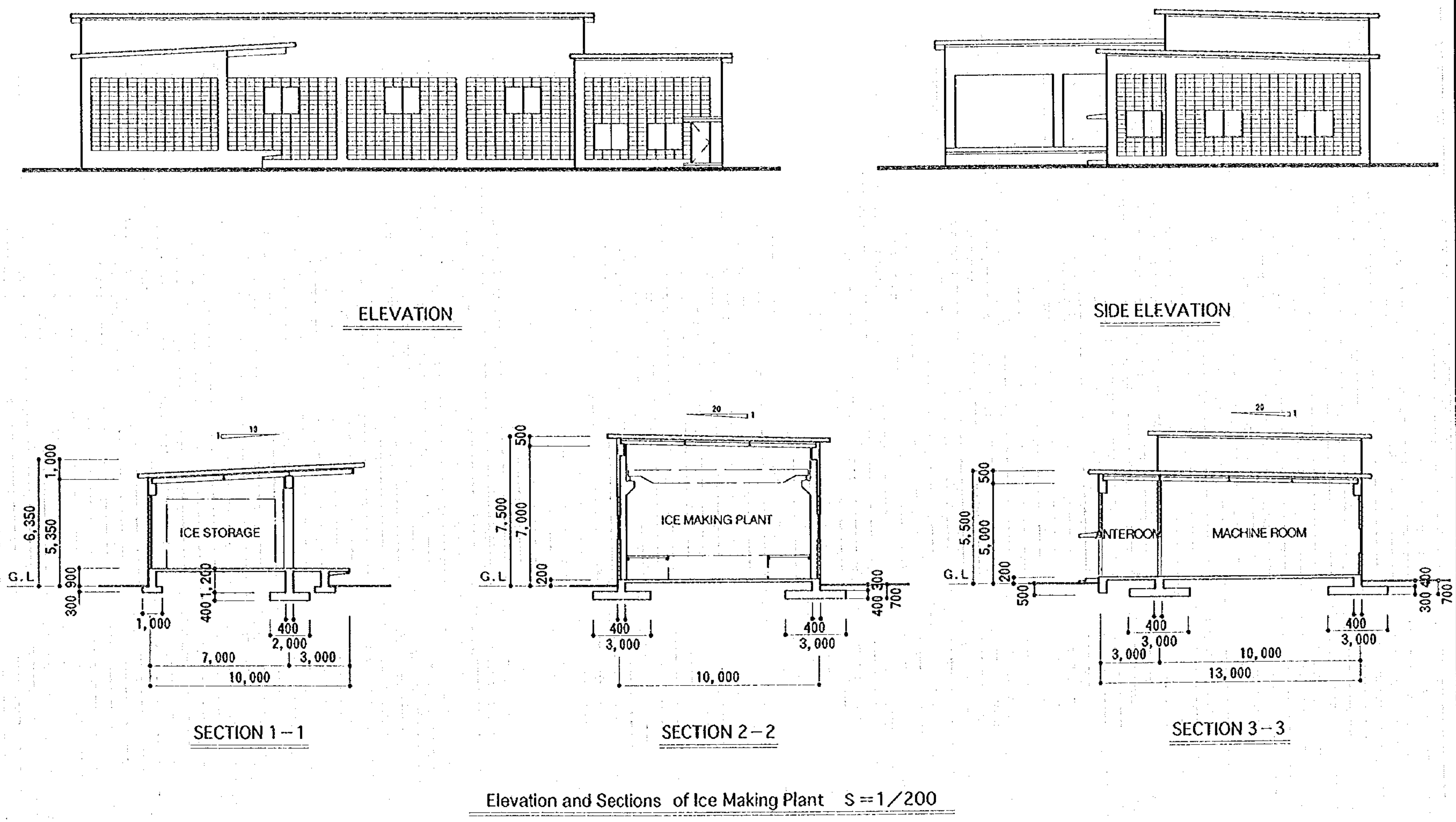
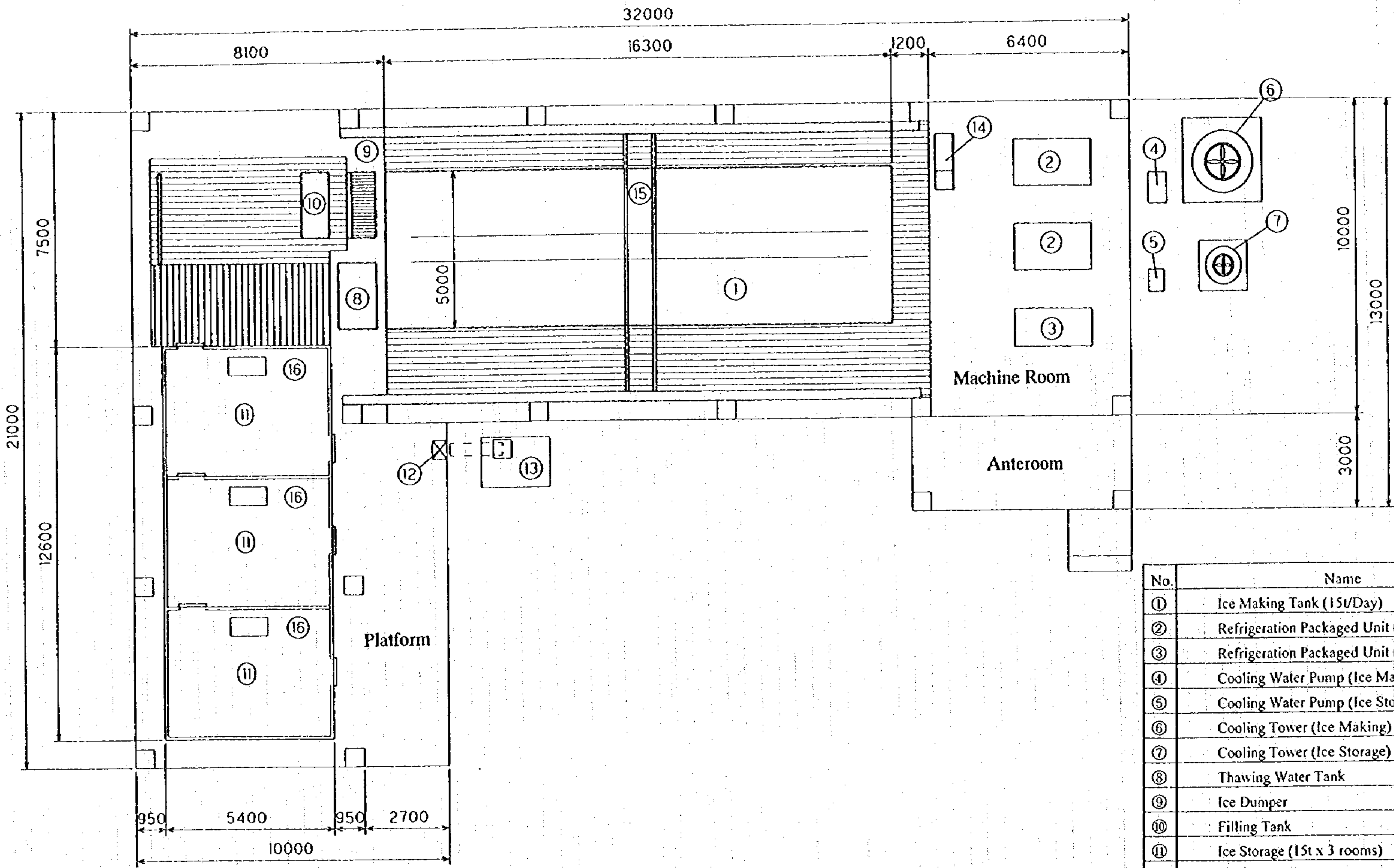
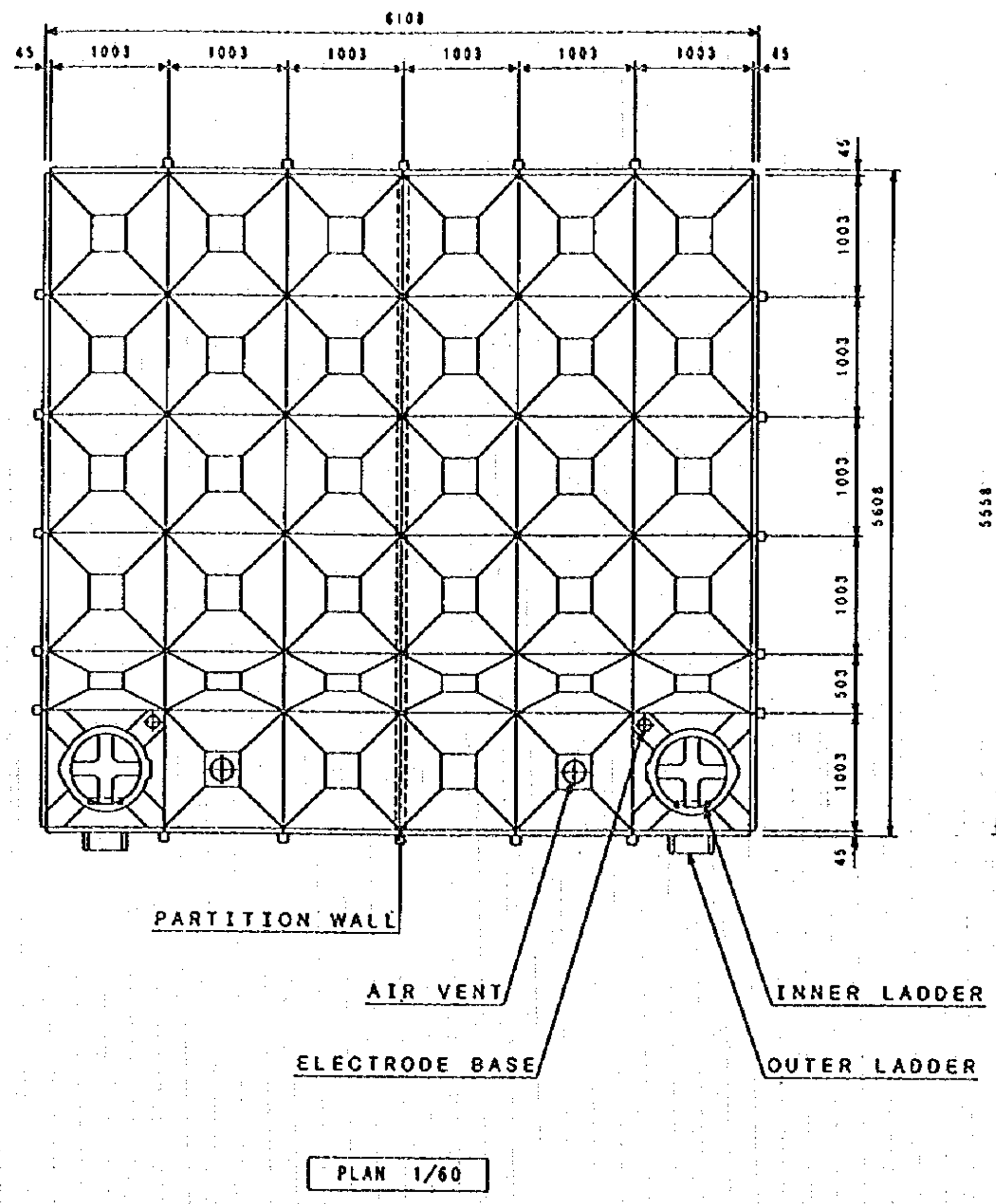


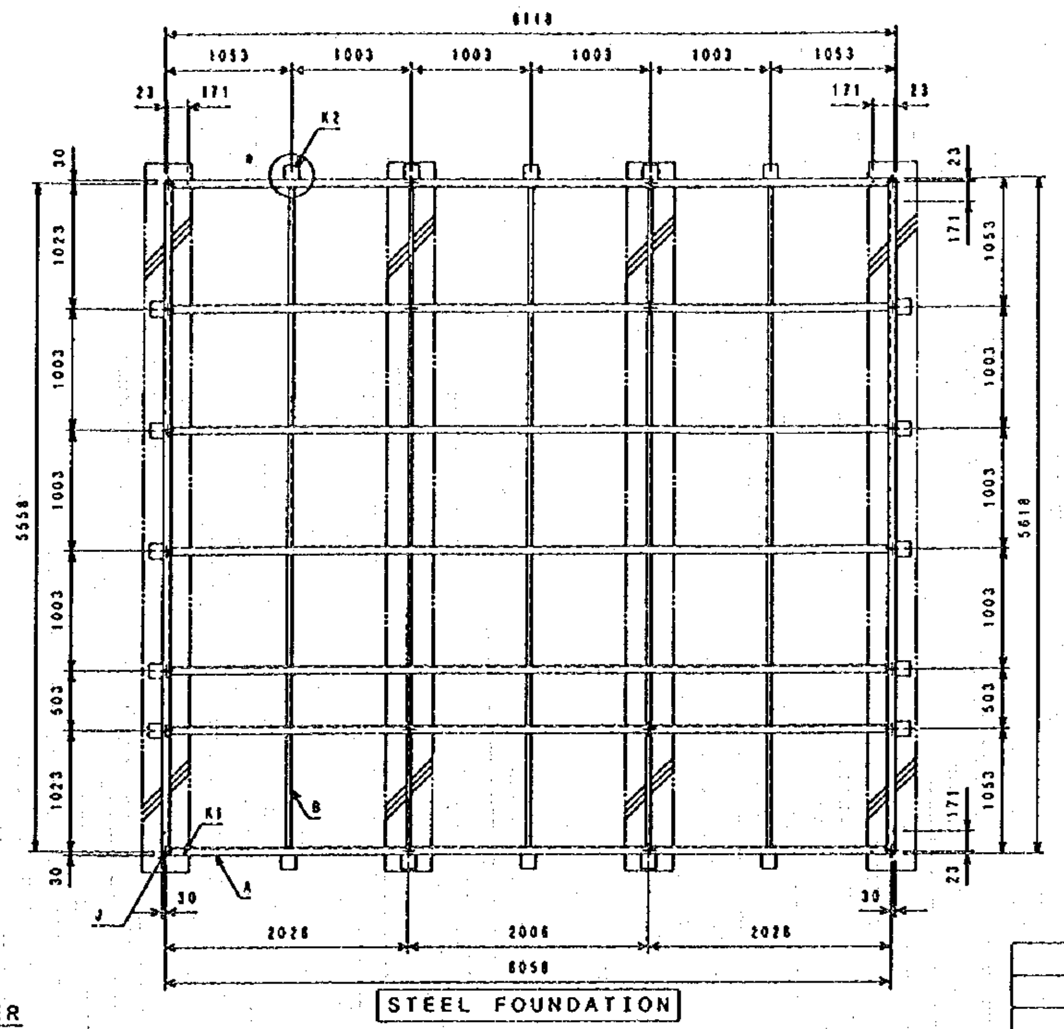
Figure-2.4.42 Elevation and Sections of Ice Making Plant

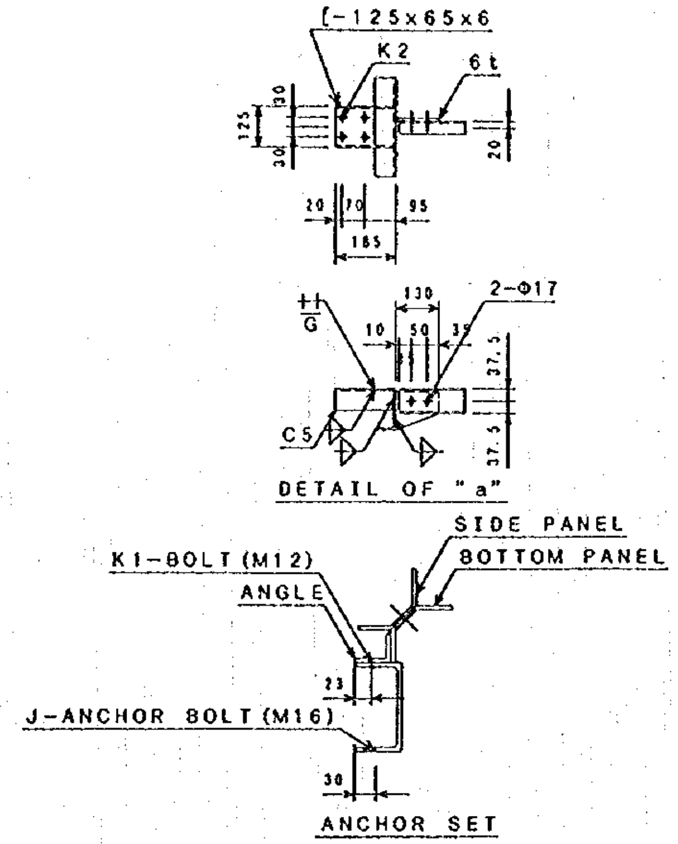


No.	Name
①	Ice Making Tank (15t/Day)
②	Refrigeration Packaged Unit (Ice Making Machine) (37.0kw x 2set)
③	Refrigeration Packaged Unit (Ice Storage Machine) (11.0kw x 1set)
④	Cooling Water Pump (Ice Making Machine)
⑤	Cooling Water Pump (Ice Storage Machine)
⑥	Cooling Tower (Ice Making)
⑦	Cooling Tower (Ice Storage)
⑧	Thawing Water Tank
⑨	Ice Dumper
⑩	Filling Tank
⑪	Ice Storage (15t x 3 rooms)
⑫	Ice Crusher
⑬	Air Discharger
⑭	Control Panel
⑮	Traveling Crane
⑯	Unit Cooler

Figure-2.4.43 Plan of Ice Making Machine and Ice Storage

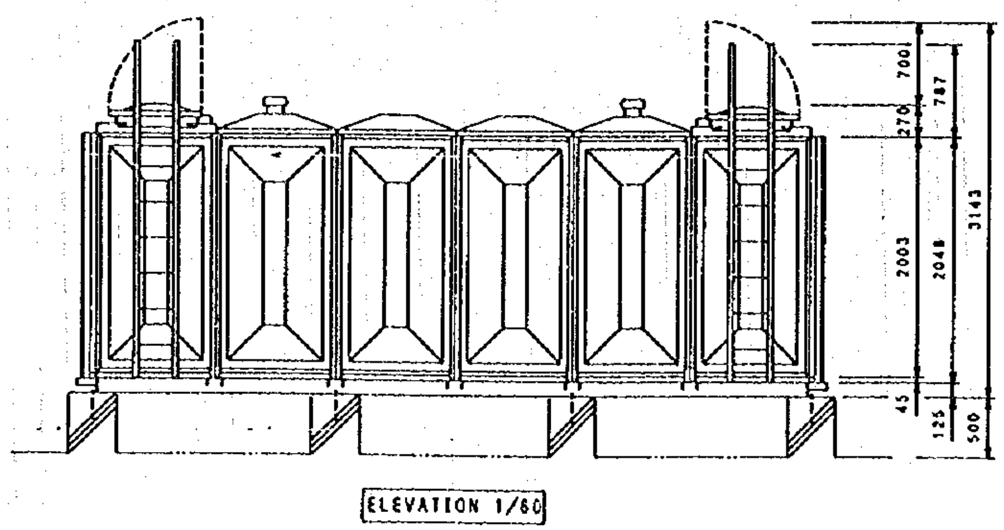






STEEL FOUNDATION NOTE	
A	[-125x65x6x8 (GALVANIZED)
B	[-75x40x5x7 (GALVANIZED)
K1	8-φ14 M12 SET BOLTS
K2	80-φ16 M12 BOTTOM BOLTS
J	22-φ18 M16 ANCHOR BOLTS

SPECIFICATION OF RESERVOIR TANK	
FRP PANEL TANK	
PFA-66. 0-07N (5. 5X6. 0X2. 0H)	
ANTI-EARTHQUAKE GRADE	2/3G
ANTI-EARTHQUAKE SPECIFICATION	BOX FRAME TYPE
BOTTOM PANEL	NON SLIP TYPE
ROOF PANEL	NON SLIP TYPE
GASKET	FOAMED P. V. C
ASSEMBLY BOLT	STAINLESS STEEL
ASSEMBLY BOLT (ABOVE THE HIGH WATER LEVEL)	PLASTIC COATED BOLT
STEEL SKID BASE	HOT DIP GALVANIZING
ANCHOR BOLT	HOT DIP GALVANIZING
COEFFICIENT OF WATER ABSORPTION	100% OR LESS
MANHOLE	LCOKABLE MANHOLE
COLOUR	IVOLY
TANK NET WEIGHT	2350kg
EFFECTIVE CAPACITY	60. 0m³



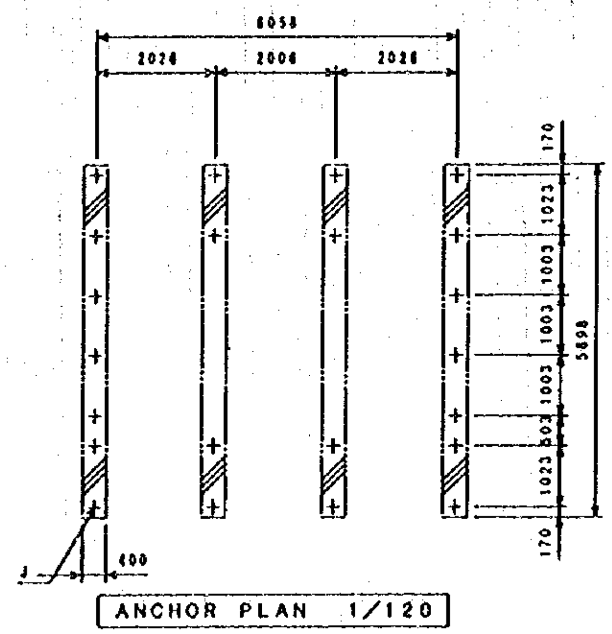


Figure-2.4.44 Structural Plan for Water Tank

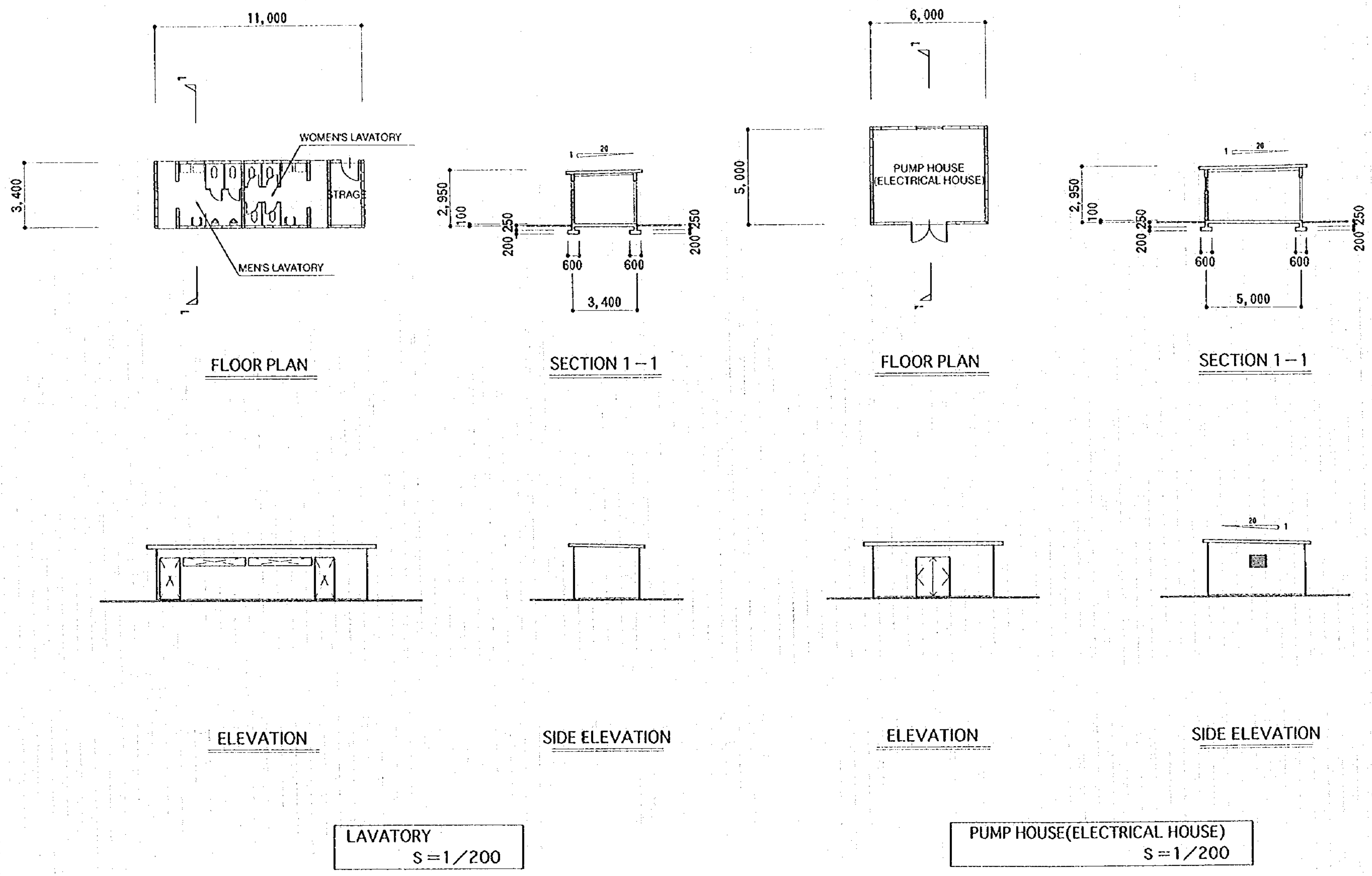


Figure-2.4.45 Structural Plan for Toilet, Pump House and Electrical House

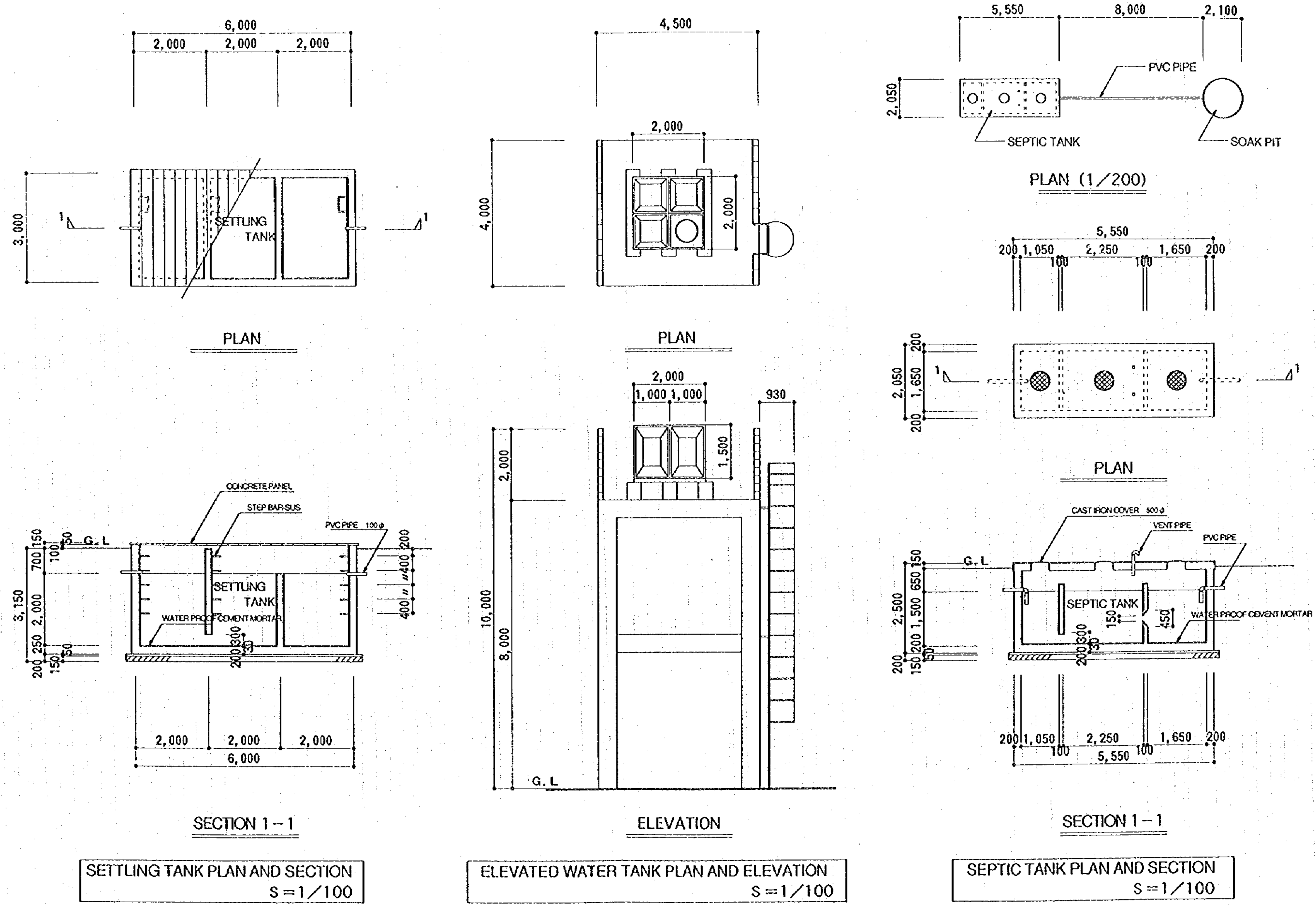


Figure-2.4.46 Structural Plan for Elevated tank, Settling Tank and Septic Tank

2-4-8 Impact due to Breakwater on Nearby Beaches

Impact of development to be made to Sekondi Fishing Port was studied based on the numerical simulations of forecast of shoreline changes and 3-Dimensional Bathymetric Deformation.

(1) Forecast of Shoreline Changes

Forecast of shoreline changes were calculated using the long term effect on the nearby beaches expected by development to Sekondi Fishing Port.

1) Present Condition of Shoreline Changes

Shoreline surveys in the Sekondi Bay area including the fishing port are not performed regularly, and the only data available for learning any shoreline changes is the aerial photographs taken in March, 1973. The shoreline changes in the area were studied based on the result of two shoreline surveys and the shoreline in the aerial photographs.

The breakwater for the Naval Base and that on the north side of the bay are the only port structures and they were completed in 1967. Comparison of the photographed shoreline and the present shoreline reveals no change, suggesting that the shoreline is now quite stable. There are also hardly any changes in the shoreline as surveyed in April and August, 1996.

The coastline in Sekondi Bay is assumed to have undergone some changes at the time the breakwater in the Naval Base was built, and then has become stable with its completion because of the shielding effect of the breakwater.

2) Forecast for Shoreline Changes

In carrying out calculation of shoreline changes, we examined whether or not the numerical model was adequate by confirming that the current shoreline profile was reproducible.

The area for which shoreline changes was calculated extends for 1 km from the existing breakwater to the south along the coast including the project site. Incoming waves were based on the frequency table of Sekondi deepwater waves, assuming three directional components (SE: 0.3%, S: 47.8%, SSW: 50.1%). The shoreline shown here is that of yearly average, and does not reflect short term shoreline changes caused by stormy weather or seasonal changes. Figure-2.4.47 forecasts the shoreline after in 10 years from the development of Sekondi Fishing Port.

The figure shows a tendency for the shoreline near the sandy beach to partially recede by about 2 m at the root of the breakwater due to the reflected waves and to advance by about 1 m at the center of the beach.

The change is negligible considering the fact that the sandy beach is currently 50 m wide and that the effect of development work of the fishing port on the nearby beach is expected to be substantially zero.

(2) Forecast of 3-D Simulation for Bathymetric Deformation

Researches and studies regarding coastal deformations have been considered as an important subject in coastal engineering, but a precise quantitative evaluation method has not yet been established because of very complicated phenomena of interaction between sediment and waves. Attempts to reproduce the sedimentation phenomena on numerical model are being made to simulate bathymetric deformations, as large capacity, high speed computers are now available. This numerical forecasting technique recently has been replaced conventional hydraulic model tests. Bathymetric changes near the port are reproduced by 3-dimensional simulation and the shoaling characteristics near the port is being evaluated.

1) Outline of 3-D simulation for Bathymetric Deformation

In 3-dimensional simulation model, the local sediment transport rate based on the distribution of the incoming waves and the nearshore currents generated by waves for the area are firstly evaluated. Secondly, bathymetric changes based on the continuous equation and the local sediment transport are calculated. The numerical model consists of three sub-models listed below, and estimation is usually carried out in these three phases.

* Estimation of wave field
* Estimation of nearshore current field
* Estimation of bathymetric changes

Since the wave and the nearshore current field will be changed when Bathymetric changes become significant, calculation of the waves and nearshore current is recalculated in order to improve the forecasting precision.

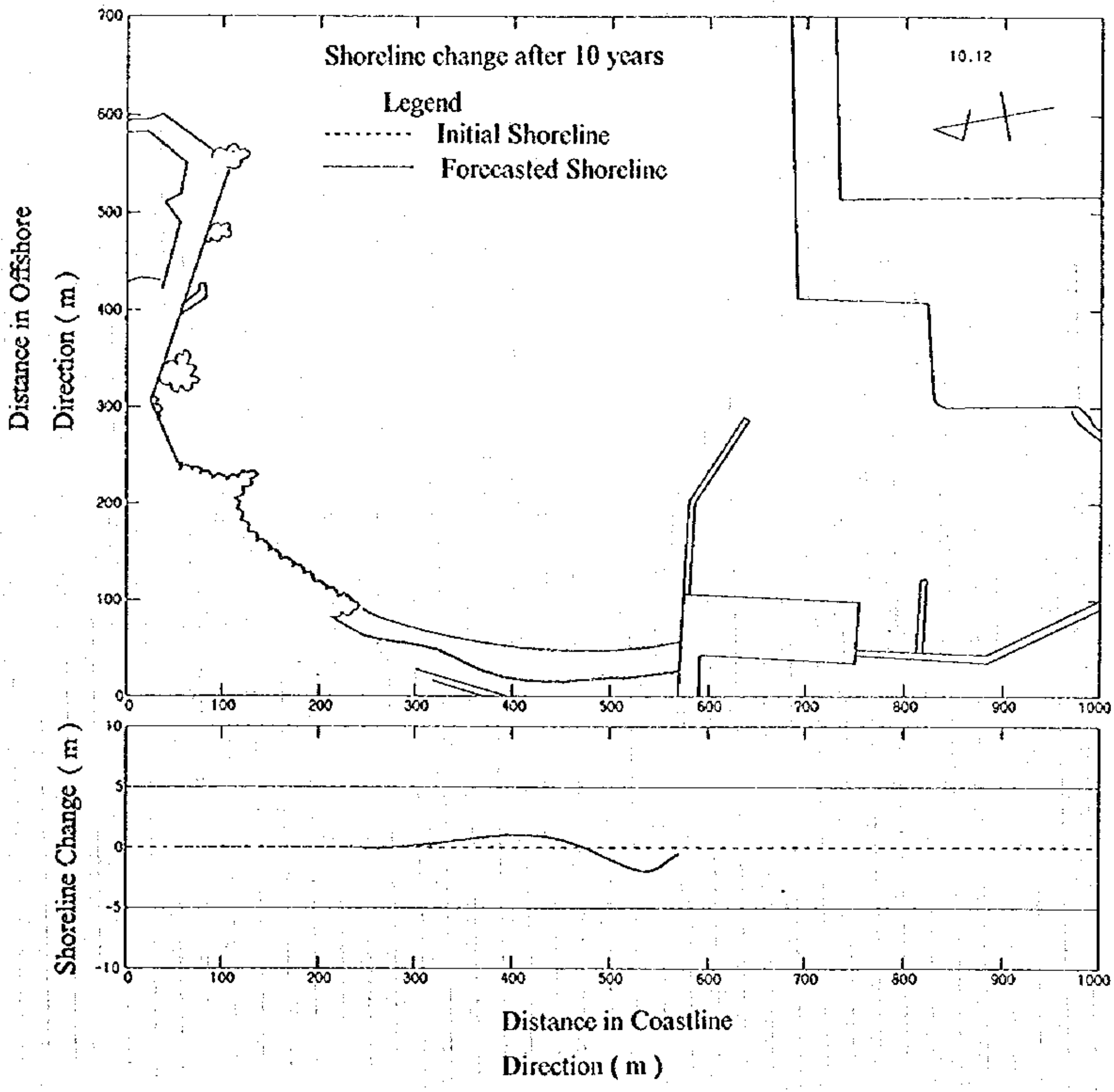


Figure- 2.4.47 Forecast of Shoreline Changes due to Fishing Port Development in 10 years

2) Forecast of Bathymetric Changes

Waves with a return period of one year (deepwater wave height: 3.0m, wave period : 9.8 sec) were applied on the simulation model obtained from the sounding survey conducted in August, 1996. The wave directions of SE and S were studied.

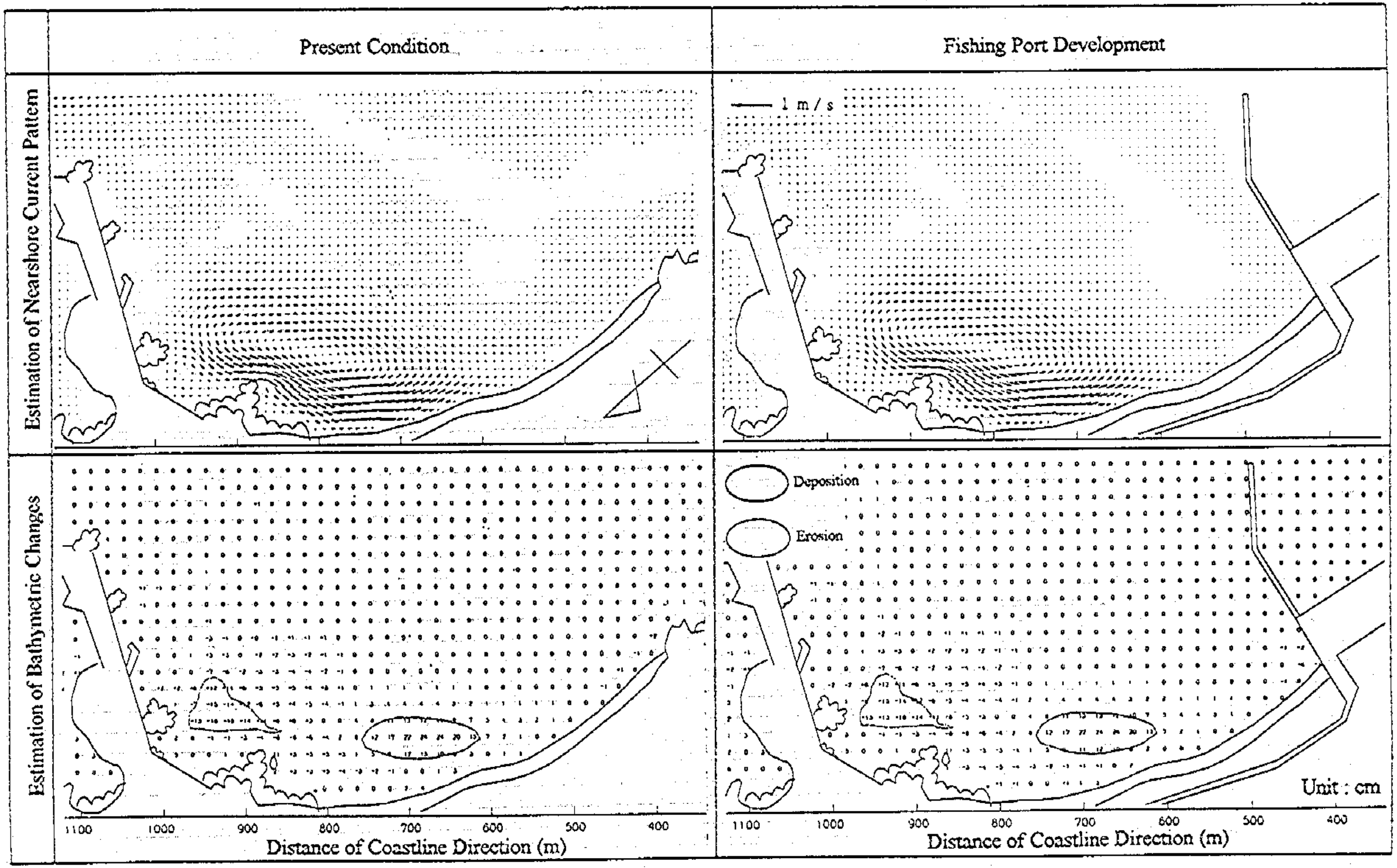
Figures-2.4.48 shows the result of comparison of the nearshore current and the bathymetric changes under the present condition and at the time when the project is completed. According to the figure, littoral drifts tend to accumulate at the center of sandy beach due to the current flowing from north of the existing breakwater to south and the nearshore current flowing from the innermost area of the bay to the north when deepwater waves are in SE direction. This is the same as the result of simulation of the present condition. Erosion tendency in the reef area on the south side of the existing breakwater is obtained on the model which assumed that the calculated area has uniformly sufficient layer of sands. As revealed by the soil survey that sands hardly deposit on the surface layer, erosion is not actually present. In the case of deepwater waves of S direction, the incident wave height is small, suggesting that no particularly notable changes occur in the nearshore current or in the coastal profile.

Since the incoming wave height is small and the other depth is relatively large at the port entrance and inside of Sekondi Fishing Port, it is assumed that no significant currents or bathymetric changes nor siltation of the port will occur.

(3) Evaluation of Impact of the Development of Fishing Port

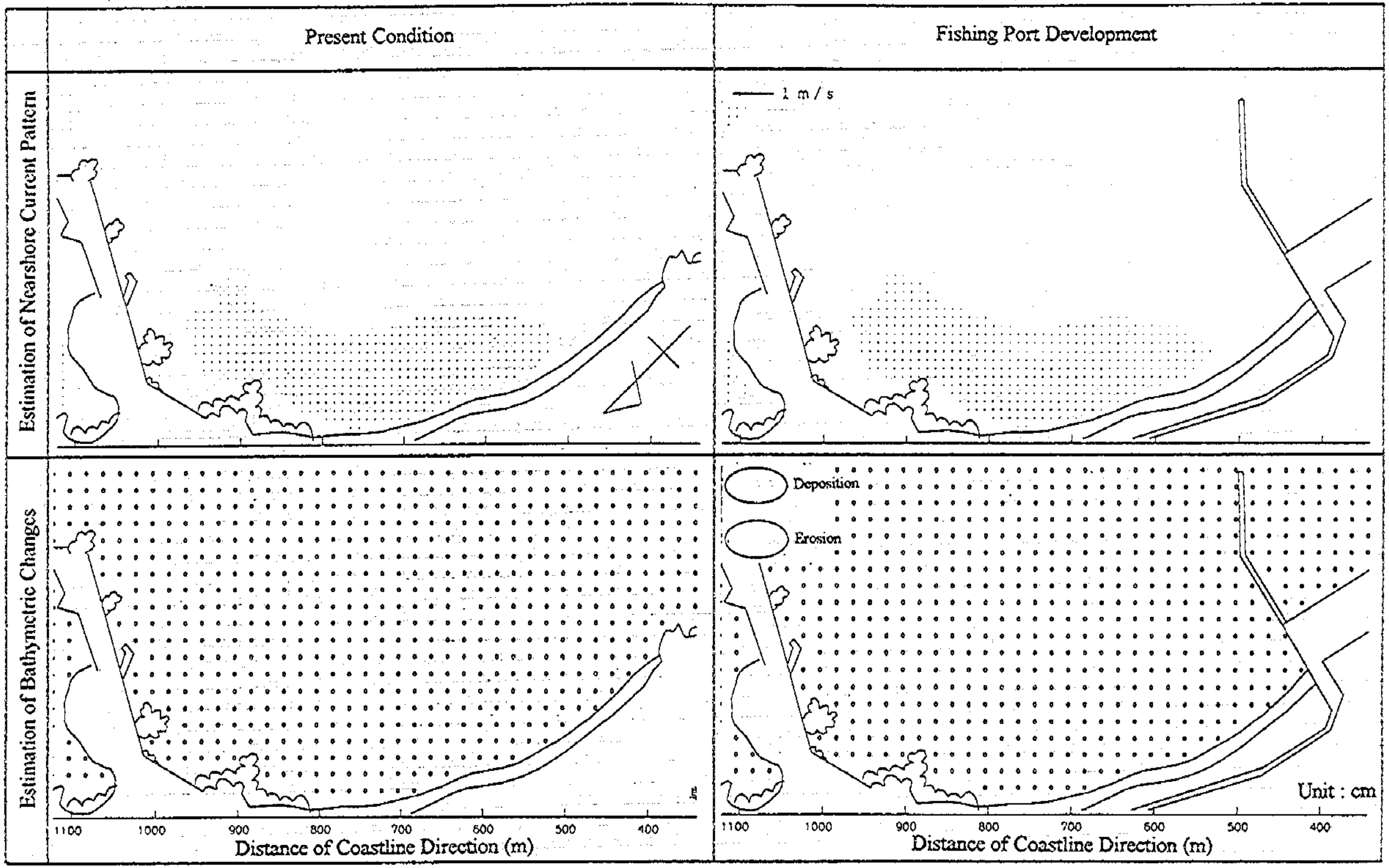
The area near Sekondi Bay has been relatively calm without any high incoming waves and has not experienced significant shoreline changes. The forecast of changes after development of the new fishing port is also insignificant. The result of calculation of 3-dimensional bathymetric deformation during stormy weather is substantially the same for the present condition and for the condition when the project is completed, suggesting that construction of the fishing port will have substantially no impact on the nearby beaches.

It should be noted, however, that the numerical model used in the shoreline change forecast is based on very limited data that are locally available regarding the shoreline survey, and improvement in terms of precision of the forecast is necessary. The effect of coastal structures on the shoreline change is an extremely sensitive phenomenon and careful observation of the shoreline changes should be continued.



(Offshore Wave Direction: SE, Offshore Wave Hight: 3 m, Offshore Period 9.8 s)

Figure-2.4.48(1) Comparison of Nearshore Current and Bathymetric Changes



(Offshore Wave Direction: S, Offshore Wave Hight: 3 m, Offshore Period 9.8 s)

Figure-2.4.48(2) Comparison of Nearshore Current and Bathymetric Changes

2-5 Environmental Assessment

2-5-1 Background of Environmental Survey

In Ghana the proponent must submit an application for environmental impact assessment (EIA) to and obtain an approval from the Environmental Protection Agency for every undertaking and development which may have an impact on the environment. The administrative flow chart of the EIA procedure is presented in Appendix-7. As construction of a fishing port under this project entails development activities such as dredging and reclamation of the sea, it is necessary to obtain an approval before implementation of the project.

2-5-2 Water Quality Survey

The result of visual observation conducted as a part of the water quality survey in Sekondi Bay revealed untreated domestic effluent discharge near the canoe landing beach, oil spills from inshore vessels at anchor, and dumped fish intestines. There is no industrial effluent since there is no plant near Sekondi.

Seawater was sampled twice (April and August, 1996) in Sekondi Bay and water quality of the sample were analyzed. Location of sampling point, the result of analysis and the environmental quality standards for sea water pollution in Japan are presented in Appendix-7.

Water quality distribution in Sekondi Bay shows that excessive organic pollution is proceeding near the canoe landing beach, and that pollutants tend to become diluted as one goes toward offshore. The dilution process of coliform counts and the distribution of turbid substances suggest that there are considerable discharge of the waste matters discharged from inhabitant (in near by area of the fishing port) including human feces from the area of canoe landing beach, which diffuse and settle in the bottom mud, and then gradually spread in the entire bay.

As the canoe landing beach is more closed than at other points, plant plankton proliferate vigorously, contributing to acceleration of organic pollution.

It is recommended to decrease the discharge of waste water into the bay by constructing a treatment plant for waste water.

2-5-3 Environmental Impact Assessment (EIA)

(1) Environmental Impact Factors

Following three factors are conceivable as the factors of environmental impact.

* Impact to landscape by reclamation of a part of the sandy beach to the north of the project site
* Impact to water quality by turbidity caused by dredging for construction of the basin and wharves and by fishing activities after the facilities are completed.
* Impact to the nearby shoreline figure by littoral drifts

(2) Forecasting Impact

1) Reclamation of Beach

Under this project, the sandy beach will be reclaimed for 40 m, which is about 13 % of the entire length (300 m). Thus, about 87% of the beach will remain intact. As the reclaimed land will be bordered by a rubble mound revetment, people will find little impact on the landscape. The hinterland will remain also intact and may be used as a park or a public space after the facilities are completed.

Therefore, it is considered that the impact on the nearby landscape by reclamation of sandy beach is negligible.

2) Water quality

Turbidity which may occur by dredging operations for construction of the basin and the wharf is studied as an impact on the water quality by this project. The bottom material in front of the landing wharf is weathered sandy rock, and turbidity by dredging is expected to be negligible. However, these in front of the lay-by wharf and canoe jetty are the sandy layer containing silts over the weathered sandy rock layer, and they are expected to cause generation and diffusion of turbidity.

Therefore, a silt protector will be laid around the dredger during the construction period. Turbidity in the nearby sea will be periodically monitored using a turbidity meter.

After the completion of facilities, there will be no water pollutant discharge from the facilities themselves. However, inshore vessels and fishermen who use the facilities are bound to dump wastes. To prevent dumping of wastes, oils and fishing nets, control by the port management and cooperation to the fishermen benefited from the facilities is necessary.

3) Littoral Drift

Impact of littoral drifts by construction of the breakwater on nearby shoreline figure is discussed in detail in Section 2-4-8. The result of forecast on shoreline changes indicates that waves are relatively calm and there are only a small amount of littoral sand and beach deformation in Sekondi Bay area, and shoreline changes on the beach after the breakwater construction are slight. Since 3D simulation for Bathymetric Deformation during stormy weather shows substantially the same result, it is judged that the impact to nearby beach by construction of the breakwater is negligible.

Since the impact to the environment by construction of the facilities cannot be said as nil, it is recommended to monitor changes in the shoreline and the bathymetry during and after construction.

CHAPTER 3

IMPLEMENTATION PLAN

CHAPTER 3 IMPLEMENTATION PLAN

3-1 Implementation Plan

3-1-1 Implementation Concept

(1) Basic Concept

1) Upon the implementation of this project, after the Exchange of Notes (E/N) between the Government of Japan and the Government of Ghana , a contract on consulting services will be concluded between the Government of Ghana and the Japanese Consulting Firm.

2) The Consultant will prepare all the tender documents such as drawings, technical specifications, cost estimation, conditions of contact and so on necessary for the tender and the construction contract. After the approval of those documents by the Government of Ghana , the Contractor for this project will be selected among Japanese construction companies through the procedure of the pre-qualification and the tender.

3) The construction works will be performed by the selected Contractor in accordance with the construction contract concluded between the Government of Ghana and the Contractor.

4) The construction period is expected to be 21 months taking into consideration the scale of the Project and the site conditions.

(2) Implementation Concept

1) The planned Sekondi Fishing Port is of a typical artificially reclaimed port type and most construction works of wharves and a basin can be performed at sea, and a breakwater and revetments can be performed at land, which will contribute to the reduction of the construction cost and the shortage of construction period.

2) There are few of construction firms in Ghana having some experiences in various fields construction field and Japanese construction company shall conduct the construction works with introducing skilled labors and construction equipment from Japan except for the some works such as a part of road pavement, interior installing, electrical cable arrangement, water supply piping and sewage and so on.

3) There are a few of consulting firms in Ghana having some experiences in narrow fields and they may be utilized for the sounding survey and water quality survey regarding monitoring of the littoral drift and environment to be performed during the construction the same as that of the basic design study stage under the instruction of Japanese Consultant.

4) As for the ice making facility, its materials, ice making plant and ice storage units will be procured from Japan with consideration of the quality and the durability, and the assembling and the erection works will require the instruction of the Japanese experts.

(3) Executing Organizations of the Government of Ghana

Executing Organizations of the Government of Ghana to implement this project are as follows:

1) Organization Responsible for the Tender
Ministry of Finance

2) Organization Responsible for the Project
Ministry of Transport and Communications

3) Organization to Supervise the Construction
Ghana Ports and Harbours Authority

4) Organization to Maintain the Facilities after the Completion
Ghana Ports and Harbours Authority

3-1-2 Implementation Conditions

(1) Construction Conditions

1) Construction Company

There are few of construction companies in Ghana having some experience, and they may be limited utilizing fields as sub- contractors of Japanese construction company.

2) Construction Equipment

Land and marine construction equipment is difficult to procure in Ghana even if normal types. The heavy equipment such as a grub dredger, a large scale of floating crane, tug boats, a truck crane and so on will be required for the construction for a long period and they will be procured from Japan as a rule.

3) Labors

The skilled expert required for the building of ice making facility which will be dispatched from Japan and unskilled labors only can be procured locally in other construction works.

4) Goods and Materials to be Imported

Goods and materials to be imported are steel bar and cement for the construction of wharves and ice making and ice storage units for ice making facility. The foreign country from which those materials will be imported should be selected with consideration of the quality and the durability. Other goods and materials can be as a rule procured from the local agents and sellers, but they may not have sufficient stocks. A careful procurement plan for use of those goods and materials is needed to secure those stable supply, and the close communication with those agents and sellers should be cultivated.

5) Safety Control

As the new fishing port is planned to be located near the existing landing beach, utmost care should be taken for the safety of inshore vessels and canoes navigating in the nearby area with installing navigational aids upon the marine construction such as breakwaters and so on. Upon the land construction, the access road to bring in the construction materials should be clarified with signs not so as to cause the traffic accidents to the circumferential inhabitants.

(2) Care for Construction

1) Appropriate construction plan should be prepared considering the natural conditions at site, especially the marine conditions.

2) Dispatch of the Japanese staffs and technical experts should be planned carefully considering the appropriate number of persons, timing and duration in accordance with the progress of works.

3) Local equipment and materials should be used as much as possible, minimizing the procurement from Japan.

4) As there will be involved long term marine works, special attention should be paid to inshore vessels and canoes navigating in the nearby area.

5) As there will be involved occurrence muddiness during basin dredging work, special attention should be paid to preventing its diffusion.

3-1-3 Scope of Works

The scope of works of the Project to be undertaken by the Government of Japan and the Government of Ghana are divided as follows:

(1) Scope of Works to be undertaken by the Government of Japan

1) Basic Facilities

* Construction of Breakwater,
* Construction of Wharves for Inshore Vessels,
* Construction of Canoe Jetty,
* Construction of Road in and around the Fishing Port,
* Construction of Revetments, and
* Construction of Pavement within the Fishing Port Area.

2) Functional Facilities

* Construction of Ice Making Plant,
* Construction of Fish Handling Shed,
* Construction of Administration Building,
* Construction of Water Supply System,
* Construction of Fire Fighting System and Sea Water Pump,
* Construction of Security Lighting,
* Construction of Toilets and Sewage Facilities, and
* Construction of Open Storage Yard.

(2) Scope of Works to be undertaken by the Government of Ghana

* Connection of the facilities for the utilities such as electricity, water and telephone line supply to the project site,
* Construction of the fence, the gate and the gate house to bound the project site
* Construction of the pavement of the access road, and
* Construction of the walkway to the project site.

3-1-4 Consultant Supervision

The policy of the Government of Japan for Grant Aid Projects requires that the Project proceeds consistently throughout the period from the detailed design stage to the construction stage with assistance of the Consultant who fully understands the objectives of the basic design. The Consultant is required to supervise the construction work by stationing capable resident engineer at the site for management and communication as well as by dispatching special engineer for a short term for inspections and instructions in accordance with the progress of works.

(1) Supervisory Policies

1) Control of the work progress in accordance with the construction schedule, with maintaining close contact and communication between the responsible organizations in both countries,

2) Provision of prompt and adequate instructions and advice to the Contractor so that they can complete the construction of the facilities in conformity with the design plans,

3) Provision of instructions for maximum adoption of local materials and sub-contractors,

4) Promotion of technology transfer in construction and engineering to make the most of grant aid project,

5) Provision of adequate instructions and advice on maintenance of the delivered facilities to help smooth operations thereof.

(2) Supervisory Works

1) Assistance on Contracting

Providing assistance on selection of the Contractor, determining the type of contract, drafting contract documents, evaluating the bill of quantities and witnessing contract awarding.

2) Evaluation and Approval of Shop Drawings, etc.

Evaluating and approving shop drawings as well as materials and equipment proposed and submitted by the Contractor.

3) Instruction to Construction Works

Reviewing construction plans and schedule, etc., providing instructions to Contractor and reporting the progress of works to the owner.

4) Assistance in Procedure of Payment

Evaluating and approving the bills on payment to the Contractor for the work in progress and upon the completion of the project.

5) Inspection and Witness

The Consultant inspect where necessary the work in progress and gives instructions to the Contractor. The Consultant, upon the confirmation of completion of the works and fulfillment of requirements of the contract, witness the delivery of the objects of the contract and confirm the Owner's acceptance thereof to complete his obligations.

The Consultant also provides reports to the Government of Japan in relation to the progress of works, payment procedures and delivery of completed facilities.

3-1-5 Procurement Plan

In procuring necessary materials and equipment for the project, special attentions are required as follows:

(1) Procurement Policy

1) Procurement from Japan

For certain construction materials to be procured from Japan, a procurement schedule must be studied carefully since such materials require an extended period from production to packing and shipping. Most construction equipment are not procurable locally and will be procured from Japan as a rule.

2) Local Procurement

In procuring the main materials such as rubble stones, aggregates, etc., the agents and sellers should be selected with thorough consideration of the quarry site, the quality, the transport capacity.

3) Cost

The lowest price has priority in selecting a procurement either locally, from Japan or the third foreign country. It should be noted that the price of procurement from Japan includes the charges for packing, transport and insurance but is exempted from tax.

From the above consideration, the procurement of construction materials and equipment required for the Project are planned as follows:

(2) Procurement Plan

1) Materials

* Local : rubble stones, aggregates, timbers, building materials, water supply and drainage materials and electricity supply materials
* Japan : fenders, aids to navigation and ice plant and ice storage materials
* Third Foreign Country : cement and steel bars

2) Equipment

* Local: none

* Japan: crawler crane, backhoe , dump track, bulldozer, trailer, grub dredger, crawler barge, flat barge, tug boats, motor grader, tire roller, testing instruments (plate bearing testing instrument, concrete compression testing machinery)

3-1-6 Implementation Schedule

Implementation of the Project under the Japan's Grant Aid Program will be proceeded in the following manners:

After the Exchange of Notes concluded between the two countries, the Japanese consulting firm will be appointed by the Government of Ghana and the consulting contract will be concluded between the said government and consultant firm. And the Project will be completed in three stages such as the preparation of detailed design documents, the execution of tender and construction contract and the execution of construction works.

(1) Preparation of Detailed Design Documents

After the consulting contract concluded between the executing organization of the project in Ghana and the Japanese consultant firm, the contract will be verified by the Government of Japan and the Consultant will start the detailed design. In the detailed design stage, tender documents consisting of detailed design drawings, technical specifications, instructions to tenderers, etc. will be prepared based on the present basic design report. Meantime, the consultation with the Government of Ghana regarding the details of the facilities will be held and the approval of all the tender documents will be obtained from the Government of Ghana.

The detailed design requires 3.0 months.

(2) Execution of Tender and Construction Contract

The Contractor (Japanese construction company) for the construction of project facilities will be decided by the tender. All the procedures regarding the tender will be performed in such order as the notification, the acceptance of the offer for the tender, the pre-qualification, the distribution of the tender documents, the evaluation of the tender results, the designation of the Contractor, and the construction contract. The whole procedure will take 1.5 month.

(3) Execution of Construction Works

Construction will be started after the conclusion of the construction contract and the verification by the Government of Japan. The construction period is expected to be 21 months considering the scale and contents of facilities, and the local construction conditions.

Figure-3.1.1 shows the implementation schedule covering from the Exchange of Notes to the completion of Project.

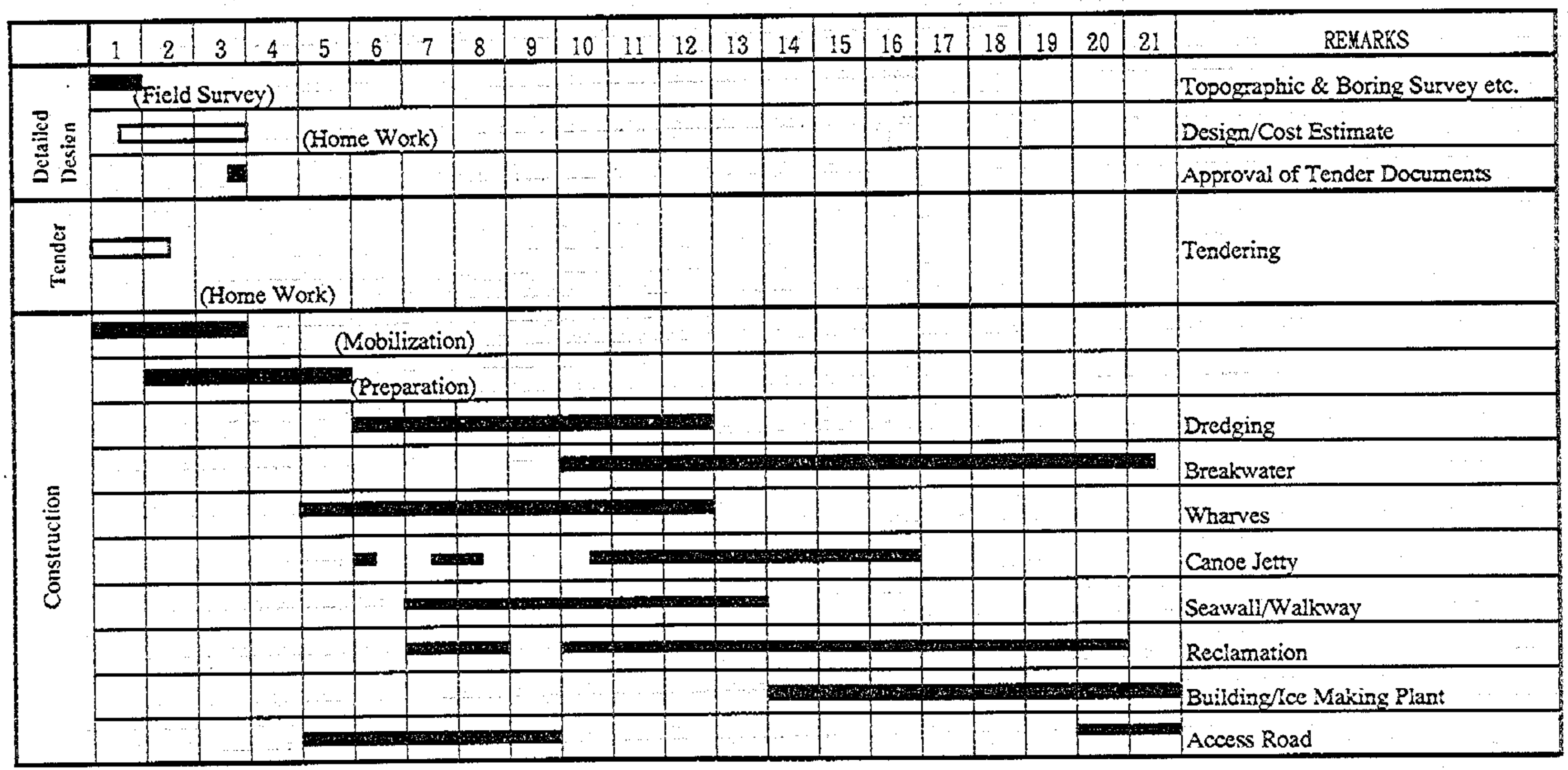


Figure-3.1.1 Implementation Schedule

3-1-7 Obligations of Recipient Country

The obligations of recipient country which have been confirmed in the Minutes of Discussions during the study are as follows:

* To secure a lot of land necessary for the Project;
* To provide a proper access road to the Project site;
* To connect project facilities to the utilities such as electricity, water supply, telephone trunk line and drainage and other incidental facilities;
* To undertake incidental outdoor works, such as gardening, fencing and other incidental facilities in and around the Project site, if necessary;
* To ensure prompt unloading and customs clearance of the products purchased under the Japan's Grant Aid at ports of disembarkation in Ghana;
* To exempt Japanese nationals from customs duties, internal taxes and fiscal levies which may be imposed in Ghana with respect to the supply of the products and services under the verified contracts;
* To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such facilities as may be necessary for their entry into Ghana and stay therein for the performance of their work;
* To bear commissions, namely advising commissions of an Authorization to Pay (A/P) and payment commissions, to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement (B/A);
* To provide necessary permissions, licenses, and other authorization for implementing the Project, if necessary;
* To ensure that the facilities constructed and equipment purchased under the Japan's Grant Aid be maintained and used properly and effectively for the project, and
* To bear all the expenses, other than those covered by the Japan's Grant Aid, necessary for the Project.

3-2 Operation and Maintenance Costs

(1) Tariff Structure

Tariff structure for fishing vessels using Sekondi Fishing Port will be set similar to those of Tema Fishing Port as below;

- * Port Dues : 750 cedis per crate
- * Harbour Rent : 200 cedis per day for fishing vessels up to 15 m length, 400 cedis per day for fishing vessels above 15 m length but not more than 22 m, 2,500 cedis per week above 22 m length but not more than 30 m, 10,000 cedis per week over 30 m length
- * Registration Fee : 8,400 cedis per year for fishing vessels up to 15 m length, 10,700 cedis per year for fishing vessels above 16 m length but not more than 50 m, 170,400 cedis per year over 50 m length

The port dues and harbour rent are collected by GPHA while the registration fee is collected by Ministry of Food and Agriculture (Fisheries Department).

(2) Income and Expenditure

Annual income of Sekondi Fishing Port is estimated at about 202 millions cedis with profit of 8.6 millions cedis. The ice making machine, ice storage, and fish handling shed are planned to be operated by GPHA. Income and expenditure are detailed as below.

1) Income

a) Port dues

Peak season: 937.5 tons
Lean season: 600 tons
Year 1,537.5 tons
1,537.5 tons / 30 kg /crate x 750 cedis /crate = 38,437,500 cedis

b)	**Harbour rent**		
	Peak season: 3,825 vessels		
	Lean season: 5,400 vessels		
	year 9,225 vessels		
	9,225 vessels x 200 cedis / day	=	1,845,000 cedis
c)	**Water supply charge**		
	Peak season: 2,400 tons		
	Lean season: 3,800 tons		
	year 6,200 tons		
	6,200 tons x 1,200 cedis / ton	=	7,440,000 cedis
d)	**Entrance charge**		
	People: 90,000 persons x 200 cedis / person	=	18,000,000 cedis
	Vehicle: 24,000 vehicles x 200 cedis / vehicle	=	4,800,000 cedis
	Year		22,800,000 cedis
e)	**Ice supply charge**		131,250,000 cedis
	Total annual income		**201,772,500 cedis**

2) Expenditure

While annual expenditure consists of personal expenses, operation and maintenance cost of facilities, etc. as below;

a)	**Administration Office**	
	Personal expenses	55,620,000 cedis
	Stationary, welfare, other expenses	27,810,000 cedis
	Utilities expenses	6,248,592 cedis
	Sub-total	89,678,592 cedis
b)	**Operation cost of ice making facilities**	80,072,000 cedis
c)	**Maintenance cost for facilities**	
	Basic facilities	5,255,023 cedis
	Building and equipment	18,176,198 cedis
	Sub-total	23,431,221 cedis
	Total annual expenditure	**193,181,813 cedis**
	Balance	**8,590,687 cedis**

The financial status of future Sekondi Fishing Port is judged to be sound through above examination with annual profit of 8.6 million cedis. Retrenchment of personal expenditure through cooperation with the other organizations and curtailment of maintenance costs of the facilities are necessary for the improvement of the financial condition of the Sekondi Fishing Port.

CHAPTER 4

PROJECT EVALUATION AND RECOMMENDATION

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

4-1 Project Effect

The Western Region including the project site is near fishing grounds, and Sekondi Fishing Port is actively used by about 50 inshore vessels and about 300 canoes. Development of this port where vigorous fishing activities are being carried out is most meaningful as it will serve as the key point in the Western Region and promote modern fishery operations in full scale.

Serious problems faced by marine fishery include poor quality of fish catches due to underdeveloped landing facilities, fish handling sheds, ice making plants, etc. in all the fishing ports except Tema.

The Government of Ghana decided promote the marine industry as the major project in its Intermediate Development Plan for Agriculture (1991-2000) , and aims to increase fish catch as animal proteins and also to increase employment opportunities and diversify the rural economic structure. Implementation of the present Project will achieve the following effects and largely contribute to promotion of marine industry as a major project for the National Development Plan.

(1) Construction of the landing wharf where vessels can berth directly will remarkably improve the fish landing efficiency of inshore vessels and radically reduce landing hours. This will improve the work efficiency and prevent deterioration of fish freshness.

(2) Construction of the landing wharf will enable orderly berthing of vessels in the port except for those landing their catch. This will improve safety of navigation in the port and smooth water/oil supplies and preparation for departing the port.

(3) The depth of basin is currently very shallow and frequently occur the damages to the hull of inshore vessels (currently about 4 million sedis/year on an average is spent for repair). Improvement of the basin and developing a new navigation channel with adequate width and depth will secure safety of navigation and berthing of the vessels, and increase income for fishery industry by reducing costs of repair to the vessels.

(4) Construction of the functional facilities such as fish handling shed, ice making plant, port access road, net repairing ground, etc. will improve the basis for fishing activities such as auction and distribution of the landed catches and repair of fishing gears. This will invigorate management of the fishing port.

(5) Currently there is no fishing port with modern facilities in the Western Region. Developed Sekondi Fishing Port is expected to function as the key port in the area. The scope for this Project is determined based on the number of inshore vessels currently using Sekondi Fishing Port and the catch amount landed. By improving the use efficiency of the facilities, the port can cope with the increases in landing amount and number of the vessels using the port, thereby contributing to overall expansion of fishery production and increase in the marine product supply in the area.

By virtue of the direct effects as mentioned above, the landing amount will be increased and about 27,000 people including about 3,800 fishermen/ship owners, wholesalers, members of fish smokers' association, and their families will benefit directly from the Project. About 780,000 people living in Sekondi, Takoradi and Kumasi, an inland city, and their neighboring areas will benefit indirectly. The Project will contribute to promotion of the marine industry which is positioned as key issues in Intermediate Development for Agriculture, and achieve expansion of fishery production in the Western Region.

Based on the result of examination as above outlined, it is considered that development of Sekondi Fishing Port under the present Project should be implemented soon by a grant aid assistance and that the present Project is valid and meaningful in view of its practical effectiveness and its character.

4-2 Recommendation

In order to encourage effective use of fishing port facilities after completion of the Project for the Construction of Sekondi Fishing Port and to realize marine industry promotion as proposed by Intermediate Development for Agriculture, following items should be implemented.

(1) Sekondi Fishing Port will be placed under the sole management of GPHA. In order to adequately and smoothly manage a fishing port, adequate guidance and regulations are necessary. It is necessary to improve the management organization at an early instance with cooperation from related organizations.

(2) Guidance to fishermen is recommended in using the landing wharf by one abreast berthing at all times for effective landing operations, and to stop non-operating inshore vessels from berthing at the lay-by wharf.

(3) Contamination of water is currently in progress at Sekondi Bay. It is recommended to rigidly control illegal dumping of waste oil and/or fishing gears by the vessels. An adequate a treatment plant for waste water should be built in order to decrease the discharge of the waste water from inhabitant in the vicinity.

(4) For smooth management of a fishing port, concerted cooperation with the private sector engaged in wholesale, oil supply, boat repair, etc. is essential. The present Project should give appropriate consideration to this point based on the understanding of local situation.