4) Protection of the environment will be considered.

(3) the structures, materials and construction methods for the Project must meet the site conditions at the proposed construction site of the Maldives.

1) The structures should be as simple as possible, the materials to be easily obtainable, and the facility easy to maintain and operate.

2) The materials should be given the highest priority.

3) The construction methods and plans should consider the natural condition of the site.

(4) The construction codes and technical standards of the Maldives are not developed and the design of the facilities will be based on the Japanese building codes and standards.

4.2 Design Conditions

Based on the field survey data, design conditions for the Project site were established as follows:

(1) Weather Conditions

① Temperature: 5°C to 70°C
② Humidity : Maximum 90%
③ Wind Speed : Maximum 23m/sec.
Predominant wind direction is between W and WNW.

(2) Sea Conditions

① Tide Levels:

	Major Four Tidal Components	
M2	Lunar Semi-Diurnal Tide	H_m = 0.26m
S2	Solar Semi-Diurnal Tide	H_s = 0.13m
O1	Lunar Diurnal Tide	H_o = 0.06m
K1	Luni-Solar Diurnal Tide	H' = 0.10m

H.W.L.	High Water Level:	+1.20m
M.S.L.	Mean Sea Level:	+0.65m
L.W.L.	Low Water Level:	+0.10m
W.D.L.	Working Datum Level:	+0.00m

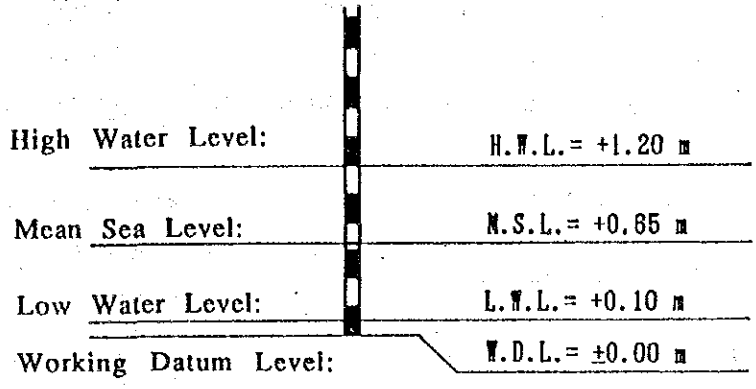


Fig. 4-1 Tide Levels

② DesignWaves

Using the weather and marine data obtained at the site. The design deep water wave was assumed as given in Appendix 6. The assumed wave condition is as follows:

Wave Condition for Structural Stability

Wave Height	:	2.3m
Period	:	5.0sec.
Wave Direction	:	WNW

Wave Condition for Normal (94% of workability) Analysis

Wave Height	:	0.8m
Period	:	3.3sec.
Wave Direction	:	WNW

In the examination of the calmness in the harbor, the deep water wave given in the above table was used to satisfy the usable maximum wave height conditions. The calculation for the

assumption of the wave height and the calmness in the harbor, are given in Appendix 6 and 7.

Maximum wave height for facilities is given as follows:

Channel	0.90m
Landing/preparation Quay	0.30m
Idle Berthing Quay	0.40m
Rough Weather Refuge Anchorage	0.60m

③ Tidal Current

See Appendix 5.

(3) Seismic Forces

Earthquakes are non-existent in the Maldives, and there are no records of earthquakes in the past records (Fig. 5.2). Hence, earthquake factors will not be considered.

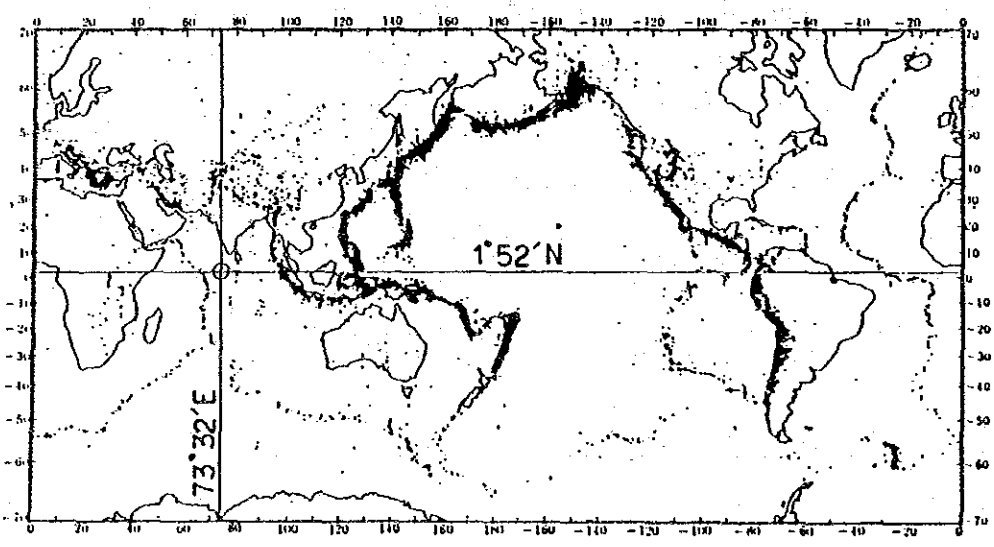


Fig. 4-2 Seismic Distribution in the World

(4) Soil Conditions

As shown in Fig. 4-3 & 4.

(5) Wharf Use Conditions

① Objective Vessels

Type of Vessel		Collector Vessel	Powered Dhonie
Overall Length	(m)	22.5	13.5
Maximum Beam	(m)	6.5	3.6
Maximum Draft	(m)	1.7	0.9
Bulwark Height	(m)	0.9	0.2
Gross tonnage		95	-
Engine Power	(PS)	240	39

② Berthing Speed: v = 0.30m/sec.

③ Towing Force of Boat: Per bollard T = 5t

④ Surcharge: 1.0t/m^2

(6) Building Loads

Freezer/Refrigerator	30.0KN/m^2	(3,000kg/m^2)
Cold Storage	40.0KN/m^2	(4,000kg/m^2)
Generator Room	10.0KN/m^2	(1,000kg/m^2)
Office	3.0KN/m^2	(300kg/m^2)

(7) Materials

Filling Materials; Angle of Internal Friction: $\phi = 30°$, $\delta = 15°$
Rubble Mound; Angle of Internal Friction: $\phi = 40°$

Unit Weight

Reinforced Concrete	:	2.45t/m^3	(in air)
		1.45t/m^3	(in water)
Plain Concrete	:	2.30t/m^3	(in air)
		1.30t/m^3	(in water)
Structural Steel	:	7.85t/m^3	(in air)
Backfill Material	:	1.80t/m^3	(in air)
		1.00t/m^3	(in water)

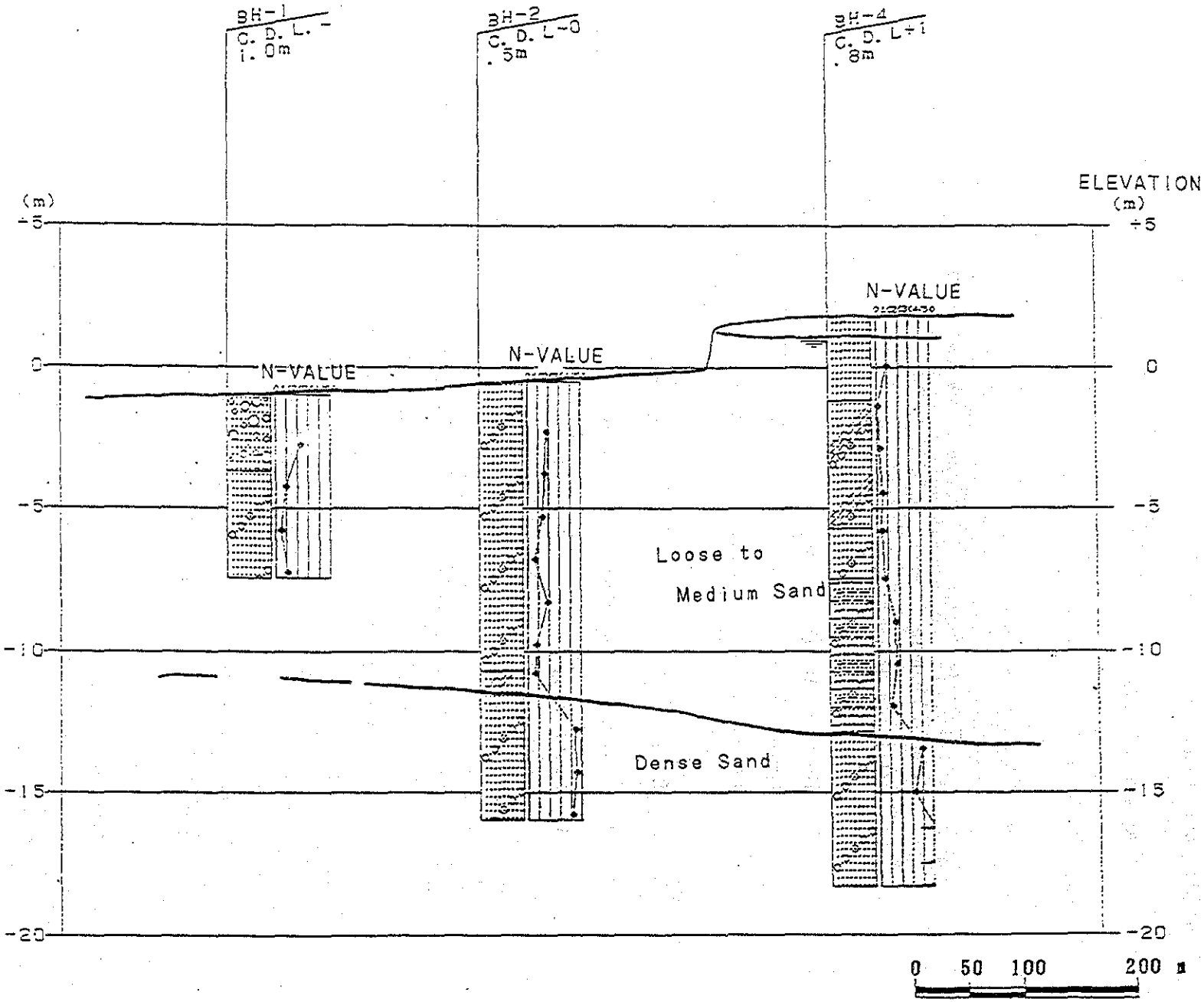


Fig. 4-3 SOIL PROFILE (X-X)

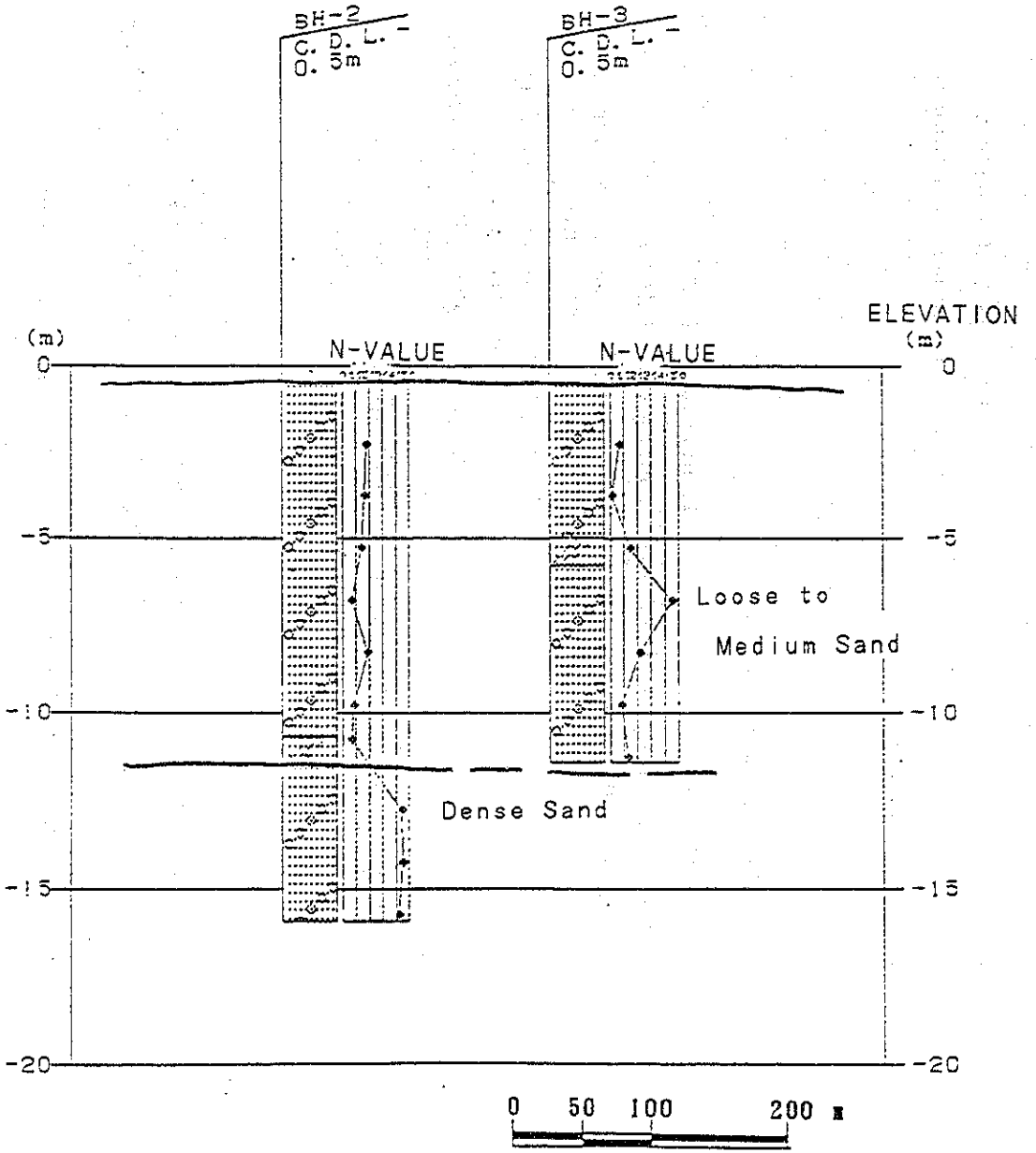


Fig. 4-4 SOIL PROFILE (Y-Y)

(8) Static Friction Coefficient

Between precast concrete and precast concrete:	0.5
Between precast concrete and rubble mound:	0.6

(9) Safety Factors

Sliding	:	1.2 (under normal conditions)
Overturning	:	1.2 (under normal conditions)
Bearing Capacity	:	2.5

(10) Allowable Stress of Materials

Structural Steel	:	1,400kg/cm^2	(SS41)
Deformed Reinforcing Steel Bar	:	1,800kg/cm^2	(SD30)
Reinforced Concrete	:	240kg/cm^2	(standard design strength)
		90kg/cm^2	(allowable bending strength)
		9kg/cm^2	(allowable shearing strength)
Plain Concrete	:	180kg/cm^2	(standard design strength)

(11) Reference Standards

Standard Concrete Specifications (Japan Association of Civil Engrs.)
Standard Design for Fishing Port Structures, 1990 (Japan Fishing Association)
Technical Standards for Port Facilities, Rev. Ed. (Japan Port Ass.)

Japan Building Standards
Japan Institute of Architects Construction Specification (JIA)
High Pressure Gas Regulations and Laws
Fire Protection Laws

4.3 Basic Design

4.3.1 Layout Plan

The flow of the fish landed at the port, the transport vehicles, personnel, etc. will be assumed in this chapter. The relation of the whereas, landing quay, and the interconnection with the hinterland are indicated by an arrow diagram in Fig.

The minutes of discussions held with the Maldivian Government officials are given in Annex 2 (see Data #4) describe in the Basic Design Investigation of Facilities, Equipment and Materials, and indicate the facilities required by arrow diagrams as follows:

Basic facilities

Outer Facilities	:	Breakwater, Revetments
Mooring Facilities	:	Landing Quay, Service Quay
Harbor Facilities	:	Channel, Anchorage

Functional Facilities

Transport Facilities	:	Roads, Causeway
Navigation Support Facilities	:	Navigational Aids, Lighting Facilities
Utilities Supply Facilities	:	Water Supply, Fuel Dispensing and Electric Power Supply
Fish Handling Facilities	:	Cargo Handling Area, Weighing Equipment, Ice Making Plant, Freezing/Refrigeration Plant, Cold Storage Facility.
Administration Facilities	:	Administration Office

4.3.2 Facility Planning

(1) Determination of Fishing Port Facility Size

1) Breakwater

The weather and sea conditions at this proposed fishing port is safe during the northeastern monsoon season, but in the

southwest monsoon the prevailing wind will be from the W-WNW, the deep water wave height 2.3m, and wave direction WNW (at almost right angle to the reef edge).

Hence, for normal safe cargo handling and for rough weather refuge, for anchorage and to maintain the calm waters, it will be mandatory to provide a breakwater. (see Appendix 7)

The project site has problems of littoral drift, and there are problems of the harbor being filled with sand, and it becomes a problem in how long to extend the breakwater seawards. Since it is impossible to fully determine the effects of the littoral sand drift during the short time allowed from the data available, it has been assumed from the wave condition as follows:

Given the conditions of the wave and sand, the depth that sand will start to travel can be determined from the Critical Water Depths for Sand Movement (Sato, et al) can be determined from the following formula:

Critical Water Depth for Surface Sand Movement of Whole Sediment

$$\frac{Ho}{Lo} = 2.4 \left(\frac{ds}{Lo}\right) \sinh \frac{(2\pi h)}{L}^{1/3} \frac{Ho}{h} \rightarrow h = 0.05 \times 17.0 = 0.85m$$

Water Depth net Transport of Surface Sediments

$$\frac{Ho}{Lo} = 1.35 \left(\frac{ds}{Lo}\right) \sinh \frac{(2\pi h)}{L}^{1/3} \frac{Ho}{h} \rightarrow h = 0.10 \times 17.0 = 1.70m$$

where:

H : deep water wave height (significant wave) = 0.8
: deep water wave length = 1.56 x (3.3)2 = 17.0m
: period of deep water wave = 3.3sec.
: diameter of sand (medium size) = 0.5mm.

These figures are the approximate depths that the sand granules will start to move, and so the tip of the breakwater will be extended to a depth of -1m as shown in General Plan.

2) Channel and Basin

i) The new channel will have to be dredged to a depth that the largest objective vessel, the collector vessel (95GT), can navigate safely and anchor. The depth of the channel can be determined from the formula given in the guidelines for Standard Design Method for Fishing Port Structures. The width of the channel will be designed for one-way travel (the length of the largest vessel or 3-4 times the maximum beam) + (margin of safety) = 30.0m.

Channel Depth = Max. Draft of Largest Vessel + Margin of Safety

= 1.7 + 1.0

= 2.7m

Say: -3.0m

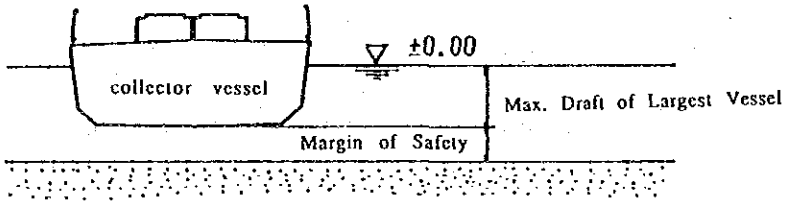


Fig. 4-5 Water Depth of Channel and Basin

ii) Depth of Basin

The depth of the anchorage will be the same as for the largest vessel and not be based on the draft of the collector boats and the Dhoanie fishing vessels that will use the facility, and determined as follows:

Depth of Anchorage = Max. Draft of Largest Vessel + Margin of Safety
= 1.7 + 0.5
= 2.2m
Say: W.D.L. - 2.5m

As shown in Fig. , the landing quay for the collector boats and Dhoanies are next to each other , and when the maneuvering of the vessels is considered, it will not be necessary to vary the depths, and so it will be fixed for a uniform depth of -2.5m.

iii) Idle Berthing Anchorage

The Dhonie will purchase fishing gear, foodstuff, and sundry items at the STO shop provided at the fishing port, and is expected to take these items back to their fishing villages, and so an idle berthing facility will be constructed by the end-on system on the seawall with a mooring system.

3) Landing Quay

i) Calculation of Landing Quay Length

- Collector Boat Quay

There will 2 collector boats assigned to this port. With lighters (work boats) proposed to work with the reefer vessel, and there will be 2 berths provided of which one will be used as a service quay, for fueling and loading of ice. The length of one berth will the length of the vessel plus an allowance of 15%, and the length was determined as follows:

L = (22.5 + 0.15 x22.5) = 25.9m

- Dhonie Landing Quay

The necessary landing quay will be calculated from the following formula:

Required Length = Σ N/r x L

where:

L : Berth Length = Boat Length + Allowance

N : (Number of Quays per day in 2 continuing months in peak season)

r : Berth Turnover Rate = Landing Hours (3:00-9:00PM)/Landing Time Per Boat = 20min.

Hence:

L = 13.5 = 0.15 x 13.5 = 15.5m

N = 2,800/(25+25) = 56 boats

r = (21:00-15:00)/0.33 = 18

Required Length: 56/18 x 15.5 = 48.2m (3 berths)

ii) Service Quay

- Collector Boat:

The preparation quay will be as described in Item i), and one berth will be provided for preparation.

From the above the total length of the quay will be 95m.

4) Revetment/Seawall

A passage corridor has been considered for the rear of the revetment, and the total length has been planned as shown in General Plan.

5) Causeway

For travel to the land, a causeway has been planned.

The length of the causeway was planned as 340m so as allow the transport of fish products while considering the port layout.

(2) Determination of the Refrigeration/Cold Storage Plant

Although the fish volume to be handled by this Project is estimated at 7,700t per annum to cover the fish catches in Laamu and Thaa Atolls as shown in Table 3-4, the capacity of the refrigeration facilities will be determined as urgent program to consider the fact that one of the mother boats, Remoara I, operating in Laamu Atoll is needed to be replaced due to deterioration.

The estimated volume to be handled by the Refrigeration/Cold Storage Plant is estimated at 3,700t based on the actual volume of fish collected by Remoara I at Maamendhu Island as shown in Table 4-1.

Table 4-1 Fish Collection Record in Laamu Atoll in 1990

Islands	Maamendhu	Maabaidhu	Maauah	Total
Jan.	272.2	208.2	0.0	480.4
Feb.	247.8	253.4	0.0	501.2
Mar.	389.0	257.6	0.0	646.6
Apr.	396.0	329.6	14.0	739.6
May	192.1	166.3	44.0	402.4
Jun	300.1	379.1	1.7	680.9
Jul.	336.2	339.2	0.4	675.8
Aug.	221.1	88.4	1.3	310.8
Sep.	254.4	122.5	0.0	376.9
Oct.	301.6	41.2	104.9	447.7
Nov.	332.1	60.7	75.5	468.3
Dec.	467.7	125.7	45.5	638.9
Total	3,710.3	2,371.9	287.3	6,369.5

1) The Freezing Plant

i) Capacity of the Plant

The Freezing Plant will be so designed as to be able to freeze the catches in peak season by the following formula.

$Cf = Vm/Od = 467.5\ t/25\ \text{days} = 18.7 \fallingdotseq 20\ t/day$

where,

Cf : Freezing Capacity

Vm : Monthly Volume (467.5 t - Dec. 1990)

Od : Operation days (25 days)

ii) Determination of Refrigeration Systems

a) Method of Refrigeration

There are the air blast, shelf-tubing semi air blast, and the brine method are generally used for freezing skipjack. The first two methods consist of placing the skipjack on freezing shelves and removing the frozen product by hand and the work is highly labor intensive. In comparison to this, the brine method is less labor intensive and is suited to processing large catch of fish at one time. Also to process the skipjack for canning the brine method is well suited from the point of heat efficiency. Therefore, this facility will use the brine method.

The brine method selected will use the sodium-chloride brine which is well suited to the freezing of skipjack for canning purposes.

For the efficient handling of the fish and the frozen product, the fish will be use the refrigerated containers, to include the entire handling process.

b) The Refrigerant

Freon and ammonia are considered for the refrigerant, but ammonia was selected as the refrigerant for the refrigeration system. (If will be the same for the cold storage and the ice making systems.)

① Ammonia is the cheaper refrigerant, (at the time of investigation, ammonia was S$3.30/kg, Freon (R-22) was S$7.00) in Maldives.

② The Felivaru Tuna Processing Plant and 6 out of the 10 refrigerated mother boats all have ammonia refrigeration systems, and the refrigeration engineers are all well versed in ammonia refrigeration systems.

③ The CFC Freon refrigerant has problems with the ozone layer, and although not all CFCs are problem creators, CFCs

will eventually be banned from productions, and so it will not be used.

Table 4-2 Comparison of Refrigerants

Refrigerant	Price	Procurement Difficulty	Refrigerant in Existing Facility	Characteristic as Refrigerant	Toxicity as Refrigerant	Effect on Environment
Freon	High	Difficult	Used by some mother boats	Either one can be used as refrigerant in this project.	None Toxics	R-22 will not affect environment but public sentiment should be considered.
Ammonia	Low	Easy	Used by existing facilities, and mother boats.		Can be dangerous if leaked in large amounts	

2) The Cold Storage

i) Capacity of the Storage

The capacity of the Storage is determined to store average monthly volume considering the calling frequency of the reefer as follows.

$Cc = Vy/12 = 3,700/12 = 300t$

Where,

Cc : Storage capacity

Vy: Volume per year

ii) The Refrigeration Methods

a) The Refrigeration Temperature

The refrigeration will be to freeze the skipjack to be used for canning. The period of freezing will be for one month to the time to be shipped. The refrigerating temperature will be -25°C. The temperature at the core of the frozen skipjack when entering the refrigerator will be -10°C, and the maximum quantity will be 20 tons, and it should have the capacity to handle this quantity.

b) The Construction of the Refrigerated Storage Facility

The facility will be of the insulated panel prefabricated refrigerated storage similar to the Felivaru Fish Processing Plant. This will result in the efficient construction of refrigerated storage facilities and result in better construction.

c) The Stowing and Stacking in the Storage facilities

The highly efficient entry and exit of the products from the storage facility is a must. Especially the loading of the ocean-going vessels must be performed very fast, and the fish cannot be loaded separately by hand. The frozen fish must be loaded in containers, and all work be moved and stacked in containers using forklifts.

3) Ice Making Plant Facilities

The ice manufactured will be used to: i) to store and preserve with ice the fish in the hold of the collector boats, ii) for storage with ice fish landed above and over the refrigeration capacity of the plant.

i) Capacity of Ice Plant/Storage

The capacity of Ice Plant/Storage is determined to cover minimum requirement as follows:

Ice Plant 5 tons/day
Ice Storage 30 tons

ii) The Ice Making Methods

a) Ice Making Waters

The water used in this project will be rain water, and will be used for the employees drinking water and other daily use, and there will not be enough to make ice with. The ice will be used to keep the skipjack cool and need not be clean water. Therefore, saline water will be considered for this project.

b) Ice Making Methods

There are block ice, plate ice and flake ice, but for this project, block ice will be considered because of the following reasons.

① The water used to make ice will be seawater, using sea water and ammonia as the refrigerant. Plate ice and flake ice will need a larger equipment, and plate ice will need automatic operating equipment.

② Plate ice and flake ice will melt faster, and are not suited for moving around.

③ The ice will not be kept for long periods of time, but the ice for internal use are kept for several days on end. The ice should be allowable to keep for several days and block ice is best suited for this purpose, whereas flake ice will bind together while kept in storage and will become one big block of ice and is not satisfactory.

④ Block ice if made too large will be difficult to handle, but if made into a smaller block (about 22kg block) it will be very easy to handle.

The above description of the freezer/refrigerated facility will be summarized as follows:

Table 4-3 Description of Refrigeration Facilites

Facility Name	Type of Structure	Scope of Equipment	Size of Facility
Freezing Facility	Refrigeration Method:	Refrigeration capacity: 20ton/day Brine Tank 10ton x 2units, Refrigerant: Ammonia	Purchase Quantity: Avg. 9-21t/dy Planned Quantity: Avg. 12t/dy yr When over 20ton, hold by preserving with ice.
Cold Storage	Prefabricated Insulated Panels.	Refrigeration capacity: 300t, 1 room Temp.: -25°C Refrigerant: Ammonia	Purchase Quantity: Avg. 230-510t/month
Ice Making Plant	Block Ice Making Plant	Refrigeration capacity: 5t/dy Ice Making Water: Sea Water Block Ice: 22kg/Block Ice Storage: 30ton Refrigerant: Ammonia	

(3) Electric Power, Water Supply Systems

1) Power Supply Facilities

There is no power available from other sources. A power plant will have to be constructed on the project site to provide all power required.

The power requirements are as follows, for a total of approx. 350kw.

Freezer/Refrigeration Equipment	Approx.	269kw
Water Pumps	Approx.	36kw
Lighting in Freezer/Refrg. Facility Exterior Areas & Quays	Approx.	45kw
Total	Approx.	350kw

The generator will be diesel engine driven, and similar to case of the Felivaru Fish Processing Plant, there will be plural number of generators, to be able to cope with variations in the power load factors.

2) Water Supply Facilities

All potable water will be used basically for the employees drinking purpose, and the collector boats and fishing boats, and the source will be rain water.

The rain water will be collected off the roofs of the freezer/refrigerator facilities using rain troughs and collecting into the reservoirs built adjacent to the facilities. The water supply will be made by a distribution piping to the water outlets with a pressure pump.

In the project site, the precipitation is 1500~1800mm per year. There is rainfall throughout the year, and the water storage shall be planned to last for a dry spell of one month. The stored amount to last for a month shall be approximately 150tons, on the following basis:

Employees: 40l/capita/day x 78persons x 30dy = 94ton
Collector Boats: 1000l/boat/trip x 5trips x 2boats = 10ton
Fishing Boats: 50l/boat x 30boats x 25dy = 38ton
(Fishing boats profession water at their fishing villages as a rule.)

3) Fuel Storage Tank and Fuel Dispensing Facilities

Fuel is a must for this project. Providing of fuel to the fishing vessels is an important item for the project, as providing of adequate fuel to the fishing vessels will affect the number of trips, and the landings. The adequate fuels storage and the fuel dispensing facilities is an important item.

The monthly amount of fuel required for one month is approximately 243l.

a) The consumption for the electric Power Plant

The plant is 350kw, so for a fuel consumption of 3kl/dy
90kl/mo

b) Fuel for Fishing Boats

80l/boat x 50boat/dy x 25/dy/mo = 100kl/mo

c) Fuel for Collect or Boats

Collector Boat: 2kl/trip x 5trips/mo x 2boats = 20kl/mo
For Fishing Boats Landing Fish: 80l/boat x 13boat/dy x 25dy/mo = 26kl/mo

d) For Forklifts, Cranes, Barges, etc.;

7kl/mo

This project has assumed refueling at about every month and has planned for a minimum of 1 month supply of 250kl.

It is planned to provide 1 fuel storage tanks of 250l. The electric power generating plant, fishing boats and collector boats will all receive their fuel from this facility, and the necessary pipelines will be provided.

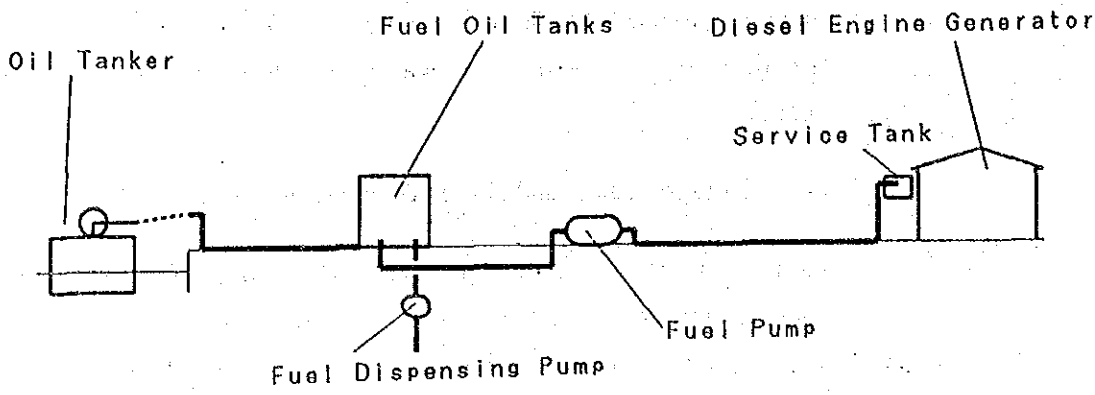


Fig. 4-6 Fuel Oil Supply System

4.3.3 Basis of Design

(1) The Design of Fishing Port Facilities

1) Breakwater

i) The Selection of the Breakwater

Breakwaters may be vertical faced or sloping compared of variously mixed or sloping types of breakwater, and other types. In consideration of the natural condition at the site, and the availability of materials, the sloping mound breakwater type was selected.

To prevent the silting of the inside of the harbor by sand, a protection sheet was provided between the inner core fill and the armor stone coating material.

ii) Determination of Breakwater Crown Height

The breakwater height is determined by adding the height R_L to the H.W.L.

$$R_L = 0.6H = 0.6 \times 1.56 = 0.94m$$

where:

H : Max Wave Height, 1.56m

R_L : Breakwater Height above H.W.L.

Therefore, Breakwater Height:

$$1.20(\text{H.W.L.}) + 0.94 = 2.14 = +2.2\text{m}$$

The width at the top of the breakwater will be 3 blocks wide.

iii) Calculation of the Armour Block Weight

The Calculation of the stable weight of the armor block stone for the breakwater is calculated from the following formula:

Hudsonic Formula

$$W = \frac{\gamma_r \omega^3 H^3}{K_D \cot \alpha \, (\gamma_r - \omega)^3}$$

where:

W : Min. Stable weight of armour (concrete block)

γ_r : Unit Weight of Concrete Block = 2.3t/m^3

H : Breaking Wave Height = 2.3m x 0.68 (Breaker Height Ratio) = 1.56m

K_D : Coefficient from experiment = 8.3 (wave braking range)

ω : Unit weight of seawater = 1.03t/m^3

α : Angle of wall with horizontal plan = 36.9°(=1:4/3)

$$W = \frac{\gamma_r \omega^3 H^3}{K_D \cot \alpha \, (\gamma_r - \omega)^3}$$

$$= \frac{2.3 \times 1.03^3 \times 1.56^3}{8.3 \times \cot 36.9° \times (2.3-1.03)^3}$$

$$= 0.42\text{t}$$

Since the concrete blocks at the edge of breakwater are subject to waves from many angles, and the armour block is susceptible to being pushed backwards, the blocks shall be planned for 50% more weight than calculated.

Weight of Concrete Block at Edge = 0.42 x 1.5 = 0.63t

The blocks will be the 1 ton armour concrete block (actual weight 0.92t), and they will be provided for one wave length or 40m.

2) Channel/Anchorage

The dredging slope at the channel and anchorage will be 1:3 due to the soil at the site being coral sand. The design width at the site will be is accordance with the drawing layout.

3) Landing Quay for Collector Boats

i) Depth of Water

The water depth will be made the same as the anchorage at W.D.L. -2.5m.

ii) Crown Height

The dock height was decided after considering the tide level, the shape and size of the fishing boats, and the methods of use as follow:

Landing Height = H.W.L. (+ 1.2) + 1.0
= W.D.L. +2.2m
(Standard Design of Fishing Ports Method)

On the other hand, the bulwark of the fishing vessels is 0.9m but there is an operation in it, and so by adding the 0.6m to the height water level

Landing Height = H.W.L. + 0.6
= +1.2 + 0.6
= W.D.L. +1.8m

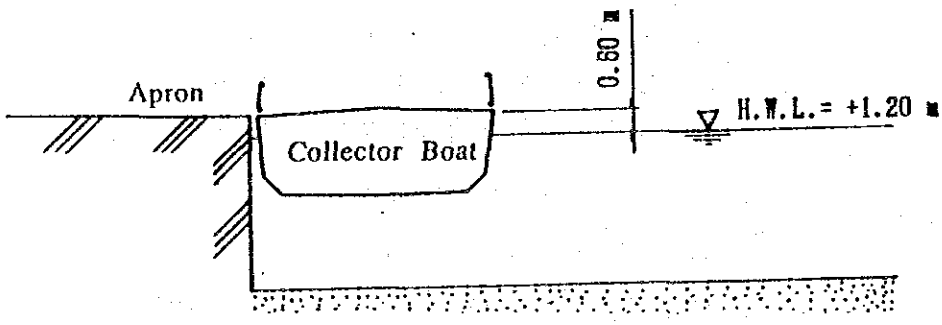


Fig. 4-7 Determination of Crown Height (Collector Boat)

The method of landing will consist of off-loading the palletes on the deck with cranes, and the existing landing piers have a height of 1.8~2.3m, so it was determined for ±1.8m.

iii) Width and Slope of Apron

The handling of the 1 ton palettes will be handled with crane and forklifts, and so the suitable width of the apron would be fixed at 10m.

For the apron slope, it is fixed at 2%.

iv) Type of Structure

The several types of structures for the landing quay was analyzed with due consideration of the following conditions:

① that the upper layer of soil with N = 10, consisting of sand mixed with gravel.

② the planned depth of water facing the quay is shallow at 2.5m.

③ there will be very little shoaling and scouring.

④ construction materials should be fairly easy to procure, and special condition equipment should not be required.

⑤ that maintenance and repair will be simple, and the structure will be of robust construction.

The quay should be of the gravity wharf type, and in consideration of the natural surroundings, materials available, workmanship available, and the method of consideration, the following 3 types were compared:

① Concrete Block type.

② Cellular concrete block type.

③ L-shaped block type.

The results of the comparison are given in Table 4-4, and the conclusion was to use ① the concrete block type.

4) Dhonie Landing Quay

The type and size of Landing Quay for Dhonies will be the same as for the Collector Boats so that any boat can berth at any quay.

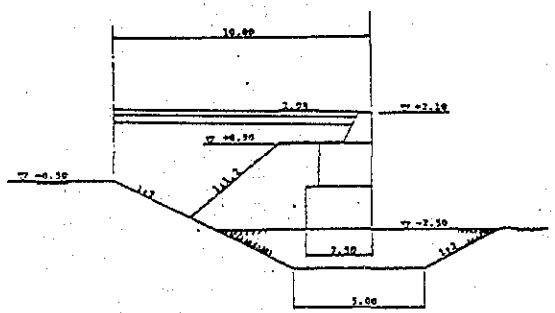
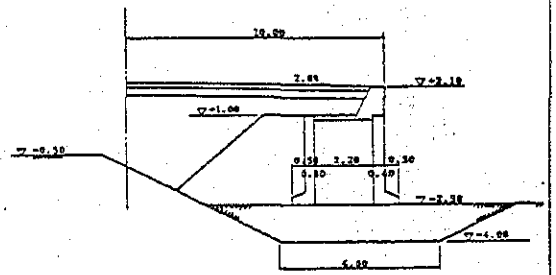
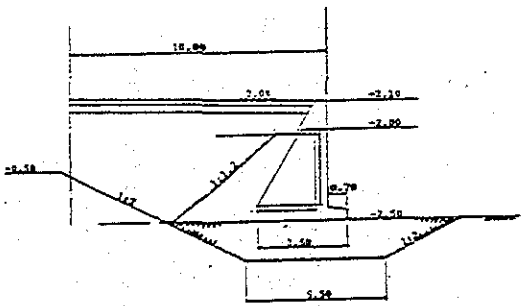
(2) Design of the Freezer/Refrigeration Facility

1) Freezing Plant

i) Design Conditions

a)	Freezing Capacity:	Freezing of skipjack, 20tons/day.
b)	Refrigeration Method:	Direct Immersion in Cold Brine.
c)	Type of Brine:	25% Sodium-chaloride brine solution. 18.9 baume, specific gravity 1.15, freezing point, -17.8°C.
d)	Refrigeration Time:	12 hours. brine temperature, -17°C fish temperature, initial +30°C finish -8° to -11°C

Table 4-4 Comparison Table of Quay Structure

Type of Structure	Gravity Block Type	Cellular Block Type	L-Shaped Block
Typical Section			
Cost Indicator	1.00	2.00	1.14
Merit	Materials - None reinforced concrete, all aggregate materials available locally, requiring only cement for import. Construction - Ease of construction. - Construction equipment simple. - Construction can be performed even with some waves.	Construction - Construction period is short, not requiring many construction equipment. - Is light weight in spite of size.	Environment - Can be used in fairly poor sea bed area.
Demerit	Construction - Will require a yard for construction. - Construction period may be relatively long. - Construction will be segmental.	Materials - All materials require importing since reinforced concrete construction. Construction - Will require good fill material in core. - Construction will be segmental.	Construction - Will require large crane for installation. - Will require backfill material to resist wave attack immediately after installation. - Due to thin wall construction, if installation is poor, backfill material will be lost.
Evaluation	○	×	△

ii) Standard Specification

a) Brine Freezing

There will be 2 brine freezing tanks of 10ton capacity each. One brine tank will be capable of accommodating 10 ton bulk fish.

One brine tank:	Steel case 10m x 4.5m, 1.5m deep x 2 each
Cooler:	Brine Cooler

b) Compressor

Compressing Temperature:	40°C
Evaporating Temperature:	-20°C
Refrigerating Tonnage:	More than 33.5 JRT (Japan Refrigerated Ton)
Compressor:	Single-stage ammonia compressor, 75kw x 2 each

2) Cold Storage

i) Design Conditions

a)	Storage Capacity:	300ton x 1 store room
b)	Storage Temperature:	-25°C
c)	Entry Temperature: and Quantity	Frozen Fish, -10°C (at center), 20 ton/day

ii) Specification of Main Facilities

a) Cold Storage

Capable of accommodating 300 frozen fish container (approx. 1 ton), stacks of 4 containers, in one store room. The entry to be provided with ante-room to soften effects of outside air. The work within the storage room will be performed with forklifts, and the aisle space, doors, and work space will be capable to perform this work.

Room Dimensions:	13.5m wide x 18.9m deep x 5.1m high x 1 room.
Type of Structure:	Prefabricated store room with insulated wall and roof panels. Insulation Thickness: Floor, Ceiling 127mm Wall (Keystone Panel) 127mm+25mm

Door Openings: 2.0m (wide) x 2.5m (ht), electric operated, double sliding door

Cooler Panels : Ammonia coil floor panels:

Δt 7.8°C → equivalent 11.7JRT

Cooling Fans: 2.2kw

Defroster: 80A x 420l/sec.

Dfrost Pump: 3.7kw

b) Compressors

Compression Temperature : 40°C

Evaporation Temperature : -35°C

To be rated more than 11.7 JRT (Japan Refrigeration Ton).

With 2-stage compressor (compound type): 37kw

iii) Method of Operation

- Refrigerated Storage:
  Thermostat Setting for supply liquid electromagnetic valve Off, Fan OFF.
- Refrigeration equipment:
  Unloader operates with decrease in load of refrigerated storage; engages automatically when room temperature rises.
- Defroster:
  Timer set to 24 hours for defrost. Operates automatically, or can be operated manually by button for mixed control.
  (Cooler Fan OFF → Cooler Gas Suction → Cooler Sprinkler → Stop Sprinkler → Fan ON → Start Refrigeration).

3) Ice Making Facility

i) Design Conditions

a) Ice Making Capacity: 5 ton/day.

b) Ice Making Water: Sea Water, Water Temperature 30°C

c) Type Ice Manufactured: Block Ice

ii) Main Equipment Specifications

a) Ice Making Tank

Ice Making Can:	22kg (50 lb) can (standard size can of Japan Refrigeration Society), galvanized steel cans, dim.130mm x 300mm x 790mm (upper dimensions)
Number of Cans:	16 rows x 9tiers, 144cans.
Ice Making Capacity:	5ton/day (ice made twice daily)
Brine Temperature:	-8°C to -10°C
Water Supply Hours:	12hrs (equivalent to clear water)
Original Water:	Sea Water
Brine:	Sodium Chloride, Baume 15, Specific Gravity 1.15, Freezing Point -13.0°C
Grid of Ice Cans:	16can/sec x 9 sets.
Cooling Tubes:	Herring-Bone Coil
Stirrer:	Vertical Agitator, 2.2 kw
Tank:	Ice Releasing Tanks, for 16cans, Water Filling Tank, for 16 cans

b) Compressor

Compression Temperature: 40°C

Evaporating Temperature: -20°C

Single-stage Ammonia Compressor: 30kw

(combine with compressor for ice storage room)

c) Hoist Crane

To use for hoisting of ice.

Electric Crane Hoist: 1 ton overhead travelling, electric operated 1.5kw

d) Ice Storage Capacity

Ice Storage Capacity:	30 ton
Type of Construction:	Prefabricated insulated panel construction
	Walls - Keystone Panel, 100mm +25mm thick
	Ceiling, Floor - Flat Panel, 100mm thick (Floor to be provided with wood duck boards)

Door opening, 1 insulated refrigerator doors.

Dimension of Ice Storage:

5m x 8.6m x 2.2m (ht)

Floor Space Requirement:

$$m^2 = \frac{\text{Ice Stored x Displaced Space}}{\text{Stacked Ice Height x Unit Weight}}$$

$$= \frac{30\text{ton x } 1.25}{1.8 \text{ x } 0.8}$$

$$= 26m^2$$

(3) Design of Building Facilities

The building facilities will be planned and designed for the various freezer/refrigerated facilities and equipment to store the purchased and collected fish.

1) Building Layout

The planned building will accommodate the freezer, cold storage, and ice making facilities and equipment. The function of the buildings will be similar to the freezer/cold storage facilities for the Felivaru Tuna Processing Plant, and using this as a reference the following layout will be made:

a) The facilities will be planned for the smooth flow for the carrying in the fresh fish, washing, freezing, refrigeration, cold storage, and the shipping out the processed fish.

b) The facilities will consider methods to minimize the attack of salt laden air, especially the effects of winds from the west due to the South West Monsoon.

c) Methods should be provided to not only protect the equipment and facilities from the salt laden air but against the direct rays of the tropical sun. Also the work of handling the refrigerated produce and to preserve with ice the excess fish catch, to protect all these from the direct rays of the sun and the high temperatures of the outside air.

d) The minimum width required for forklifts to handle the goods, and adequate size should be provided to handle the products and the necessary corridor width.

The space requirements for the various facilities shall be as follows:

i) Freezer/Refrigerated Facilities

a) Freezer Facilities: Brine Cooler, approx. 110m^2 (11.0m x 10.0m)

b) Cooled Storage Facilities: Prefabricated insulated panel Storage facilities, approximately 255m^2 (13.5m x 18.9m, 1 room)

c) Ice Making Facilities: Brine ice making tanks, approx. 55m^2 (5m x 11m)
Ice storage room, approx. 43m^2(5m x 8.5m)

d) Work & Corridor Space for Handling Refrigerated Fish

Work Space: Receive fresh fish, wash, and space to handle fish container. Space to be provided in front of refrigeration racks. Approx. 66m^2 (11m x 6m)

Corridor Space: Provide corridor in front of refrigerated storage. Space to be used by forklifts loaded with refrigerated container from entry/exit to refrigerated space and for two-way traffic. Approx. 63m^2 (6m x 10.5m)

e) Refrigeration Machine Room: Approx. 90m^2 (6m x 15m)

f) Electric Generator Room: Approx. 48m^2 (6m x 8m)

ii) Other Related Facilities

a) Workshop & Storage: Space to fabricate and repair parts, with space to store tools and materials. Approx. 18m^2(6.0m x 3m)

b) Office: Combination Office and work shop. Management Personal 4, Technician 2, allow 5m^2/person. Approx. 27m^2(4.5m x 6.0)

The above given the minimum various spaces required, the work flow, and the flow of the fish. The electric generator room, and the mechanical room will be provisioned on the east side of the facility to protect them from the salt laden air.

2) Structural Design

i) Type of Structure

For the body of the structure, wood, structural steel, concrete block, reinforced concrete structures can be considered, but in view of the refrigeration, and refrigerated storage spaces, it was decided to construct the building of reinforced concrete structured to be cast at the site for the following reasons:

a) Design facilities that will allow construction by local methods.

b) Design facilities for economical construction.

c) Provide durable construction.

d) Provide design that will stand up to salt laden air.

ii) The Type of Foundation

Soil investigation reveals that the soils in the project area to be of soft sand, and so pile footings will be driven down to bearing strata. The footings will be pile foundation, and reinforce concrete foundation beams will be supported by piles.

iii) Roof Structure

The roof framing will be of structural truss, supported on reinforced concrete columns.

3) Exterior Finish

The natural condition and the facility usage conditions will be considered in the selection of the various externe finishes as follows:

a) The project site is located at the water front and so materials that can resist the effects of salt air will be selected.

b) The project site if of high temperature and humidity, and so finish material which can resist the effects of weather extremes will be selected.

c) The finish natural shall be capable of being soiled by fish products, and shall be materials which can be easily washed.

d) The finish materials shall be highly durable.

The materials shall be as follows to meet the above requirements:

1. Roof Construction

The roof structure shall be of structural steel truss construction. The roof plates shall be steel decking with roof insulation and roofing.

2. Wall construction

The exterior walls shall be factory painted steel wall panels for ease of construction, resistance to corrorion and economy.

3. Door and Window Sash

Door in outside walls will be bonded steel door with oil paint finish to resist the effects of salt laden air. Interior door will be wood doors. Window sash will be aluminium sash.

4. Large openings in the exterior walls be provided with steel shutters. The electric generating room and mechanical room shall be provided with lower or ducts to radiate heat.

4) Electrical Facilities

Electrical power will be generated within the project, and distributed to the various facilities through the panelboards.

i) Powered Equipment

Ice Making Tank Crane	Approx. 2.7kw, 1 each
Pump for Misc. Refrigerated Prod.	Approx. 5.5kw, 1 each

ii) Lighting and Receptacles

General Lighting Fixtures will be fluorescent lighting fixtures, the light fixtures in the refrigerated spaces will be incandescent lighting fixtures with protector guards. Wall convenience outlets will be provided for the minimum

requirements in the various room and be provided with a grounding pole. The illuminance levels for the principal rooms will be as follows:

Refrigerated Produce Work Room	100 lux
Mechanical Room, Generating Room	100 lux
Work Room	100 lux
Office	300 lux

iii) Other Related Items

Lightning protection system will be provided.

5) Drainage System

The drainage system for the refrigerated storage facility will consist of fish waste washings, wasted brine, and various washings throughout the facility. All waste waters will be initially strained through gratings on the floor ducts at the various processing rooms and then collected in a septic tank. The effluent will be allowed to leach into the soil after being decomposed.

(4) The Design of Utility Facility

1) Electric Generating Plant

The electric generating plant will be provide all the required electricity

The required electricity: Power, Ac 400V, 50Hz, 3 phase, 4 wire
Lights, Ac 230V, 50Hz, single phase

Maximum Power Requirement: Approx. 350kw

It will be necessary to ensure that the maximum load will not be imposed on the generator, nor the equipment be required with the minimum load, and this should be impressed on the maintenance of the system. The load should be in the range of 1/2 to 3/4 of the load, and multiple generators be provided, and the load be controllable.

i) Electric Generator

Alternating current generator, Diesel-engine driven, 400V, 50Hz 3 phase, 4 wire, 250KVA	3 each

ii) Control Panelboard and Accessories

Control Panel for Generators	3 each
Control Panel for Series Operation	1 each
Manual Changeover Panel	1 each
Panelboard	1 each
Fuel Service tank, Approx. 2.5 kl	1 each

2) Water Supply System

As described in the Facilities Planning Section, the rainwater on the roof of the facilities will be collected, and the water will be supplied to the employees dormitory, the collector boats and the fishing boats for use as drinking water.

i)	rain troughs and conductors	LS
ii)	storage tank amount stored 150ton material, reinforced concrete	1each
iii)	water pump *pump with pressure tank*, 5.5kw	1each
iv)	water distribution line water line from the water pump to the water outlets at the dock.	

3) Fuel Oil Storage Tank and Fuel Dispensing Facility

i) Fuel Oil Storage tank

Capacity:	250kl/Tank
Dimensions:	Diam, approx. 7.7m, Height Approx 6.0m
Material:	Structural Steel
Accessories:	Concrete oil impoundment dike.
Location:	Adjacent to Refrigeration Bldg.

ii) Fuel Oil Transfer Pump

To tramper full oil from storage tanks to fuel transfer pump on service tank of generator station.

Type of Transfer Pump: Gear Pump
Electric Motor Driven, Approx. 5.5kw, Totally Enclosed, Explosion-Proof.
Location: Dockside

iii) Fuel Oil Disparating Pump 1 Each

To fuel fishing boats and Fish Collector Boat
Water Pump, with flow gauge

Location: Dockside

iv) Fuel Supply Piping

Fuel supply piping from oil fill plug at end of breakwater LS
Steel piping, 150mmϕ

Fuel supply piping from fuel tank to generator LS
Steel piping, 65mmϕ

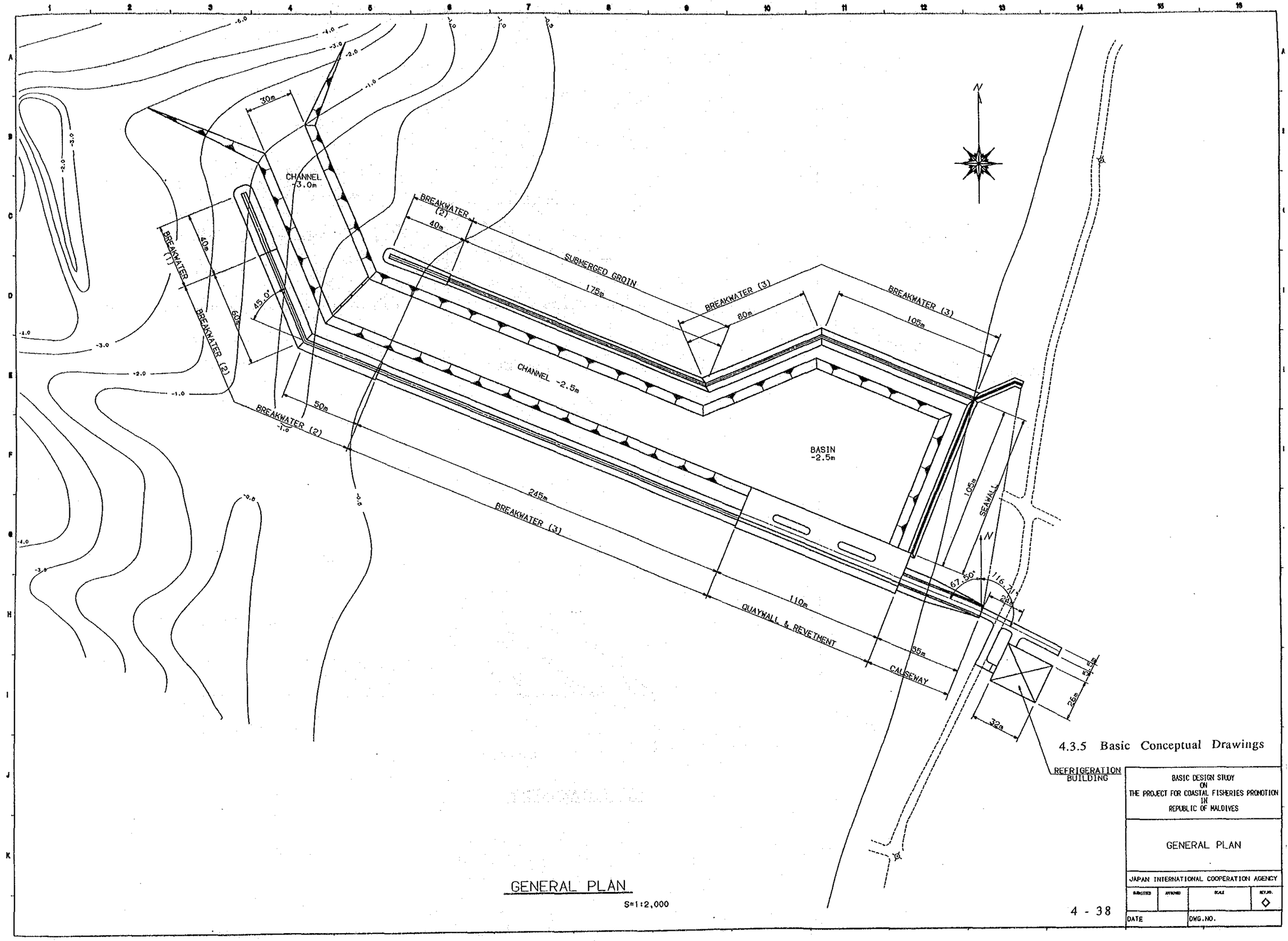
Fuel supply piping from fuel tank to fishing boat fuel dispensing LS
Steel piping, 65mmϕ

4) Exterior Area Lighting

Lighting fixtures will be provided to illuminate front of refrigerated storage and fish landing quay.

Illumination for front of refrigerated storage,

	Mercury Lamp 25 lux
Landing Quay	Mercury Lamp 25 lux
Causeway	Mercury Lamp 10 lux



GENERAL PLAN

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4.3.5 Basic Conceptual Drawings

BASIC DESIGN STUDY ON THE PROJECT FOR COASTAL FISHERIES PROMOTION IN REPUBLIC OF MALDIVES	
GENERAL PLAN	
JAPAN INTERNATIONAL COOPERATION AGENCY	
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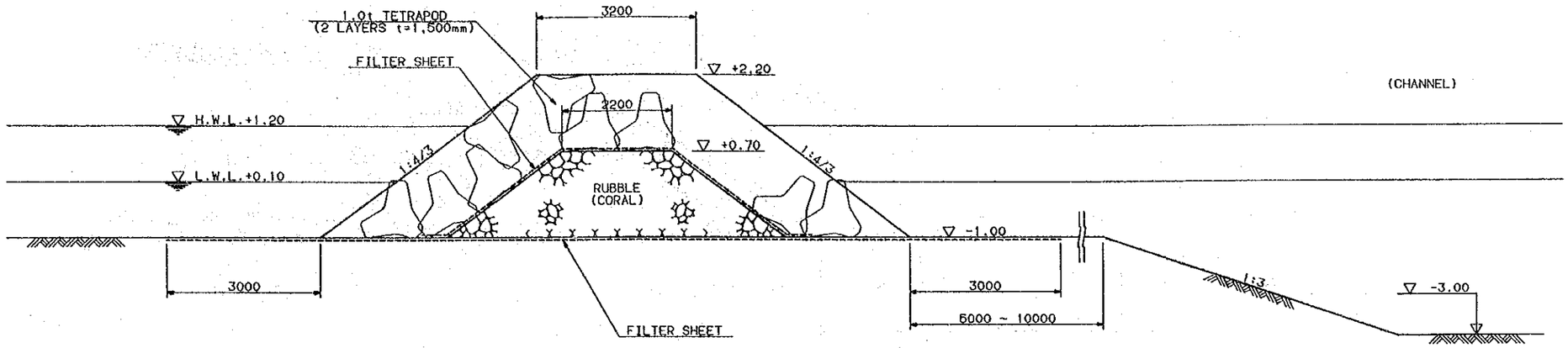

BREAKWATER (1)

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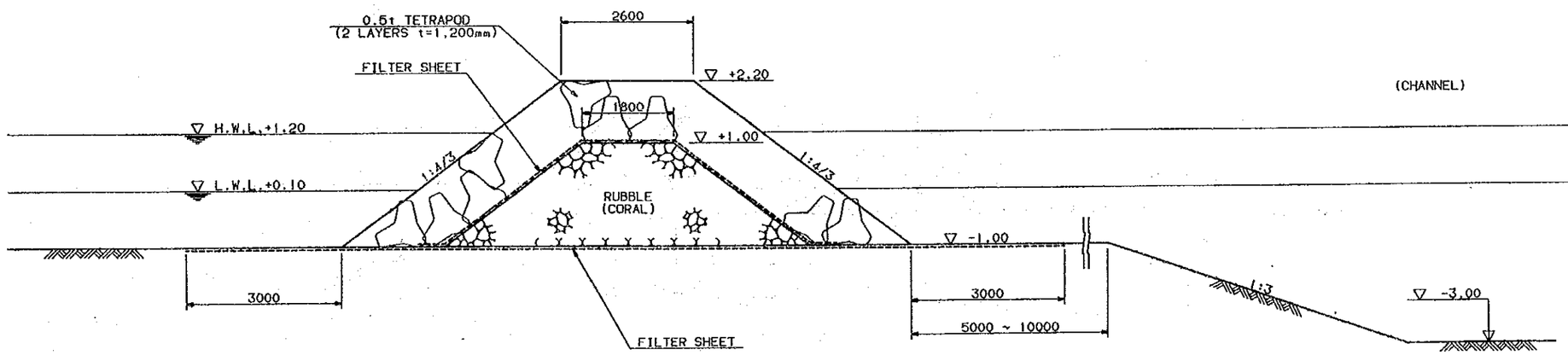

BREAKWATER (2)

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BASIC DESIGN STUDY
ON
THE PROJECT FOR COASTAL FISHERIES PROMOTION
IN
REPUBLIC OF MALDIVES

TYPICAL SECTIONS
OF
BREAKWATER (1) & (2)

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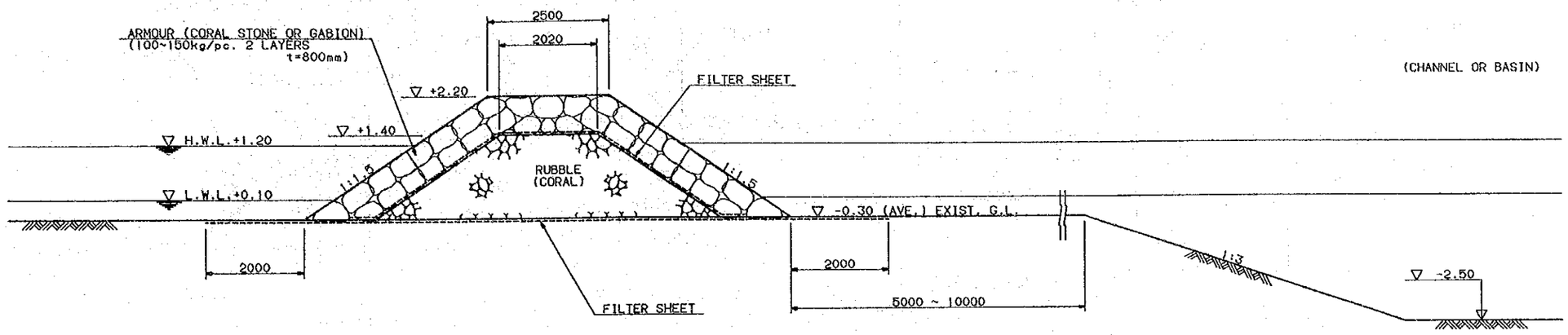

BREAKWATER (3)

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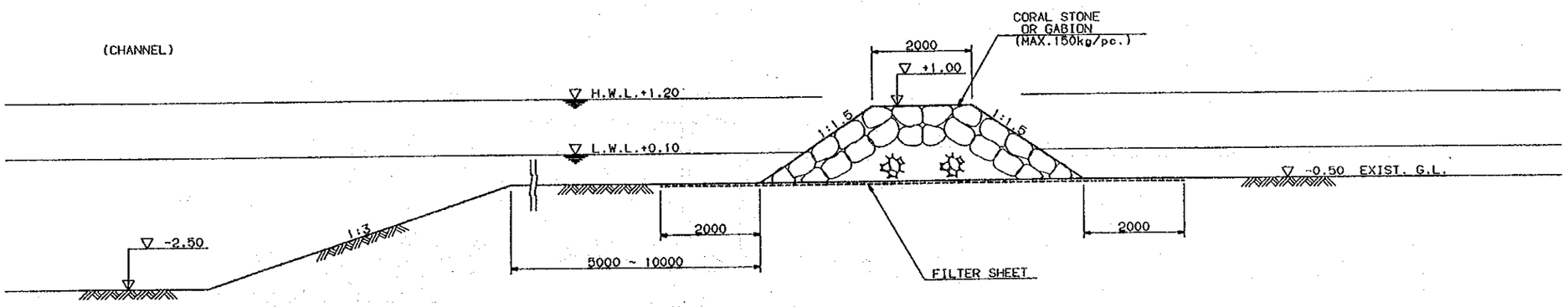

SUBMERGED GROIN

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BASIC DESIGN STUDY
ON
THE PROJECT FOR COASTAL FISHERIES PROMOTION
IN
REPUBLIC OF MALDIVES

TYPICAL SECTIONS
OF
BREAKWATER (3)
& SUBMERGED GROIN

JAPAN INTERNATIONAL COOPERATION AGENCY

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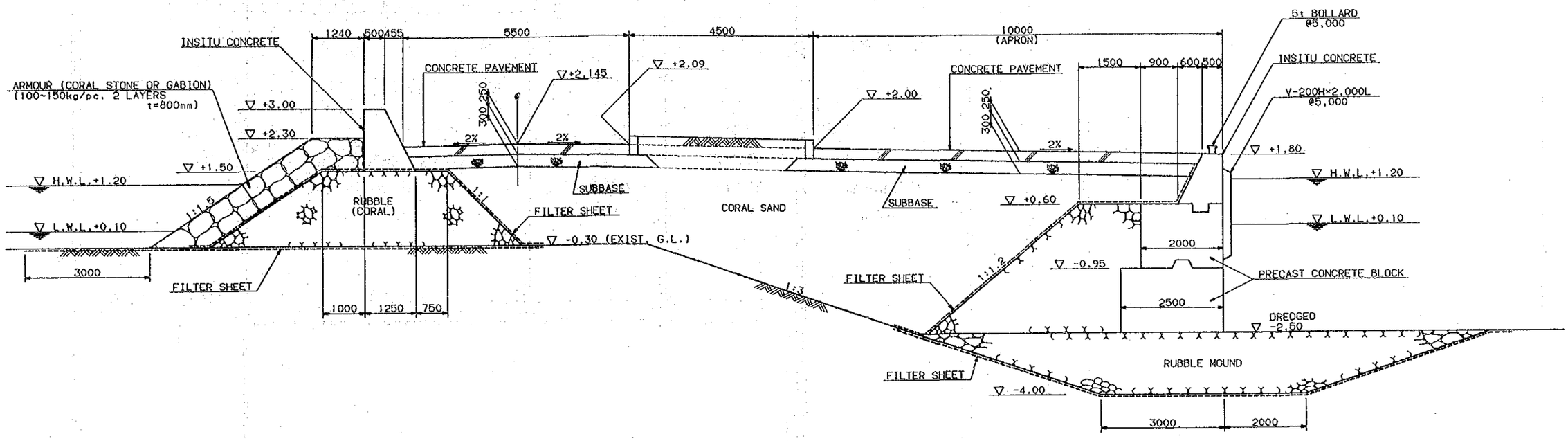

-2.5m QUAYWALL & REVETMENT

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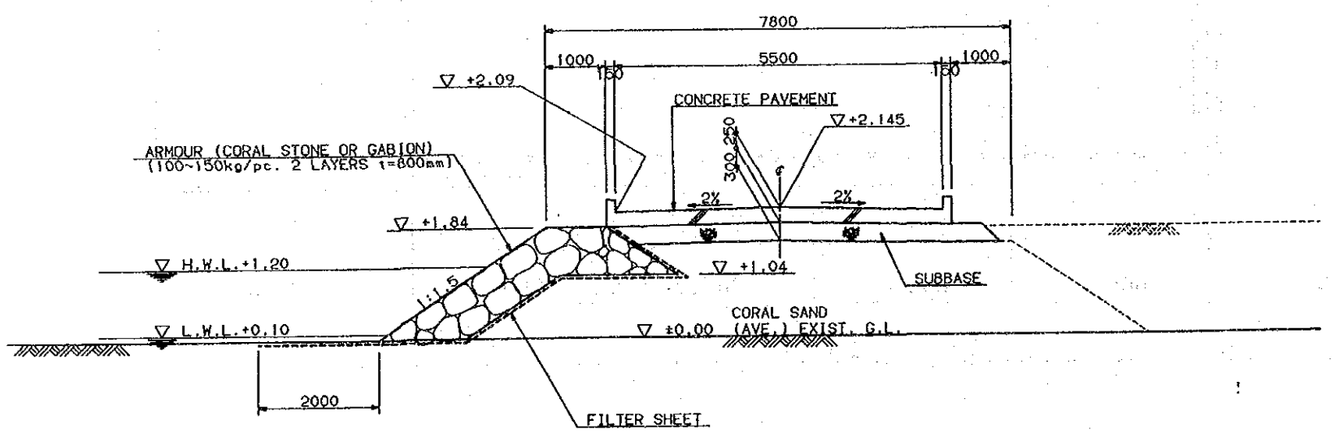

CAUSEWAY

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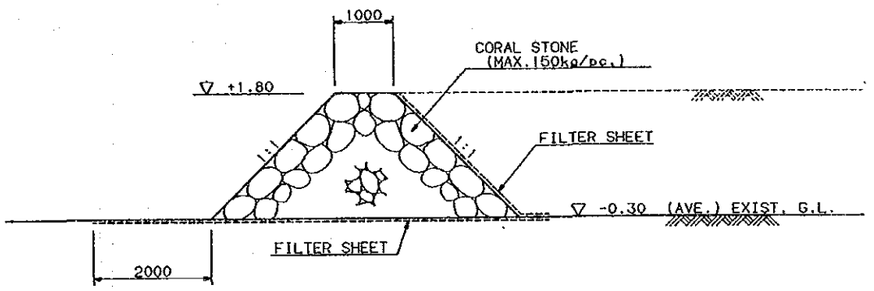

SEAWALL

S=1:100

BASIC DESIGN STUDY
ON
THE PROJECT FOR COASTAL FISHERIES PROMOTION
IN
REPUBLIC OF MALDIVES

TYPICAL SECTIONS
OF
-2.5m QUAYWALL & REVETMENT,
CAUSEWAY AND SEAWALL

JAPAN INTERNATIONAL COOPERATION AGENCY

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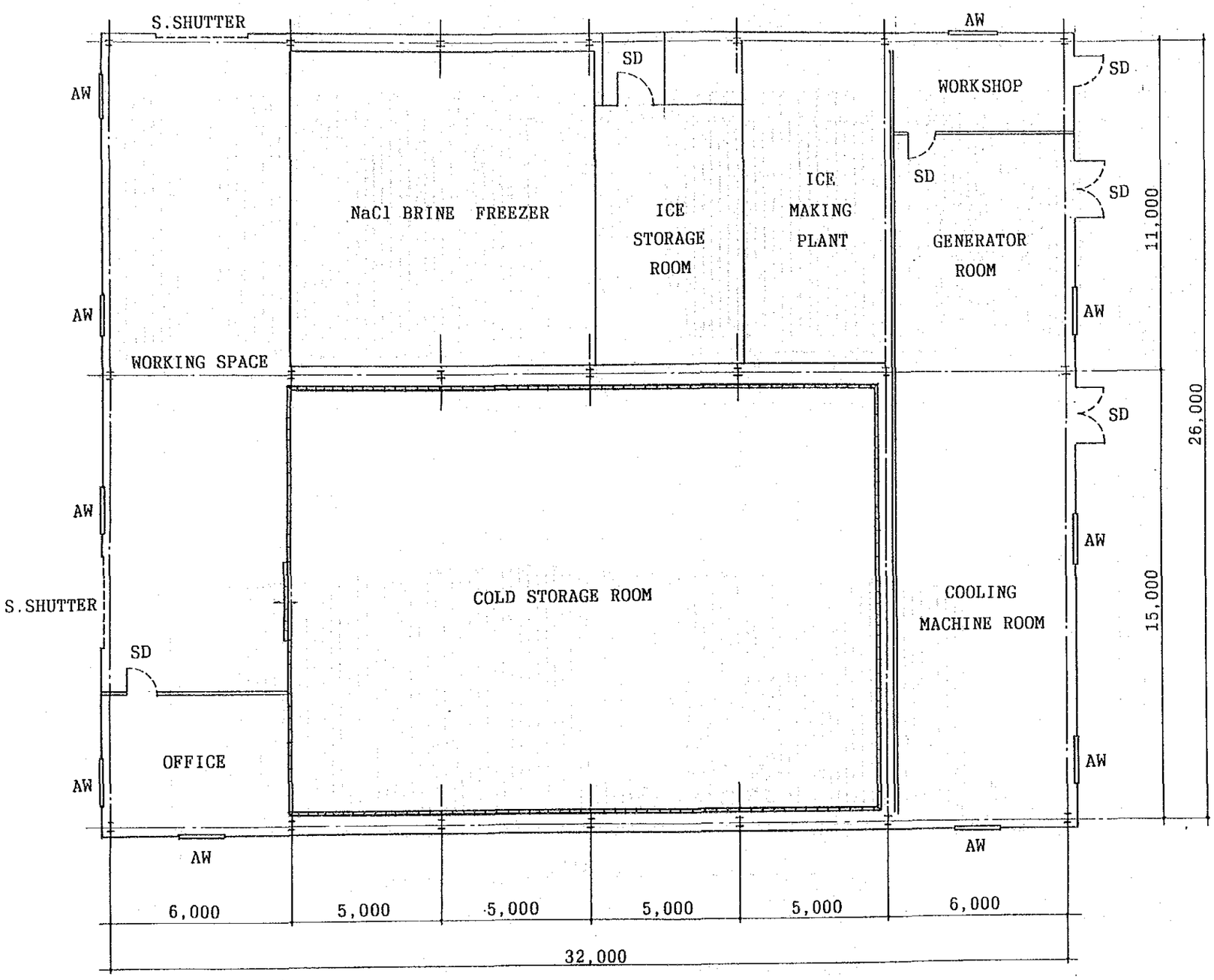
DATE		DWG.NO.	



BASIC DESIGN STUDY
ON
THE PROJECT FOR COASTAL FISHERIES PROMOTION
IN
REPUBLIC OF MALDIVES

PLAN OF
REFRIGERATION
BUILDING

JAPAN INTERNATIONAL COOPERATION AGENCY

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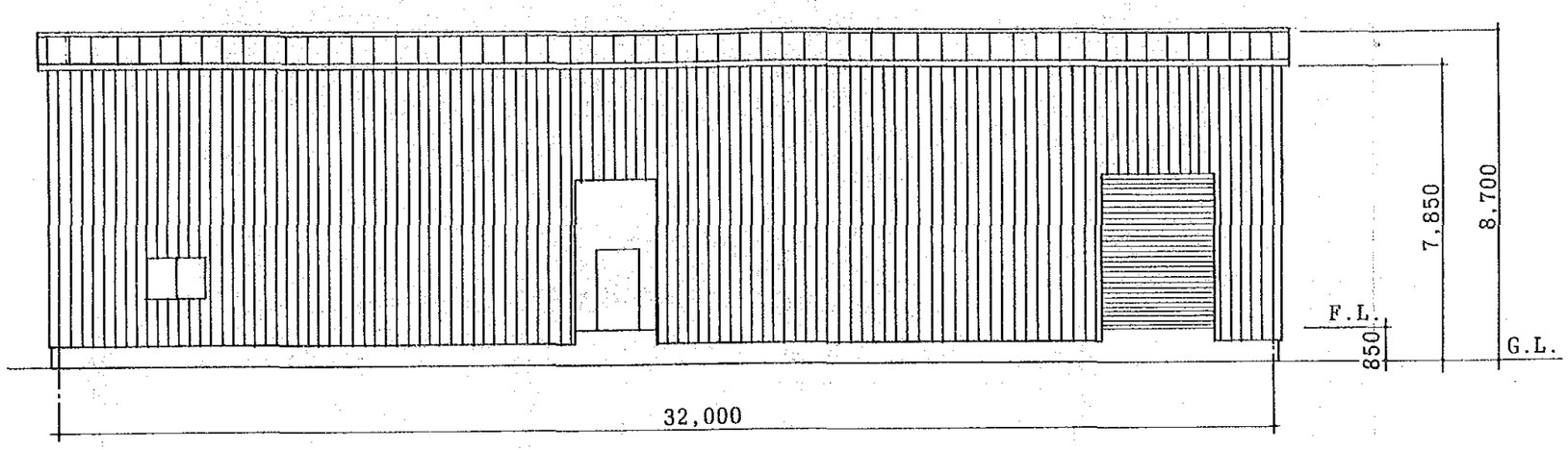
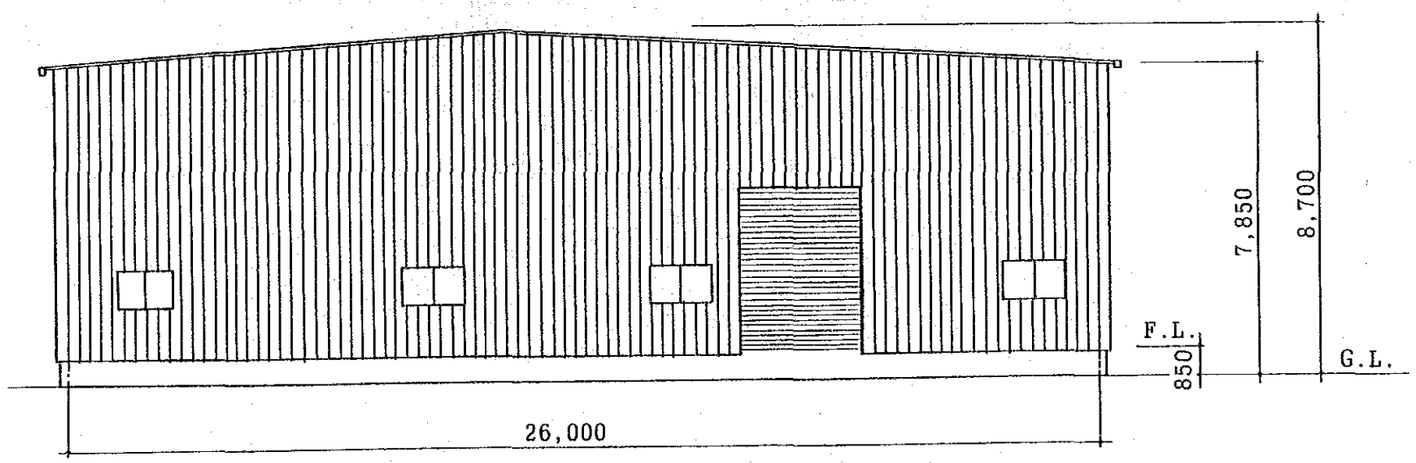
			◇
DATE		DWG.NO.	





BASIC DESIGN STUDY
ON
THE PROJECT FOR COASTAL FISHERIES PROMOTION
IN
REPUBLIC OF MALDIVES

ELEVATION OF REFRIGERATION BUILDING

JAPAN INTERNATIONAL COOPERATION AGENCY

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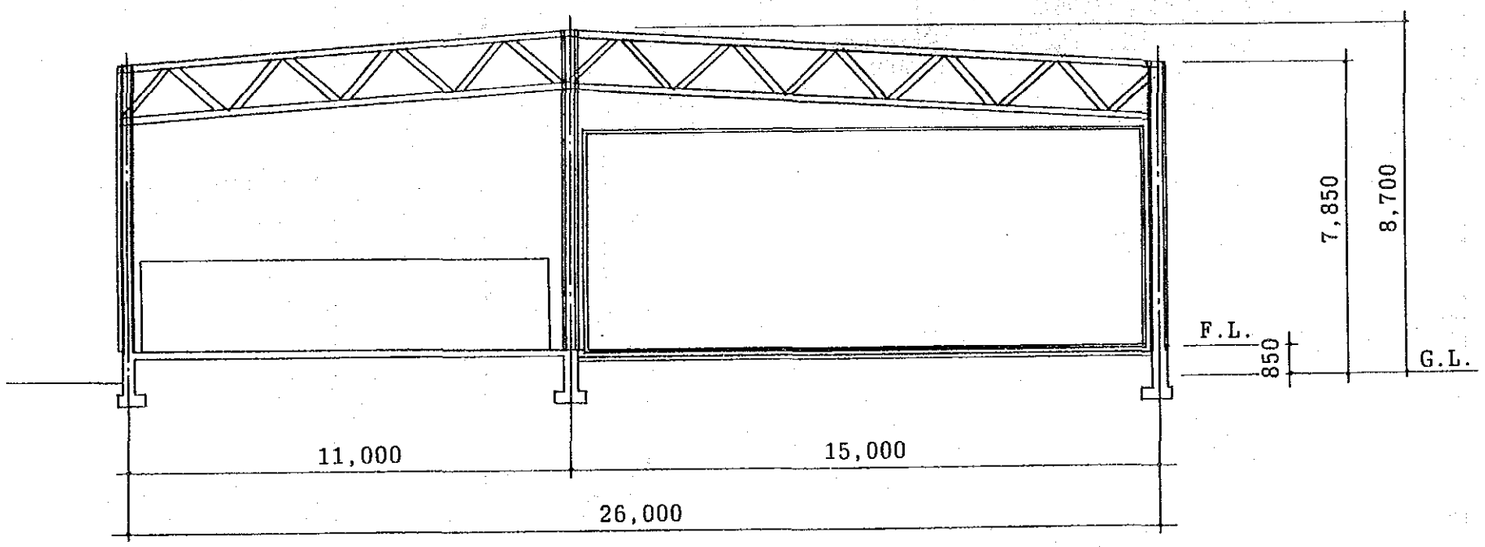
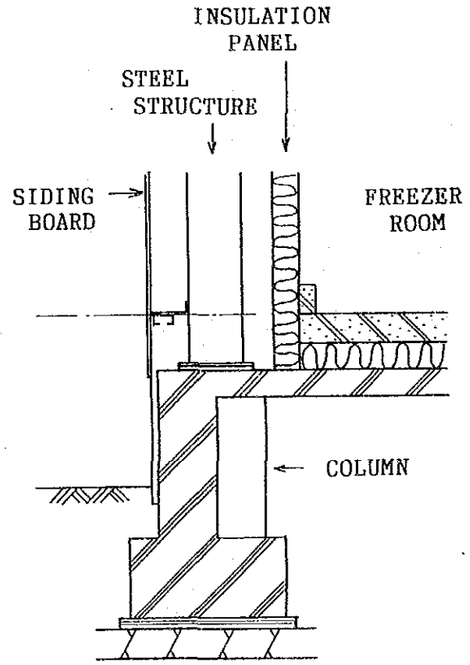


SECTION



DETAIL

BASIC DESIGN STUDY ON THE PROJECT FOR COASTAL FISHERIES PROMOTION IN REPUBLIC OF MALDIVES			
SECTION OF REFRIGERATION BUILDING			
JAPAN INTERNATIONAL COOPERATION AGENCY			
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COOLING WATER PIPE 150^
(UNDER GROUND)

SEAWATER PIPE 40^

25^
(UNDER GROUND)

32^

32^

GARDEN HOSE VALVE ×2
W/HOSE ×2

VP150^

GRATING

TO ICE MAKING POUR TANK

RAIN WATER TANK 150T

SEDIMENTATION TANK
3.0× 6.0× 2.0"

TO SPARE (FAUCET)
DEFROST TANK
CANGRID
FROM GENERATOR ROOM

WATER SUPPLY PUMP ×2

40^

DRAIN 150^

SEWERAGE PIT
500^

DRAIN 150^

FROM MACHINE ROOM

125^

125^

OIL PUMP
200l/min × 3.7KW

REFRIGERATION BUILDING

COOLING WATER TANK
6TON

TO OIL SERVICE TANK

OIL TANK
250KL

OIL PIPE 65^

OIL GUARD DIKE

VP150^

DRAIN DITCH W/CONCRETE COVER

BASIC DESIGN STUDY
ON
THE PROJECT FOR COASTAL FISHERIES PROMOTION
IN
REPUBLIC OF MALDIVES

PIPING PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

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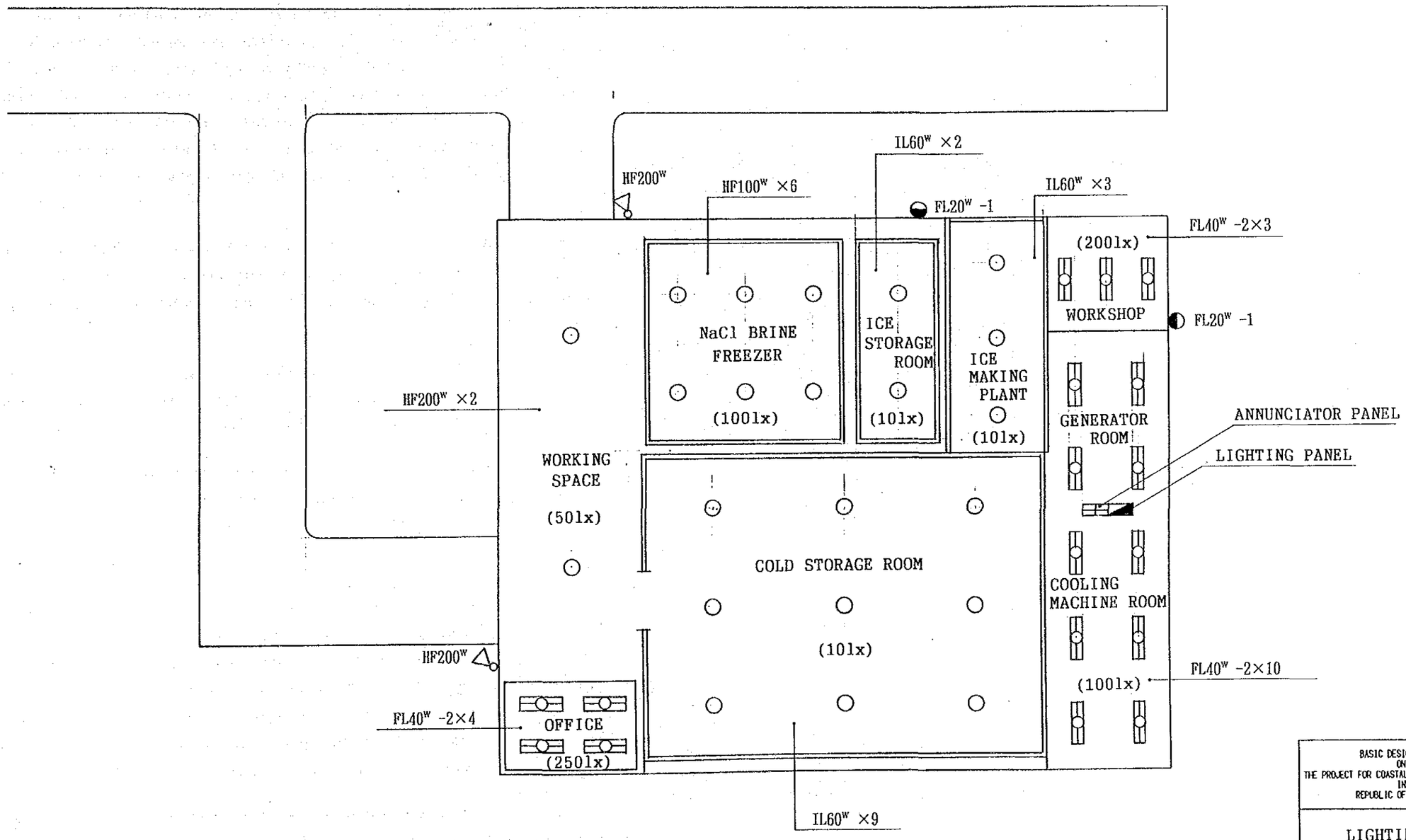

BASIC DESIGN STUDY
ON
THE PROJECT FOR COASTAL FISHERIES PROMOTION
IN
REPUBLIC OF MALDIVES

LIGHTING
LAYOUT PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

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DATE		DWG.NO.	

4.4 Implementation Planning

4.4.1 Construction Condition

The construction industry in the Maldives was investigated from the aspects of materials, construction equipment, and the labor, and it is a very special island country where there is almost nothing available that rerates to construction. If will be necessary to import almost everything from Japan or other 3rd National Countries. For this reason, information concerning construction was obtained from Sri Lanka and Malaysia which are the main source of supply, and this was also necessary to obtain price data on costs.

The fuel oil required during construction (approximately 900kℓ) becomes an important item, and it becomes imperative to have a steady supply provided by the implementing agency STO in order to perform the work at all.

The only construction material available locally, is coral aggregates (entrained amount, approx. 15,000m^3) which will be utilized for structures. It will be necessary to have a steady supply provided by STO.

The construction was based on having design supervision and the construction performed by Japanese eretupries.

4.4.2 Implementation Method

In the Maldives there is the Maldives Transport and Contracting Co. (MTCC), a quasi-governmental firm and several private companies, who perform small building and civil works projects, and all major projects which involve marine construction are managed by foreign construction contractors. Examples are the recently constructed Hanimaduu Airport construction, and the Japanese Grant-Aid Seawall Construction Project for Male Island, which were performed by Japanese construction firms.

The water supply for construction is an indispensable item, which is available in the Project Site since rain water and well water can be obtained in sufficient quantities. Electric power is available in Kadu Island where there is a diesel generating plant but there is not enough capacity to

supply to the project site. It will be necessary to provide a power generating plant during the construction period as well as to provide a power plant for the project.

4.4.3 Construction Supervision

In accordance with the steps to take under the Japanese Grant-Aid procedure, Japanese consultants will contract with the STO for the Detailed Design and Supervisory Service for this project, and obtain the verification of the Japanese Government.

The consultant will be required to perform the following work.

Detailed Designing

The Consultant shall prepare the detailed design based on the flied surveys and Exchange of Notes (E/N) between the two Governments from which the construction contractors could prepare their tender, and shall prepare the tender documents to include condition of contract, specification, drawings, bills of quantity, bond forms, instructions to bidders, and other supplementary information for the bidder to calculates costs and to arrivd at a reasonable bid.

Tender Assistance

The consultant shall discuss with the Implementing Agency of the Maldives and assist in the selection of the construction contractor and the Tender Procedure, and assist in the actual Tender Proceedings, as follows:

Public Announcement of Tender
Pre-qualification of Tenders
Explanation of Tender Documents to Tenders
Assistance and Witness of Tender Opening
Evaluation of Tender

Construction Supervision Stage

The consultant shall supervise the performance of the contractor, and to monitor to see whether the project is proceeding according to schedule.

During the construction period, the consultant shall assign one resident representative, who shall supervise the construction, and conduct quality control, and shall explain the project to the government authorities concerned as required.

The consultant shall dispatch to the site the required experts to monitor the quality control of the building constructions and the mechanical/electrical works.

4.4.4 Procurement Plan

1) Construction Materials

The construction materials shall be procured from the various sources as follows:

Local Supplies	: Fuel oils
From 3rd Countries	: Portland cement
	Fine and coarse aggregates for reinforced concrete
	Fine and coarse aggregates for non-reinforced concrete, Rip-rap stone, amour stone
	Cement admixtures
	Reinforcing steel bars
	Sand protection sheet
	Structural Steel
	Concrete form materials
	Temporary building structures
	Steel for temporary works
	Lube oils and grease
	Oxygen and acetylene
From Japan	: Form materials for concrete block units (tetrapod)
	Rubben Fenders
	Mooring bollards
	Freezer/Refrigeration equipment
	Generators
	Other related materials.

4.4.5 Implementation Schedule

The implementation schedule for the works by the Japanese side are tabulated as follows:

Table 4-5 Implementation Schedule

		Month	1	2	3	4	5	6	7	8	9	10	11	12
Phase 1	Detailed Design	Site Survey Work in Japan Total (2.0 months)												
	Construction	[FISHING PORT FACILITIES] Preparatory Work Temporary Work Dredging Breakwater (Main) Revetments Behind Quay (Total 12.0 months)												
Phase 2	Detailed Design	Site Survey Work in Japan (Total 3.0 months)												
	Construction	Preparatory Work [FISHING PORT FACILITIES] Breakwater (Sub) Quay Submerged Groin/Seawall Causeway [REFRIGERATION BUILDING] Preparatory Work Shop Fabrication Foundation Erection of Structure Finishing Building Utilities [UTILITY FACILITIES] [PLANT] Preparatory Work Procurement/Manufacturing Installation/Adjustment Test Run (Total 12.0 months)												
Phase 3	Detailed Design	Site Survey Work in Japan (Total 2.0 months)												
	Construction	[REFRIGERATION BUILDING] Preparatory Work Shop Fabrication Foundation Erection of Structure Finishing Building Utilities [UTILITY FACILITIES] [PLANT] Preparatory Work Procurement/Manufacturing Installation/Adjustment Test Run (Total 8.0 months)												

4.4.6 Scope of Work

The responsibility for performance of the works by the two Governments shall be as follows:

Responsibility of the Japanese Side

Civil Works for the Fishing Port

- Breakwater and Groins
- Dredging of Navigation Channel and Anchorage
- Construction of Quays
- Construction of Revetment
- Causeway Construction

Building Construction

- Refrigeration Building (incl. Office)

Utilities Construction

- Water Supply System
- Fuel Oil Facilities
- Electrical Distribution System
- Drainage System

Plant Construction

- Refrigeration Plant
- Cold Storage
- Ice Making Plant
- Ice Storage Facility
- Electric Generating Plant
- Project Equipment Supply

Responsibility of the Maldives Side

- Provide the land for this project
- Removal of all obstacles presently on the project site
- Provide telephone lines (2 lines) during the construction period

- Landing of imported materials, clearing customs, the fast movement of materials, duty-free import procedures of materials
- Obtain permits for construction and materials (incl. coral/sand borrow pit) and all necessary licenses
- The supply of fuel oils required for construction
- Duty free entry of Japanese citizens authorized under the contract, and tax exemption for their possessions and taxes.
- The issue of entry and residence permits for authorized Japanese citizens entering Maldives under the contract to perform the work.
- The payment of all expense required for the project (to exclude expenses under the Japanese Grant-Aid Agreement)

Chapter 5 Project Evaluation and Conclusion

Chapter 5 Project Evaluation and Conclusion

5.1 The effects of the Project

The fishing industry is the largest and the only export industry undertaken by the Maldives people. This project will through its implementation bring to the fishermen, the local residents, the STO, and the National level the following effects.

(1) The Fishermen

- Due to the lack of capacity of the refrigerated mother boats, there has been a limit to the quantity of fish that could be purchased from the fishermen during, the good season. If this project is implemented, the fish can be purchased even if the capacity of the plant is exceeded, since the excees quantities can be temporarily stored in ice, and all the fish caught by the fishermen can be purchased by STO. The prices of fish is fixed and so if more fish is purchased it will mean more income for the fishermen.

- The STO will be able to expand their export market, and the expense of the fleet will be reduced. This will result in the purchase price to be raised, and mean more income for the fishermen.

- The fishermen will be able to land their catch directly, and the collector boats can be dispatched to the neighboring atolls to purchase more fish and activate the fishing industry. The expansion of the fishing industry will help to invigorate the fishermen in the outlying areas.

- With the increase in the income, the fishing boats will expand their sphere of activity and result in efficient fishing, to create more fishing by the fishermen.

- The purchase by the STO is the only means to ship the fresh fish. The fishermen would rather sell the fish for cash than to process

the fish to salt-dry, and will become an incentive to the young fishermen to increase their catch.

- The classical method of processing (smoking & salt-dry) is very labor intensive and large catch of fish comet be processed. Drying the fish requires firewood and salt, and requires large amounts of labor, and the market is very limited and the STO is not actively collecting the dried fish, and so there is very little incentive to process dried fish.

(2) The Fishermen in the Outlying Districts

- With the construction of the fishing port, the movement of goods will become more active, and the development of the outlying districts will be activated. The project site has been marked for development, and there is a fish procuring plant planned togher with other industries. This will open the way for more employment for the people in this district and help to increase their income.

- The increase in the area to accept more fish and increase the purchased amounts, will lead to a stable fish purchase program and help to develop the outlying areas.

(3) The State Trading Organization (STO)

- Will be able to purchase and refrigerate more fish by the mother boats at a lower cost.

- The operating personnel of the refrigerated mother boats are required to work for long periods of time and the work is hard, and it is difficult to keep the people. If their work can be performed on land, it will induce more people to apply for work.

- The export market will expand, and help to reduce the fleet cost.

- It will be possible to assign the refrigerated mother boasts presently assigned at the Laamu Atolls to other islands and activate the fishermen, and thereby increase the fish catch.

- The quality of the fish procured can be improved at the new plant.

(4) The National Level

- With the increase in the sphere of activity of the fishing boats, the total fish catch will be increased. The refrigerated facilities, and the plant facilities will be further developed, and increase the fish catch, and result in efficient utilization of resources.

- Expended markets and efficient utilization of resources will result in increase in the National revenue.

- The trend of the population to concentrate in the capital city will be reduced which has been very large compared to the outlying directs, and will result in increased employment.

- There will be room for development in the natural resources.

5.2 A Word of Advice

The following word of advice is made to make this project more effective.

(1) In accordance with the Minutes of Discussions dated March 6, 1991, the Government of Maldives should procure the necessary handling facilities such as forklifts, fish container, mobile crane, working boats etc. prior to the completion of the Project.

(2) In order to make the operation and control of the port facilities, and the refrigerated storage facilities, it is recommended to set up an overall operation and management organization immediately. Establish a personnel planning chart for the refrigerated facilities, and to assign them to the site during the construction phase so that they could because acquainted with the facility and the electrical/mechanical equipment. This will simplify the problems of future maintenance monitoring to other similar cases.

(3) To make it more convenient to the fishermen and residents, it is proposed to establish a supply depot with fishing tackle, boat gear, food supplies, and daily necessities at the fishing ports, so that they

could take there back after they have landed their catch, and make the port an attractive place for the fishermen.

(4) Establish a regular purchase schedule for the Collector Boat, and to try to purchase as much fish as possible for the effective use of the facilities.

5.3 Conclusion

This project is expected to have far reaching effects and help to develop the fishing industry and improve the livlihood of the fishermen, and fully justifies the Grant-Aid Program. The operation and management for this project has been assigned with the necessary organization, personnel and funding by the Implementing Agency.

Appendix

Appendix 1. Member List of Survey Team

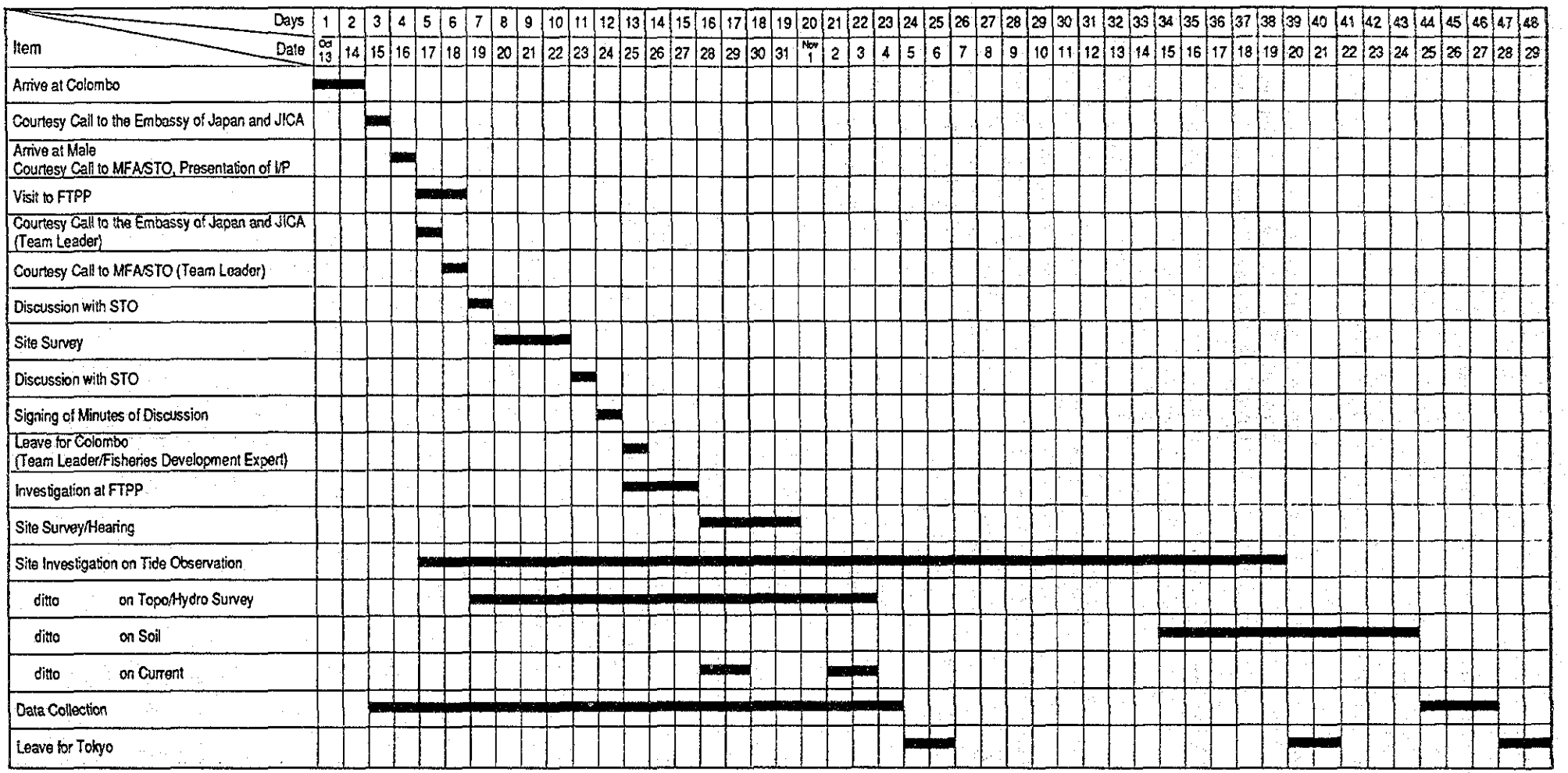
Site Survey Mission (October 13 - November 29, 1990)

Mr. Shiny NAKAI	(Team Leader)	Director, Second Basic Design Study Division Grant Aid Study & Design Development Japan International Cooperation Agency (JICA)
Mr. Tomomasa KAGEYAMA	(Fisheries Development)	Deputy Director, Planning Division, Fishing Port Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries
Mr. Sadao ORISHIMO	(Fishing Port Planning)	PACIFIC CONSULTANTS INTERNATIONAL
Mr. Katsuhiko TAKAHASHI	(Port Structure Design)	PACIFIC CONSULTANTS INTERNATIONAL
Mr. Mutsumi ITO	(Ice Plant/Cold Storage Design)	PACIFIC CONSULTANTS INTERNATIONAL
Mr. Kazumi IIDA	(Fisheries and Marketing)	PACIFIC CONSULTANTS INTERNATIONAL
Mr. Jun YAMAUCHI	(Topographic/Hydrographic Survey)	PACIFIC CONSULTANTS INTERNATIONAL

Draft Report Explanation Mission (February 26 - March 10, 1991)

Mr. Shinya NAKAI	(Team Leader)	Director, Second Basic Design Study Division Grant Aid Study & Design Development Japan International Cooperation Agency (JICA)
Mr. Motohumi MANABE KAGEYAMA	(Fisheries Development)	Manager, Planning Division, Fishing Port Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries
Mr. Sadao ORISHIMO	(Fishing Port Planning)	PACIFIC CONSULTANTS INTERNATIONAL
Mr. Katsuhiko TAKAHASHI	(Port Structure Design)	PACIFIC CONSULTANTS INTERNATIONAL
Mr. Mutsumi ITO	(Ice Plant/Cold Storage Design)	PACIFIC CONSULTANTS INTERNATIONAL

Appendix 2. Suryey Schedule (First Mission : October 13 - November 29 1990)



Appendix 2. Second Mission (February 26 to March 10, 1991)

Days	Date	Itinerary	Job Description
01	2/26(Tu)	Narita-Bangkok (TG641)	Leave for Colombo
02	27(We)	Bangkok-Colombo (TG307)	Transfer (Consultants)
03	28(Th)	Colombo-Male (UL101)	Courtesy Call to JICA Colombo Office
04	3/ 1(Fr)	Male	Internal Meeting
05	2(Sa)	Narita-Male Male	Leave for Male (Government Officials) Explanation of Draft Report to State Trading Organization
06	3(Su)	Male	Explanation of Draft Report to Ministry of Foreign Affairs and State Trading Organization
07	4(Mo)	Male	Discussions on Draft Report with Maldivian Officials Concerned
08	5(Tu)	Male	Discussions on Draft Report with Maldivian Officials Concerned Courtesy Call to UNDP Representive
09	6(We)	Male	Signing of Minutes of Discussions

Days	Date	Itinerary	Job Description
10	7(Th)	Male-Colombo (UL102)	Leave for Colombo (Government Officials)
11	8(Fr)	Colombo	Courtesy Call to Embassy of Japan and JICA (Government Officials)
		Male	Data Collection/Discussions with STO (Consultants)
12	9(Sa)	Colombo-Singapore (SQ401) Singapore-Narita (JL712)	Leave for Narita (Government Officials)
		Male-Singapore (SQ033)	Leave for Narita (Consultants)
13	10(Su)	Singapore-Narita (SQ012)	

Appendix 3. Member List of Concerning Parties in Maldives

FIRST MISSION (October 13 to November 29, 1990)

MALDIVIAN SIDE

Ministry of Foreign Affairs:MFA

Mr. Mohamed Shihab	Director, Department of External Resources (DER) Ministry of Foreign Affairs (MFA)
Mr. Ali Rilwan	English Secretary, DER

State Trading Organization:STO

Mr. Ibrahim Shakeer	Director

Fisheries Projects Implementation Department:FPID

Mr. Mohamed Maniku	Deputy Director
Mr. Hassan Haleem	Assistant Director
Mr. Ibrahim Waseem	Manager
Mr. Adnan Ali	Technical and Operation Department
Mr. Abdul Sattar Moosa	Assistant Manager
Mr. Hussain Zameel	Asst. Personnel Officer
Mr. Edwardo S. Estoque	Management Consultant
Mr. Randy Jose	Technical Consultant

Felivaru Tuna Processing Plant:FTPP

Mr. Abdul Fathah Hussain	Sr. Engineering Manager
Mr. Bill Burns	Engineering and Maintenance Manager
Mr. Edward Townsend	Production Manager

Ministry of Fisheries and Agriculture:MFAG

Mr. Jadullah Jameel	Director of Planning and Coordination
Mr. Ali Naeem	

Ministry of Public Works and Labour:MPWL

Mr. Abdulla Shakeeb	Asst. Under-secretary
Mr. Adam Saleem	Director Maldives Transport and Contracting Co. Ltd.

Ministry of Education

Mr. Abdul Ghanee	Deputy Director Vocational Training Centre

Department of Meteorology

Mr. Abdullahi Majeed	Director
Mr. Ali Shareef	Asst. Forecaster

Ministry of Atoll Administration

Mr. Moosa Hassan	Senior Under-secretary

Atoll Office

Mr. Ali Moosa	Atool Chief of Lhaviyani
Mr. Abdul Raheem A. Majeed	Atoll Chief of Meemu
Mr. Mohamed Adam	Island Chief of Diggaru
Mr. Ibrahim Maniku Dhon M.	Atoll Chief of Thaa
Mr. Ibrahim Rasheed	Vice Atoll Chief of Thaa
Mr. Mohamed Abdulla	Asst. Atoll Chief of Laamu
Mr. Mohamed Jameel	Island Chief of Mabaidhoo
Mr. Abdulah Waheed	Island Chief of Maamenghoo
Mr. Achmed Hussain Fulhu	Island Chief of Mundoo

JAPAN SIDE

Mr. Yoshio Kanzaki	Second Secretary of Japanese Embassy in Sri Lanka
Mr. Hideo Yasuki	Resident Representative of JICA in Sri Lanka
Mr. Hiroshi Niinou	Representative
Mr. Isaku Yuki	Coordinator of JOCV in Maldives, JICA
Mr. Tadao Ozaki	Captain of REMOARA 1

SECOND MISSION (February 26 to March 10, 1991)

MALDIVIAN SIDE

Ministry of Foreign Affairs:MFA

Mr. Mohamed Shihab	Director, Department of External Resources (Ministry of Foreign Affairs (MFA)
Mr. Mohamed Naseer	Secretary, DER

State Trading Organization:STO

Mr. Ibrahim Shakeeb	Director

Fisheries Projects Implementation Department:FPID

Mr. Mohamed Maniku	Deputy Director
Mr. Hassan Haleem	Assistant Director
Mr. Ibrahim Waseem	Manager
Mr. Adnan Ali	Technical and Operation Department

Ministry of Public Works and Labour:MPWL

Mr. Maizan Ibrahim Maniku	Director of Public Works
Mr. Hussain Zahir	

Ministry of Planning and Environment:MPE

Mr. Mohamed Saeed
Mr. Hussain Shihab

United Nations Development Program

Mr. Youssef M. Rashad	Deputy Resident Representative

JAPAN SIDE

Dr. Kubota	Second Secretary of Japanese Embassy in Sri Lanka
Mr. Hideo Yasuki	Resident Representative of JICA in Sri Lanka
Mr. Hiroshi Niinou	Representative
Mr. Isaku Yuki	Coordinator of JOCV in Maldives, JICA

MINUTES OF DISCUSSION
OF
THE BASIC DESIGN STUDY
ON THE PROJECT FOR COASTAL FISHERIES PROMOTION
IN THE REPUBLIC OF MALDIVES

In response to the request of the Goverment of the Republic of Maldives , the Goverment of Japan decided to conduct a basic design study (the Study) on the Project for Coastal Fisheries Promotion and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Republic of Maldives the Study Team headed by Mr. Shinya NAKAI, Director for Second Basic Design Study Division, Grant Aid Design and Study Department, JICA, from October 13 to 25, 1990. The Team had a series of discussions on the Project with the officals concerened officials of the Government of Maldives and conducted field survey.

As a result of the discussions, both parties agreed the fundamental factors for conducting the Study as attached herewith.

Male', October 24, 1990.

Shinya Nakai
Leader,
Basic Design Study Team
Japan International
Cooperation Agency (JICA)
JAPAN

Mohamed Shihab
Director of External Resources
Ministry of Foreign Affairs
Republic of Maldives

ATTACHMENT

1. Definition of the Project

The Project is composed of following two (2) components:

1. Infrastructure
2. Refrigeration Complex

2. Objective of the Project

The objective of the Project is to promote the coastal fisheries in the southern area which covers Laamu, Thaa, Meemu and Dhaalu Atoll through the establishment of the most appropriate fishery related facilities to be recommended by the Study.

3. Organization

Executing Agency: Ministry of Foreign Affairs (MFA)
Implementing Agency: State Trading Organization (STO)

4. Project site

The site of the Project is located at the Maandhu Island in Laamu Atoll as shown in ANNEX - 1.

5. Major items requested by the Government of Maldives for the Project

The outline of the facilities and major equipments is shown in the ANNEX - 2

6. Japan 's Grant Aid Program

The Goverment of Maldives has understood the system of Japn's Grant Aid Program explained by the Team, which includes a principle and the role of the Japanese consultants and Japanese firms for the implementation of the Project.

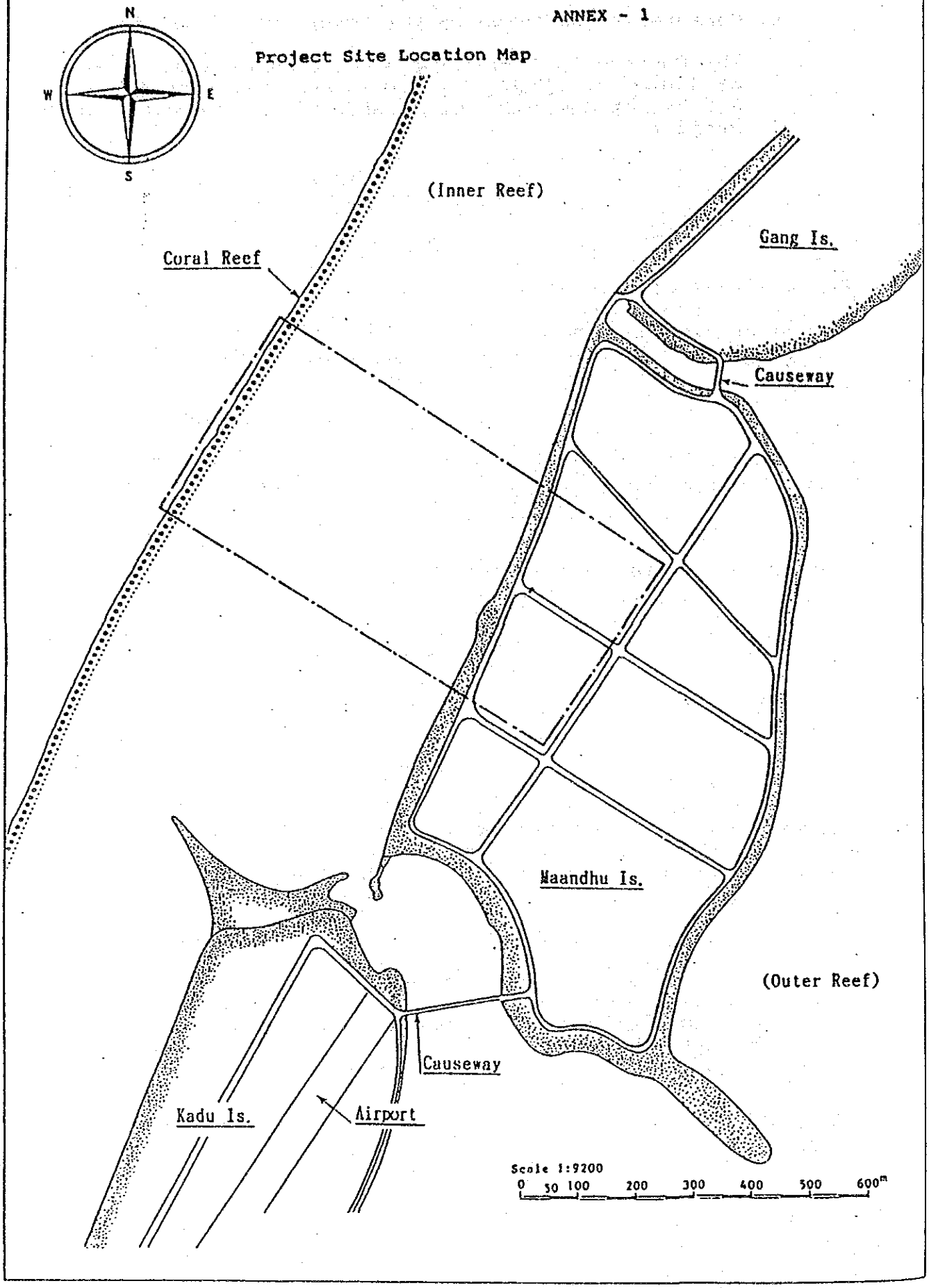
7. Provision of Necessary Buduget and Personnel

The Goverment of Maldives will assure the necessary budget and perssonel for the operation and maintance of the facilities and equipment provided, on condition that the Grant Aid by the Goverment of Japan is extended to the Project.

8. Measures to be taken by the Goverment of Maldives

The Goverment of Maldives will take necessary measures as listed in ANNEX - 3 , on condition that the Grant Aid by the Goverment of Japan would be extended to the Project.

ANNEX - 1


Project Site Location Map
N
W
E
S
(Inner Reef)
Coral Reef
Gang Is.
Causeway
Maandhu Is.
(Outer Reef)
Causeway
Kadu Is.
Airport
Scale 1:9200
0 50 100 200 300 400 500 600m

ANNEX - 2

Request made by the Gvoerment of Maldives

1. Infrastructure

   - Wharf
   - Breakwater
   - Channel

2. Refrigration Facilities

   - Freezer
   - Cold Storage
   - Ice Plant/Storage
   - Power Supply
   - Water Supply
   - Administration Office

3. Others
   - Fish Handling Equipment
   - Fuel Oil Supply Facility for Fishing Boats
   - Working Boat.

ANNEX - 3

Necessary measures to be taken by the Goverment of Maldives:

1. To secure the site for the Project.

2. To clear and reclaim the site prior to the commencement of the construction work.

3. To ensure prompt unloading ,tax exemption and customs clearance of the Project goods at the port and/or airport of disembarkation in the Maldives.

4. To accord Japanese national whose services may be required in connection with the supply of the products and the services under the verfied contracts such facilities as may be necessary for their entry into the Republic of Maldives and stay therein for the performance of their work.

5. To exempt Japanese national from customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Maldives with respect to the supply of the products and services under the verified contracts.

6. To maintain and use properly and effectively the facilities constructed and the equipment provided under the Grant Aid.

7. To bear all the expenses other than those to be borne by the Grant Aid necessary for the execution of the Project.

MINUTES OF DISCUSSIONS
THE BASIC DESIGN STUDY
ON THE PROJECT FOR COASTAL FISHERIES PROMOTION
IN THE REPUBLIC OF MALDIVES

In October 1990, the Japan International Cooperation Agency (JICA) dispatched the Basic Design Study Team on the Project for Coastal Fisheries Promotion (the Project), and through a series of discussions, field survey and technical examination of the results in Japan, has designed the appropriate plan for the Project and prepared the Draft Report of the Basic Design Study.

In order to explain and to consult on the contents of the Draft Report, JICA sent a team, headed by Mr. Shinya NAKAI, Director of the Second Basic Design Study Division, Grant Aid Design and Study Department, JICA, from March 2nd to 9th, 1991.

As a result of the discussions and field survey, both parties confirmed the main items described on the Attachment.

Male', March 6, 1991

Mr. Shinya Nakai
Team Leader
Draft Report Explanation Team
Japan International
Cooperation Agency (JICA)
Japan

Mr. Mohamed Shihab
Director of External Resources
Ministry of Foreign Affairs
Republic of Maldives

ATTACHMENT

1. Contents of Draft Report

The Government of Maldives has agreed and accepted, in principle, the contents described in the Draft Report proposed by the Team.
However, the layout of the fishing port facilities and the capacity of the refrigeration facilities are modified as follows.

(1) Layout of the fishing port facilities is shown in Annex-I by reason of easy fish handling .
(2) Capacity of the refrigeration facilities to be designed is 20 tons/day for Brine Freezer, 300 tons for Cold Storage, 5 tons/day for Ice Making Plant and 30 tons for Ice Storage for urgent requirement.
(3) The Government of Maldives intends to install an additional requirement of the Refrigeration Complex by its own effort for the next stage.

2. Fish Handling Equipment and Working Boat(s)

The Government of Maldives will procure the fish handling equipment such as forklifts, truck crane, fish containers, etc. and working boat(s) to be utilized for transportation of frozen fish to the reefer vessel.

3. Project Site

The Government of Maldives reconfirmed that the Maandhu Island has been selected as the Project Site through due governmental formality.

4. Project Implementation

The Government of Maldives assured to provide the personnel and the operation cost necessary for the implementation of the Project.

5. Environmental Aspects

The Government of Maldives confirmed that the construction including harbour dredging and the implementation of the Project are acceptable from the environmental point of view except for the coral mining.

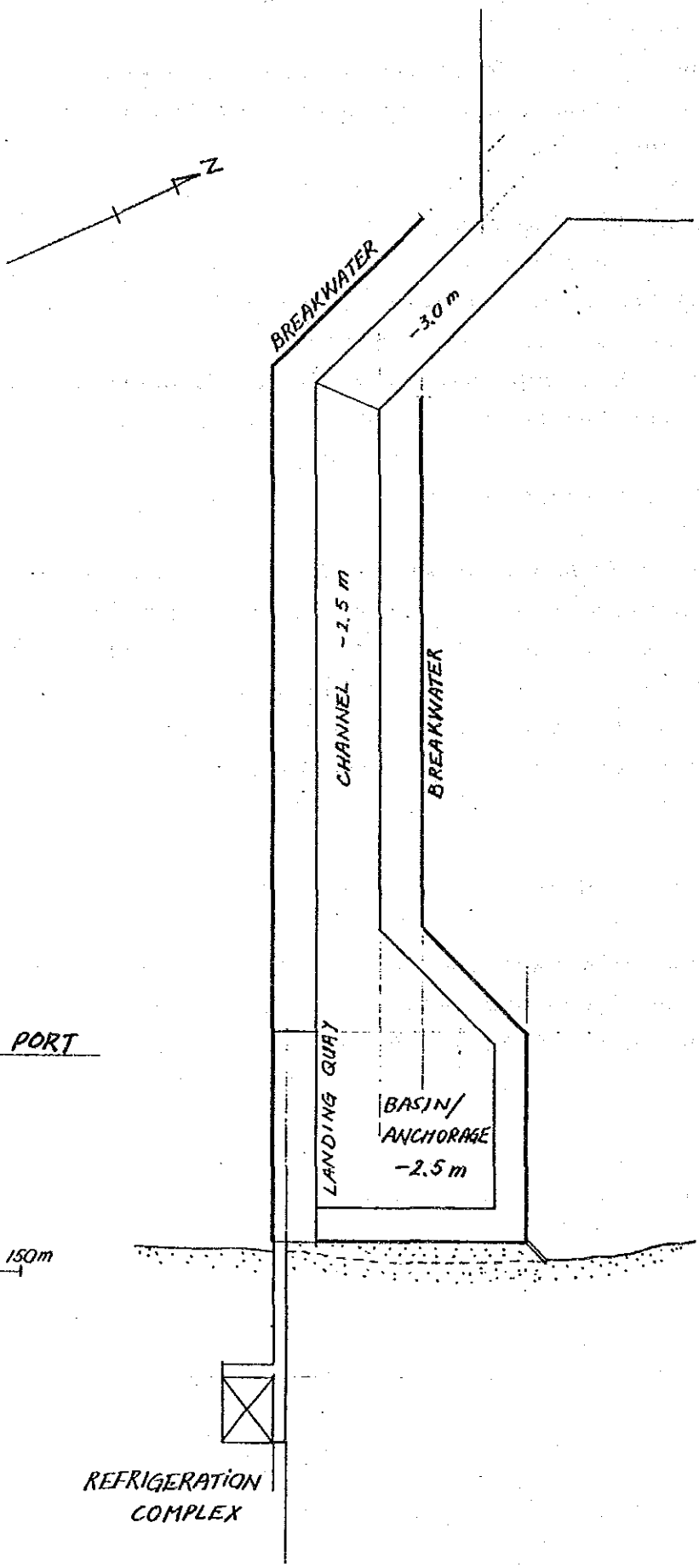
6. Japan's Grant Aid System

(1) The Government of Maldives has understood the system of Japanese Grant Aid explained by the Team.
(2) The Government of Maldives will take the necessary measures, described in Annex II, for smooth implementation of the Project on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

7. Further Schedule

The Team will make the Final Report in accordance with the confirmed items and send to the Government of Maldives by the beginning of July, 1991.

ANNEX I



LAYOUT OF FISHING PORT

0 50 100 150m

SCALE = 1 : 3,000

ANNEX II

Necessary measures to be taken by the Government of Maldives:

1. To secure the site for the Project.

2. To clear and reclaim the site prior to the commencement of the construction work.

3. To ensure prompt unloading, tax exemption and customs clearance of the Project goods at the port and/or airport of disembarkation.

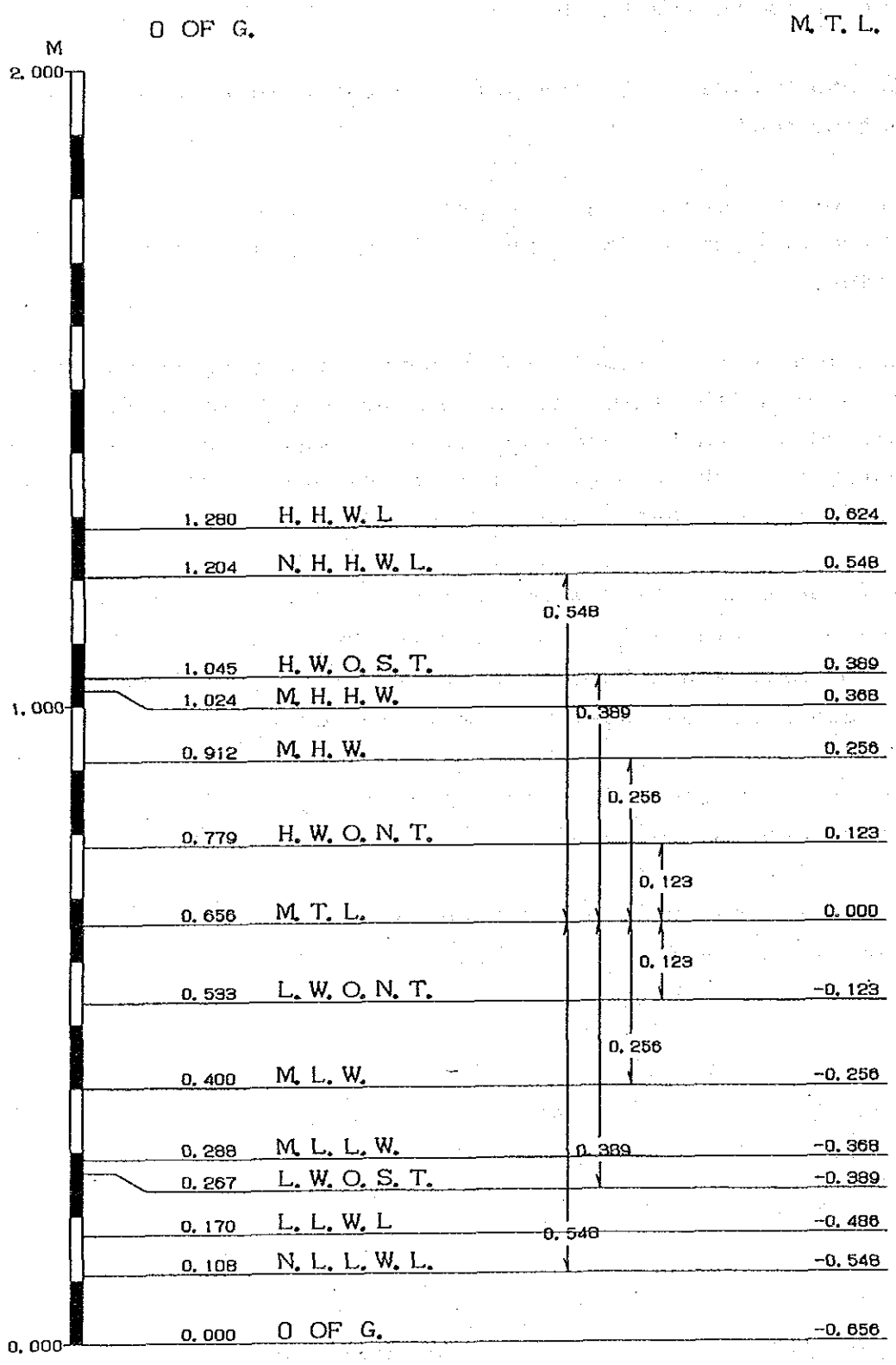
4. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such facilities as may be necessary for their entry into the Republic of Maldives and stay therein for the performance of their work.

5. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Maldives with respect to the supply of the products and services under the verified contracts.

6. To maintain and use properly and effectively the facilities constructed and the equipment provided under the Grant Aid.

7. To bear all the expenses other than those to be borne by the Grant Aid necessary for the execution of the Project.

Appendix 5.



TIDAL DIAGRAM AT Maldives

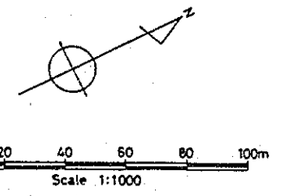
表　　潮汐１ケ月調和分解成果表

海　域：Maldives
測　点：Maandhu Island
緯　度：　1°　52'　　0" N
経　度：　73°　32'　　0" E
観測期間：1990年　10月　19日　～1990年　11月　19日
基準時：　-5.0時
基準面：C．D．L．
計算手法：１ケ月 T．I．法

分　潮	振　幅 (cm)	遅　角 (°)
Mm	1.8	291.1
MSf	1.9	345.3
Q1	1.4	71.1
O1	6.0	69.8
M1	0.2	75.7
K1	9.9	60.2
J1	0.8	76.8
OO1	0.6	56.9
P1	3.3	60.2
μ2	1.0	25.4
N2	3.7	10.0
ν2	0.7	10.0
M2	25.6	28.7
L2	2.0	51.3
S2	13.3	65.1

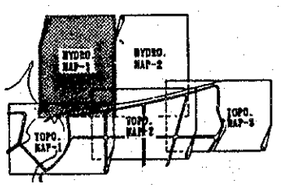
分　潮	振　幅 (cm)	遅　角 (°)
K2	3.6	65.1
2SM2	2.0	313.3
MO3	0.6	79.3
M3	0.5	91.1
MK3	0.7	63.6
MN4	0.4	317.6
M4	0.9	351.6
SN4	0.1	7.4
MS4	0.9	31.9
2MN6	0.2	102.9
M6	0.4	255.8
MSN6	0.2	239.4
2MS6	0.1	297.8
2SM6	0.2	275.8
A0	65.6	

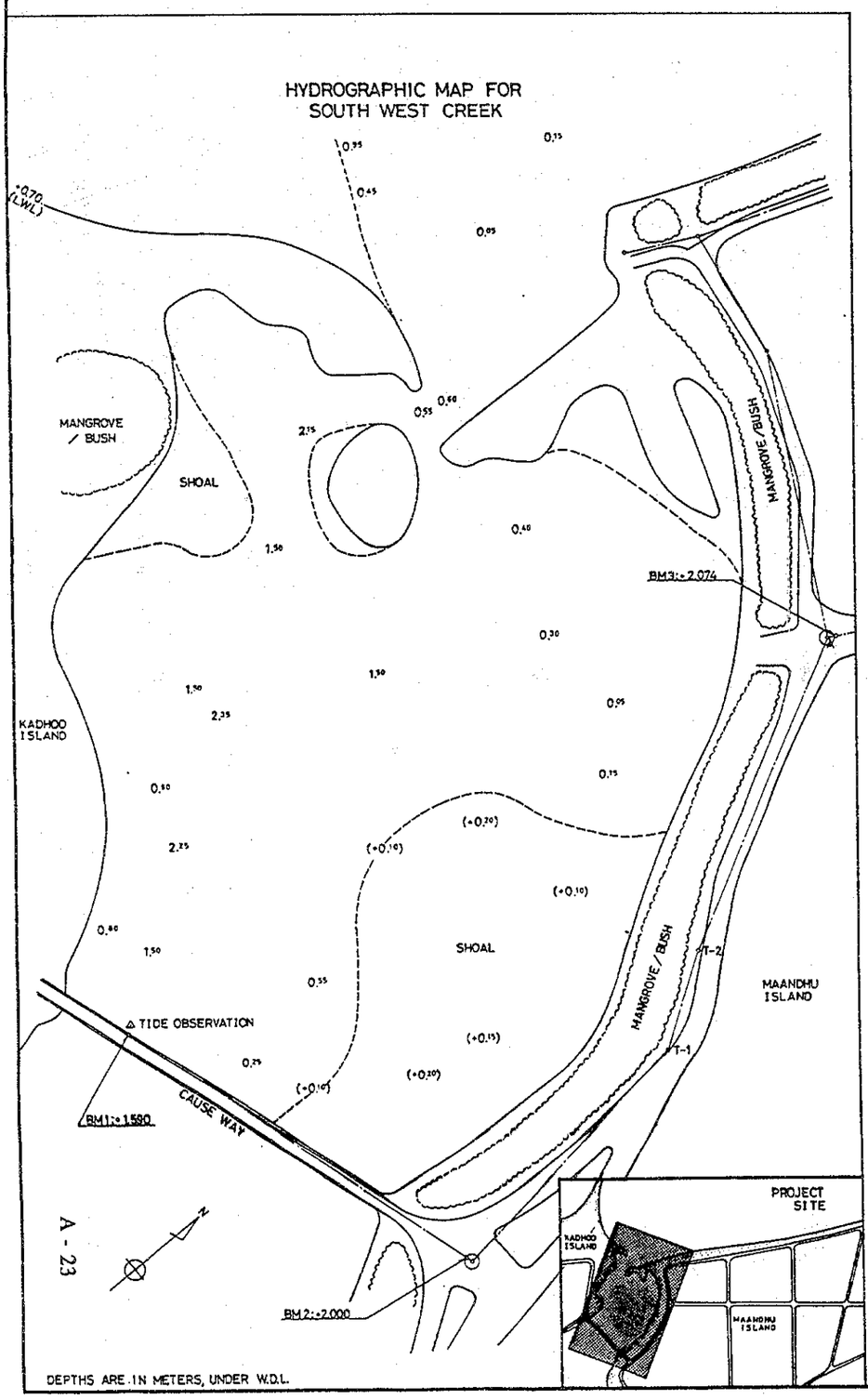
5－1　深浅測量図（その1）

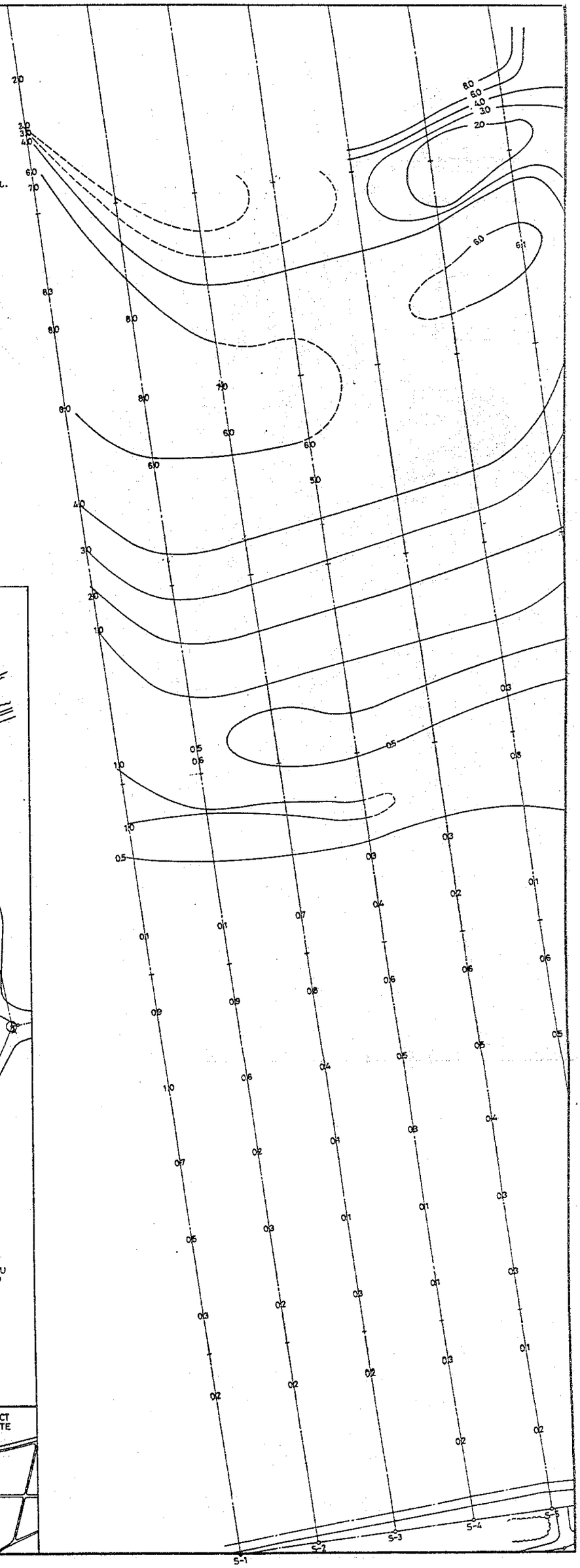


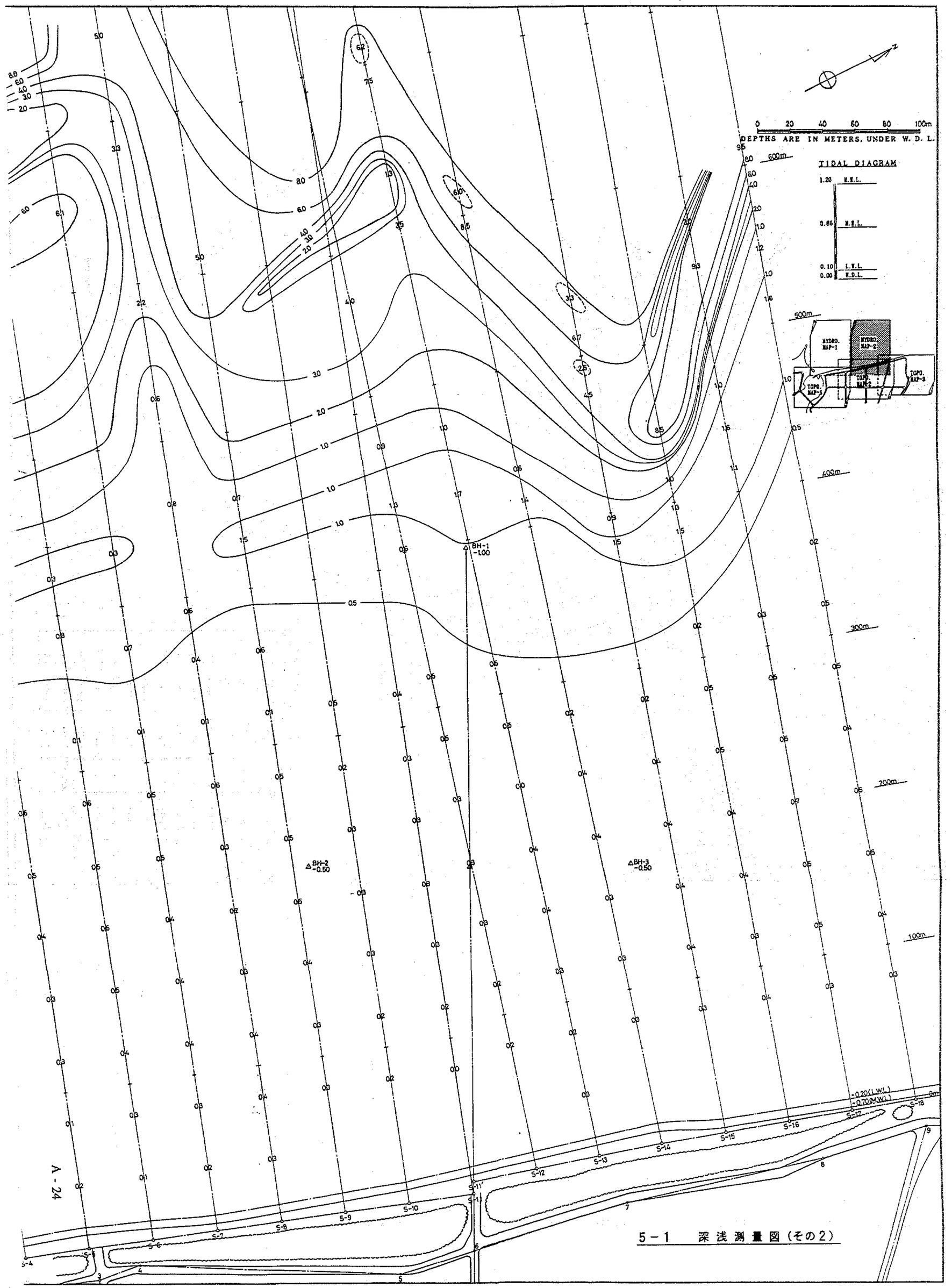
DEPTHS ARE IN METERS, UNDER W. D. L.

TIDAL DIAGRAM








0 20 40 60 80 100m
DEPTHS ARE IN METERS, UNDER W. D. L.
TIDAL DIAGRAM
1.20 H.W.L.
0.65 M.S.L.
0.10 L.W.L.
0.00 W.D.L.
HYDRO. MAP-1
HYDRO. MAP-2
TOPO. MAP-1
TOPO. MAP-2
TOPO. MAP-3
600m
500m
400m
300m
200m
100m
△BH-1 -1.00
△BH-2 -0.50
△BH-3 -0.50
-0.20(L.W.L.)
-0.70(M.W.L.)
S-1
S-4
S-5
S-6
S-7
S-8
S-9
S-10
S-11
S-11'
S-12
S-13
S-14
S-15
S-16
S-17
S-18
A - 24

5－1　深浅測量図（その2）

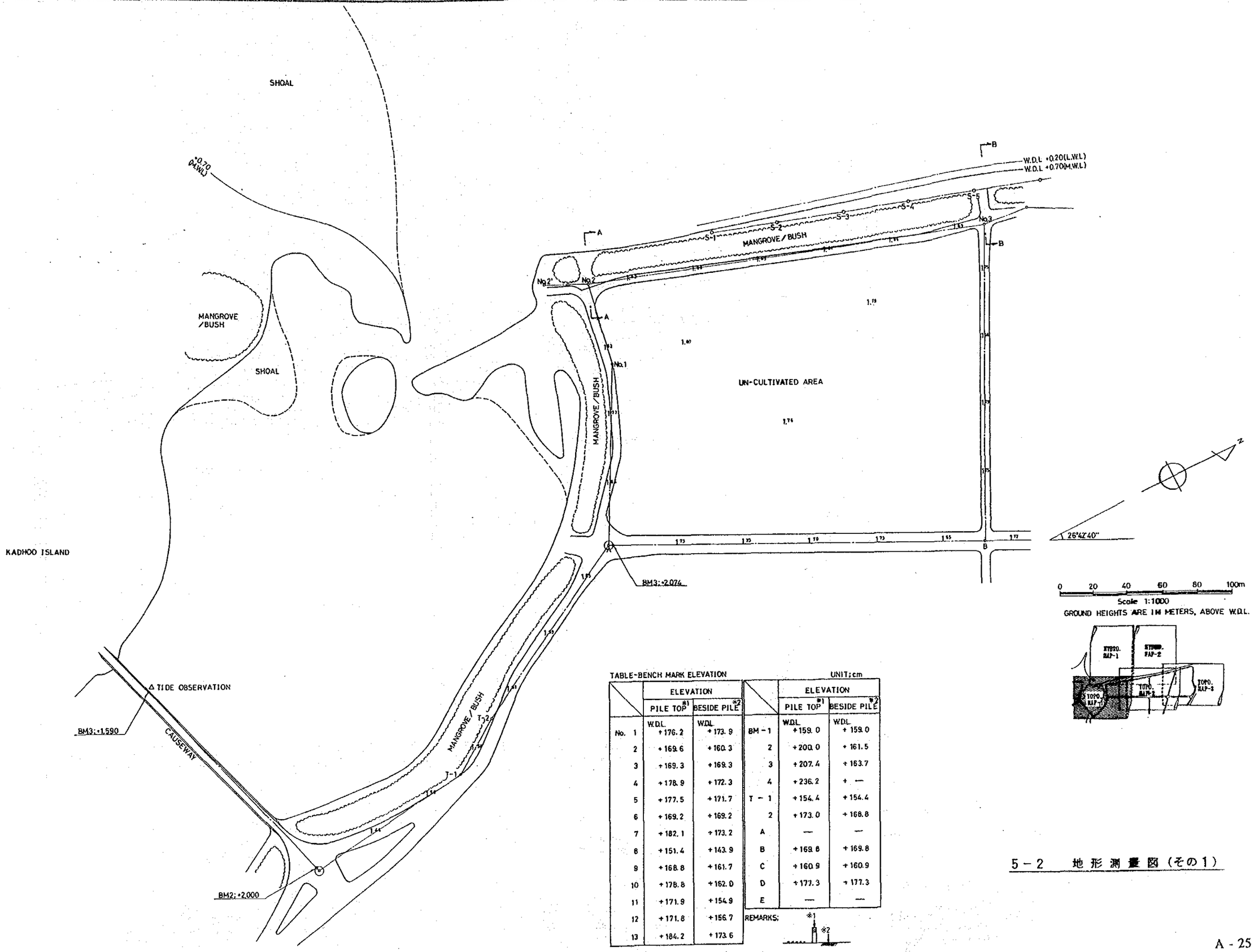


TABLE-BENCH MARK ELEVATION

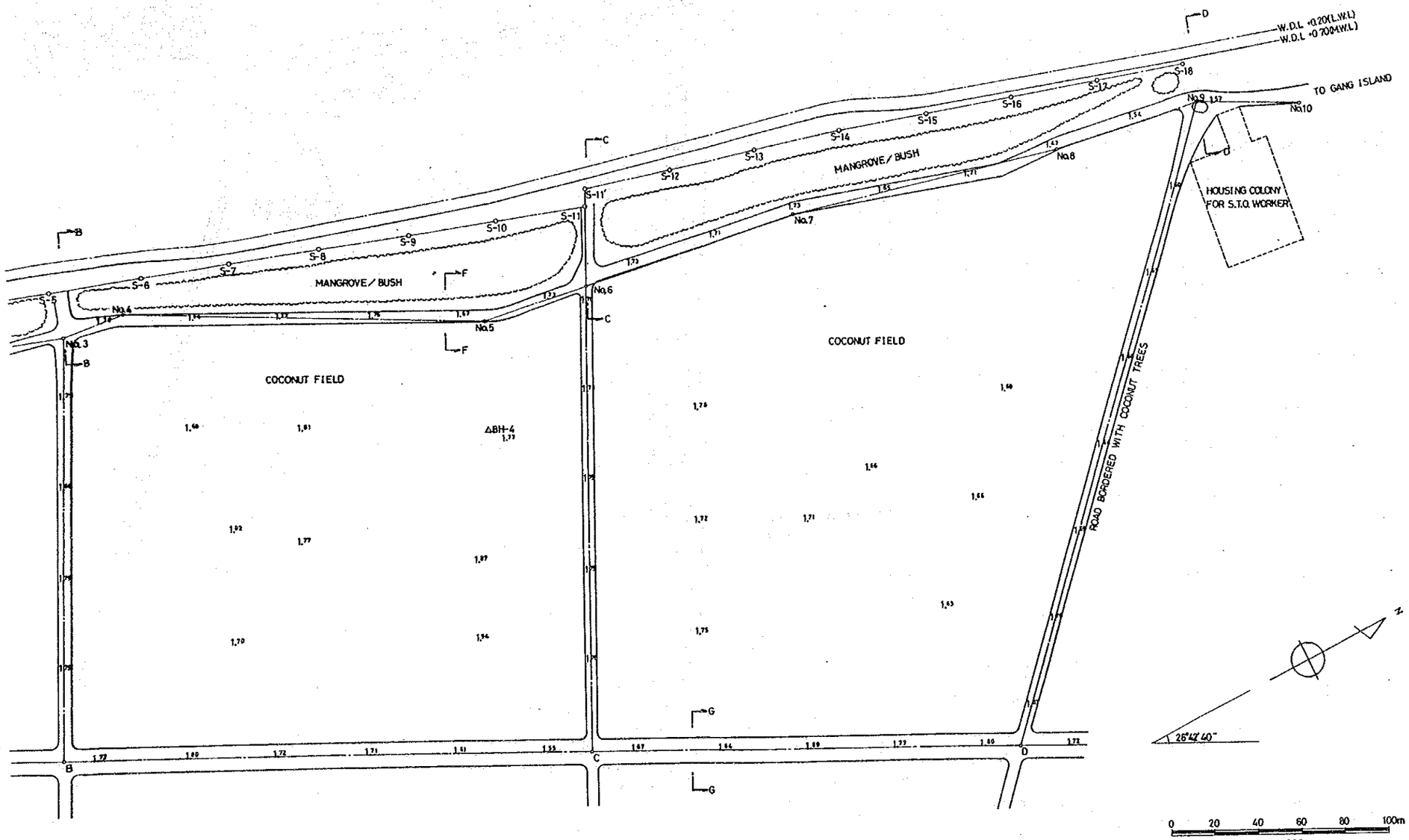
UNIT; cm

	ELEVATION	
	PILE TOP *1	BESIDE PILE *2
	W.D.L.	W.D.L.
No. 1	+176.2	+173.9
2	+169.6	+160.3
3	+169.3	+169.3
4	+178.9	+172.3
5	+177.5	+171.7
6	+169.2	+169.2
7	+182.1	+173.2
8	+151.4	+143.9
9	+168.8	+161.7
10	+178.8	+162.0
11	+171.9	+154.9
12	+171.8	+156.7
13	+184.2	+173.6

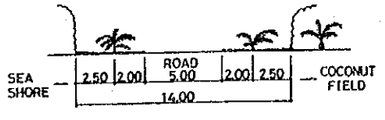
	ELEVATION	
	PILE TOP *1	BESIDE PILE *2
	W.D.L.	W.D.L.
BM-1	+159.0	+159.0
2	+200.0	+161.5
3	+207.4	+163.7
4	+236.2	+ —
T-1	+154.4	+154.4
2	+173.0	+168.8
A	—	—
B	+168.8	+169.8
C	+160.9	+160.9
D	+177.3	+177.3
E	—	—

REMARKS: *1 *2

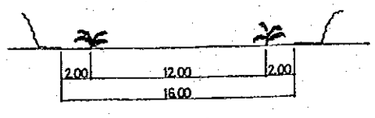
5-2 地形測量図（その1）

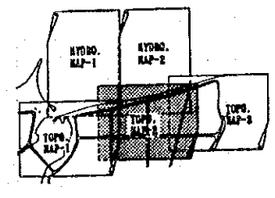


SECTION F-F
(COASTAL ROAD)

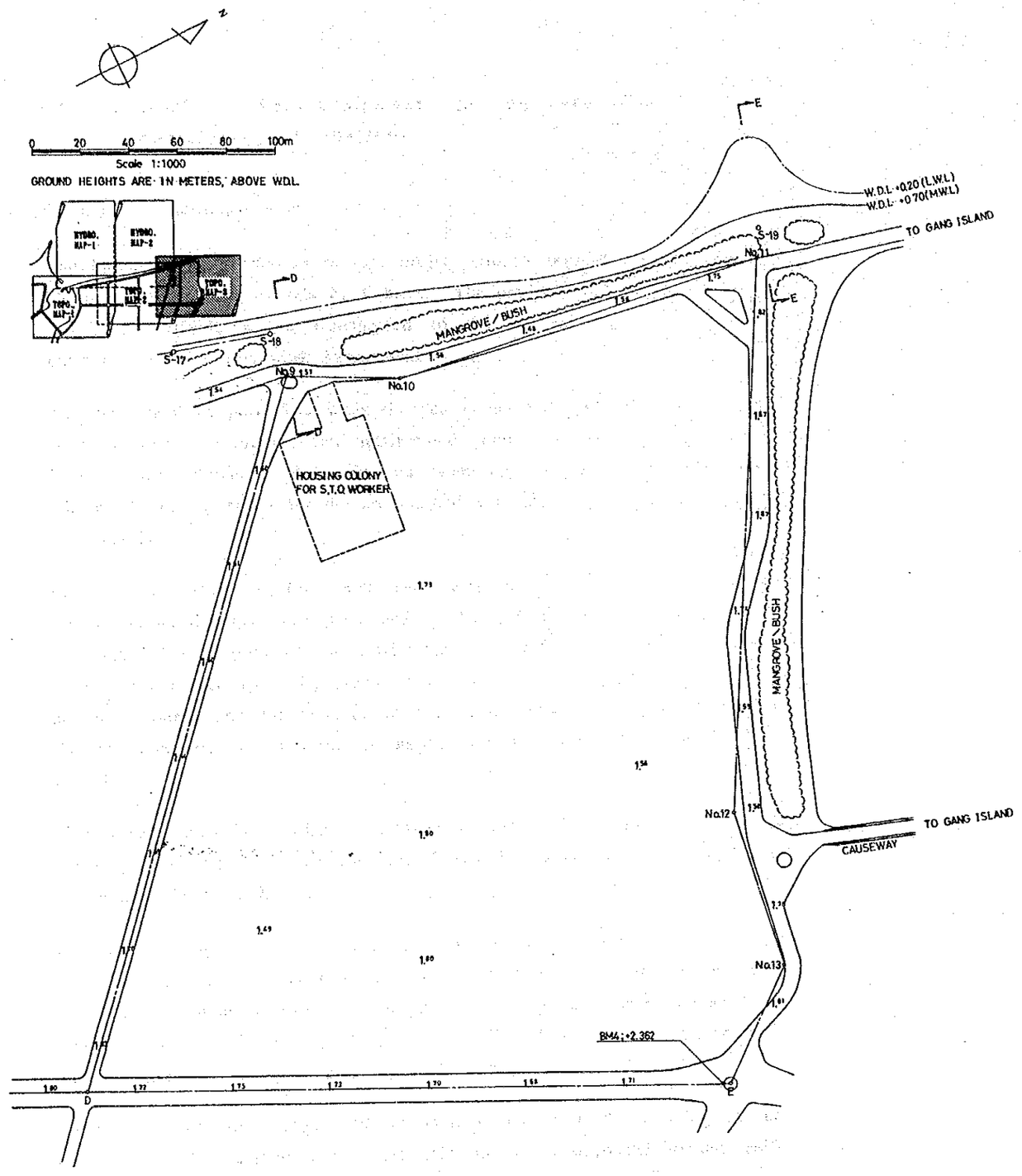


SECTION G-G
(CENTER ROAD)



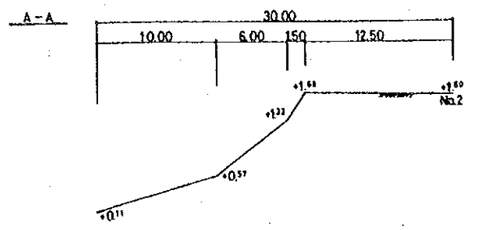


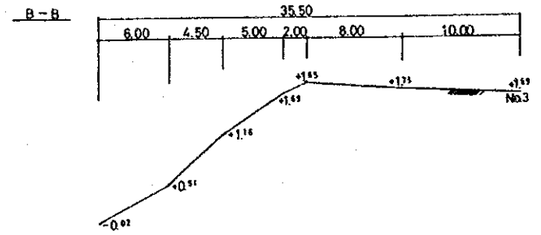
5－2　地形測量図（その2）

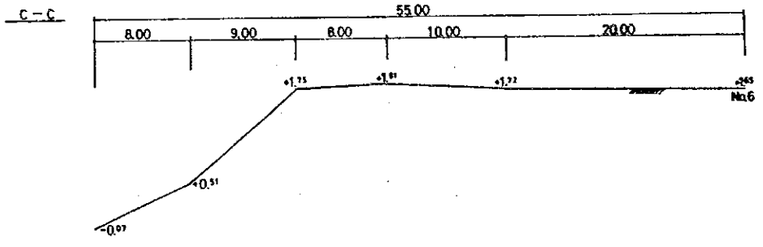


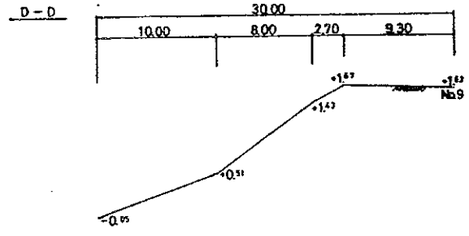
CROSS SECTION OF COASTAL LINE

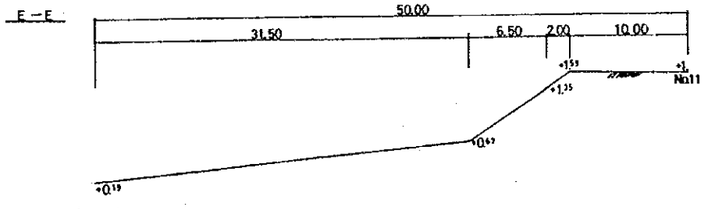
Scale H; 1:250
V; 1:400











5－2　地形測量図（その3）

Appendix 6. Working Boat/Equipment to be provided by the Government of Maldives

Appendix 6-1 Working Boat

The loading of the products of this project (frozen skipjack) will be loaded on to the ocean-going vessels by lighters. The products will be loaded on to the barges (lighters) and transported to the refrigerated vessels in the outer harbor. For this work barges will be used.

This work will be performed when the sun is not at its hottest such as after sundown since the products are refrigerated goods. It will be necessary to load at least 150tons in one night, and when this cannot be performed there will be a penalty posed for demurrage, and will affect the future charter of the vessels.

In the past the transfer from the refrigerated mother boat to the refrigerated carrier has been performed at the rate of about 200tons in 7 to 8 hours. The transfer of the refrigerated products to the vessels will be more difficult than from the mother boats to the vessels since the products are refrigerated, and the transfer of the goods must be performed in the shortest time possible to store the goods into the holds of the refrigerated vessels.

This project must be capable of transferring the same amount of goods as presently performed, and be capable of handling approximately 200tons in one night (about 12 hours).

In order to keep the hauling time from the refrigerated storage to the hold of the carrier vessel as short as possible, it is planned, rather than to haul, the largest volume possible at one time, to haul a smaller quantity in several trips. It will be kept to a load of about 30tons, in 7 trips using 2 barges alternately as follows.

Rather than tow the barges with tugboats which make the docking at the dock side and alongside the vessel difficult, it is proposed to use self-propelled barges for efficient handling.

Working Boat (Barge) 2 each

Steel hull, wood lined hold in compartmented holds

Self-propelled

Loading Capacity, Frozen skipjack , 30ton/boat

Design of Working Boats

These working boats will be designed to haul the frozen skipjack from the dockside to the refrigerated carrier vessels anchored at the outer harbor to act as barges. These working boats shall be sturdy and very stable boats.

The specifications shall be as follows:

Self Propelled Working Boat: 2 Each

Loading capacity: Refrigerated Skipjack, approx. 30ton

Construction: Steel

Dimensions: Overall length

approx.18m x Width approx.4m.

draft approx. 2.5m

Dim. of hold: Length approx.11m x Width approx.3.5m

Draft approx. 1.6.

Hold: Finished hold, all wood lined.

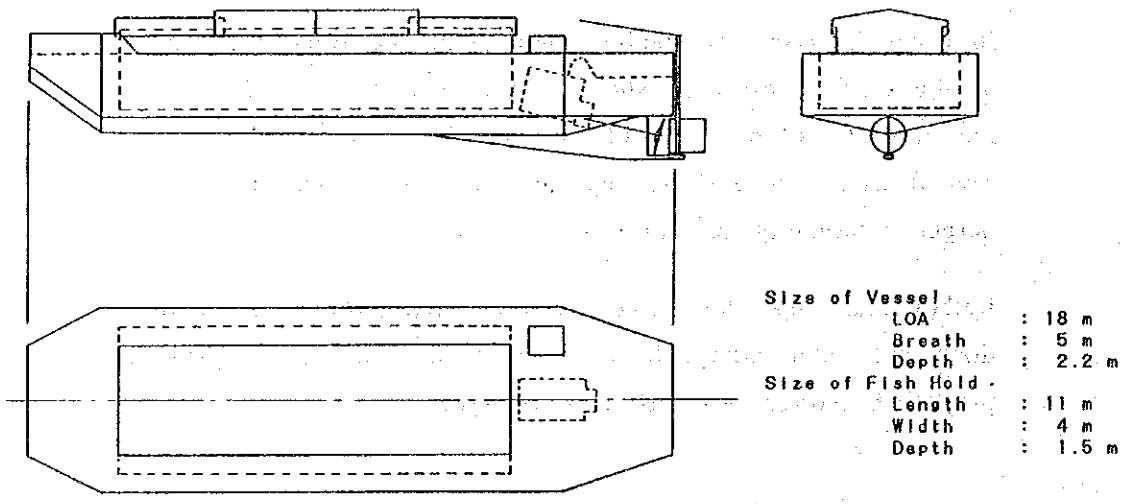
Hatch Cover: Steel, Sliding

Propulsion System: Inboard, marine diesel engine

Output, approx. 300Hp

Starting system, electric start

Steering System: Manual Steer



WORKING BOAT

Appendix 6-2 Equipment Planning

The smooth handling of the fish will be an important factor in the operation of this project. For this purpose, the efficient handling of the fish will be most important from the receipt of the fish to its refrigeration, storage, issue, and loading which requires smooth, fast and dependable handling by machine and equipment.

If the manpower was available, it would be an opportune time to hire more people. However, due to the fish catch which could exceed 30ton in one day, it is more than could be handled by manpower. The work is simple in nature and very dirty, requiring manual labor for which it is difficult to find the laborers. Labor is the key to this problem, and the flow of fish can be hung up by the lack of labor. In turn, this affects the freshness of the fish, and cause the quality to deteriorate.

For this reason, handling of each fish by hand is reduced, and this task is being replaced by efficient and speedy operations by the one of machines. From the receipt of the fish, the classification by size, and weighing, the units is transferred to a palettes (freezing container), and the hauling, the stacking in the refrigerating hold, storage, and shipping are all being mechanized. This mechanizing has been tried and being performed at the Felivaru Fish Processing Plant, and can be applied in this project.

The principal equipment will be the forklifts and cranes. The equipment will come to the fore at the time of shipping out of the procured fish, and is performed with the least amount of equipment.

The shipping out of the product will be 30ton per hour (of frozen skipjack) which will be loaded on barges, and the least amount of equipment is as follows:

Delivery and Loading on Ocean-Going Vessel

Loading Equipment	Amount of Work	No. of Equpt.
Electric Forklifts	Location of Work: Cold Storage & Front of Cold Storage Amount of Work : 30ton/hr Capacity of Work: 1ton/trip/4 min. 15 lifts per forklift (15ton)/hr	2 ea
Diesel Forklift, Articulated	Location of Work: Cold Storage & Front of Cold Storage Amount of Work : 30ton/hr Capacity of Work: 1ton/trip/6 min. 10 lifts per forklift (10ton)/hr	3 ea
Mobile Crane	Location of Work: Dock & Barge Amount of Work : 30ton/hr Capacity of Work: 2ton/trip/4 min. 15 lifts per crane (30ton)/hr	1 ea

The freight handling equipment for this project are planned as follows:

(1) Forklift

a) Forklift, Diesel-Engine Driven, Articulated 3 Each
Lifting capacity 2 ton (height of center-of-gravity 0.7m), Hoisting Height 3m

b) Forklift, Electric-Driven 2 Each
Lifting capacity 2 ton (height of center-of-gravity 0.7m), For use in cold storage space.

(2) Truck Crane 1 Each

Lifting Capacity approx, 2ton (when working radius 7m)

(3) Plastic Fish Container 100 Each

(4) Fish Container

Refrigerated Container, approx. 1 ton of skipjack 310 Each
Galvanized Steel Construction
Inside Dimension: Approx. 1.5m x 1.2m x 1.0m(h)

(5) Belt coveyor for Brine Freezer 1 Each

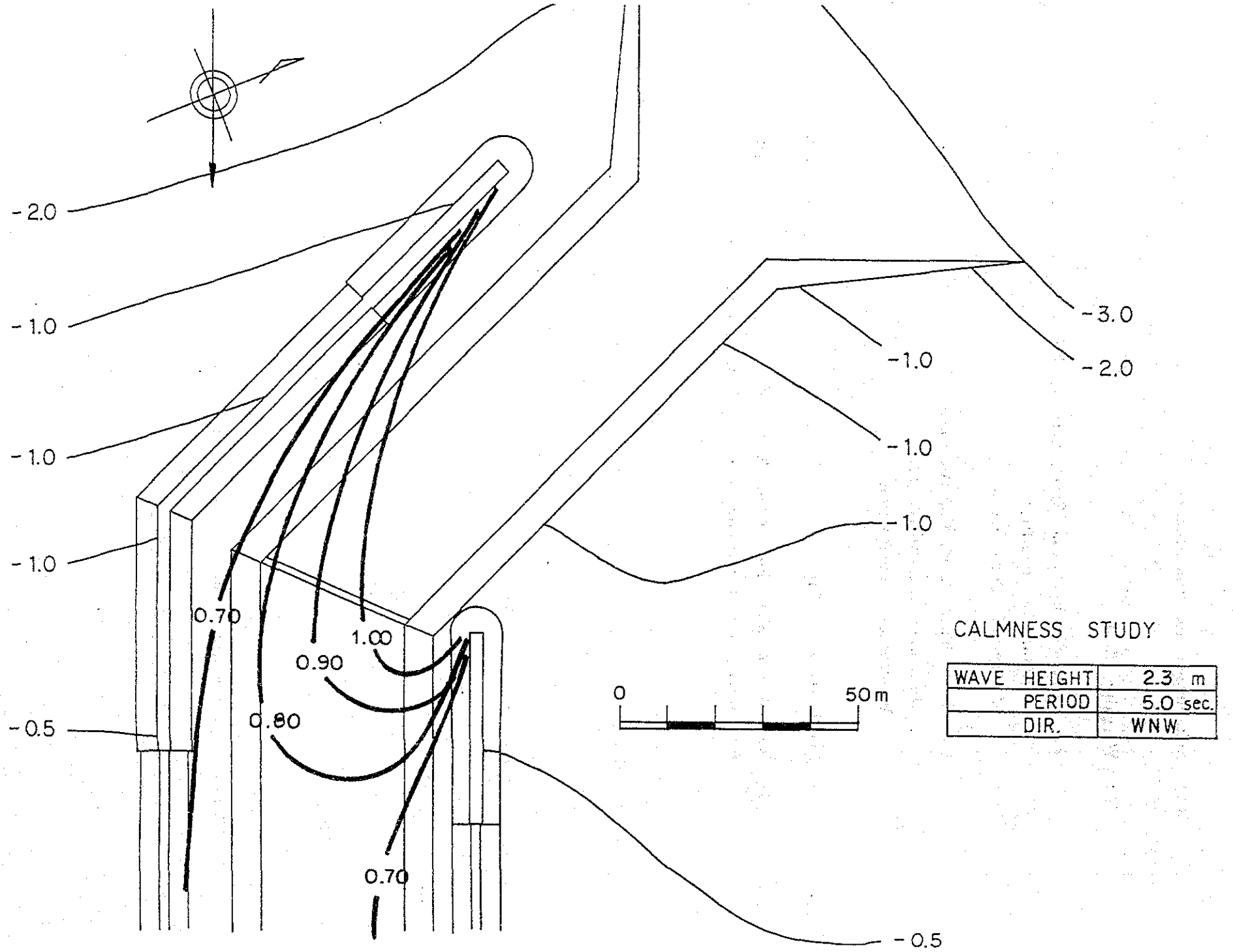
(6) Weighing Scale

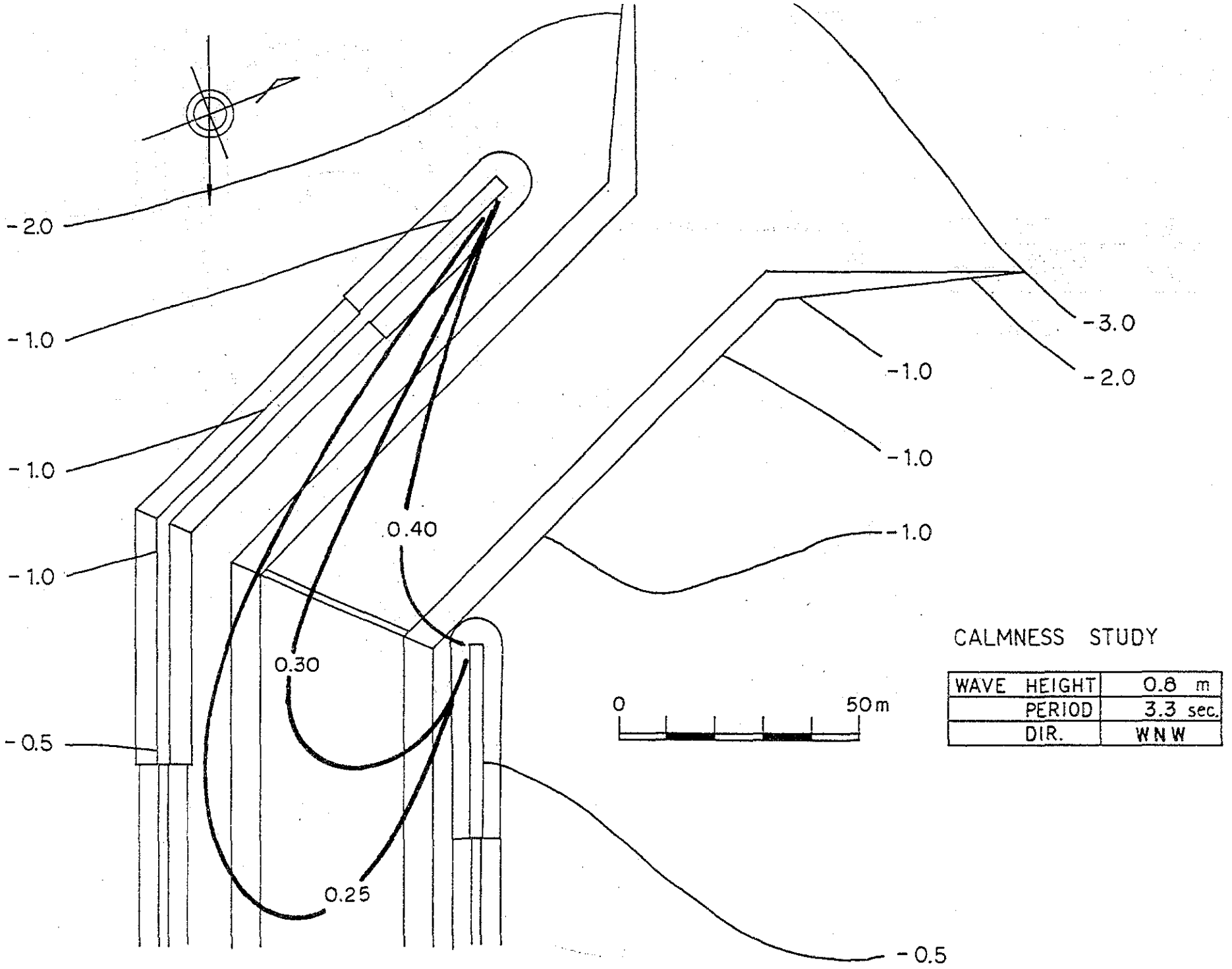
a) Large Platform Beam Scale, Capacity 1.5ton 1 Each
Minimum Readability: 1kg
Waterproof Construction

b) Small Beam Scale, Capacity 100kg 2 Each
Minimum Readability: 1kg
Waterproof Construction

(7) Plastic Tank (3 m^3) 10 Each

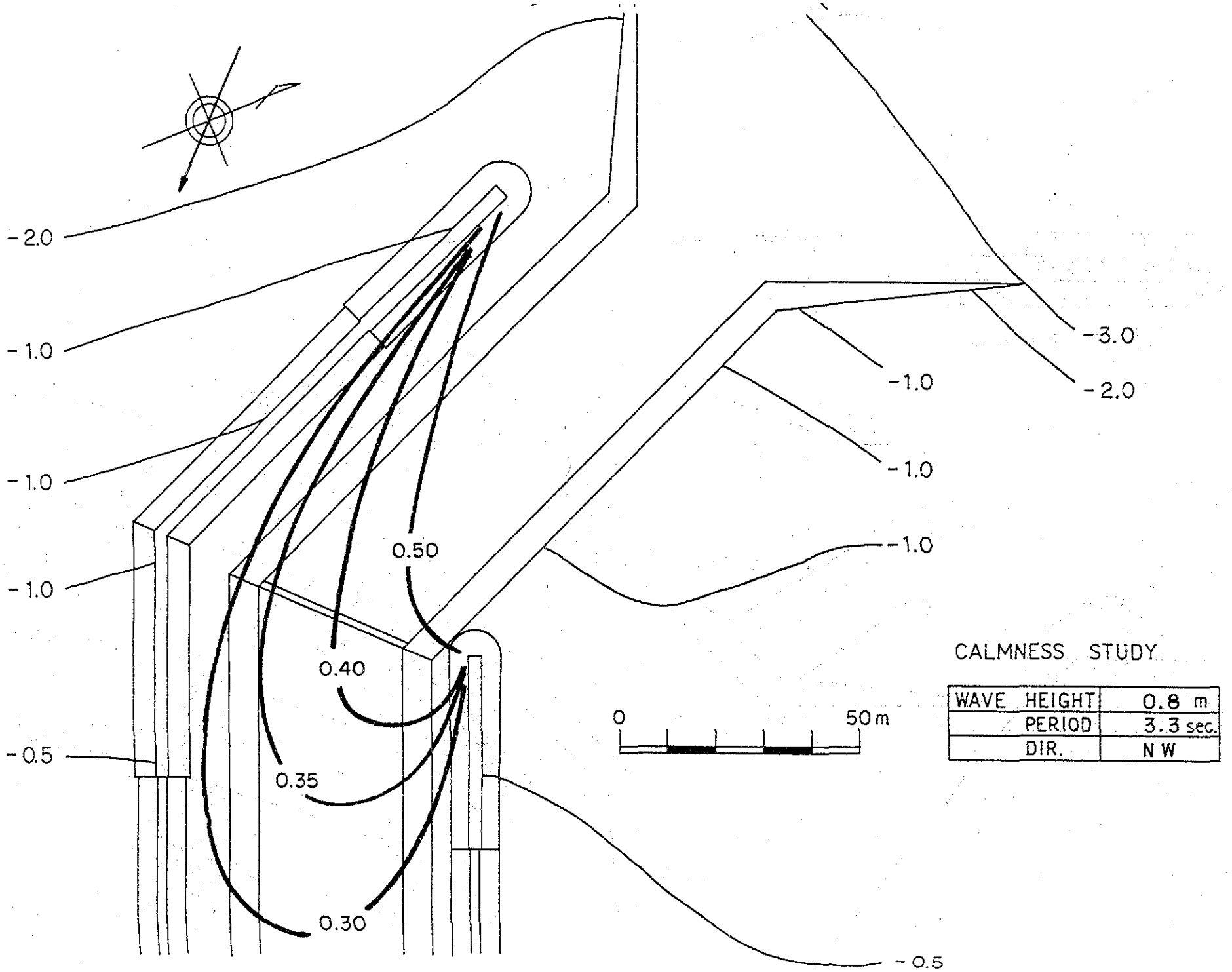
(8) Rope-Woven Mat. for Loading/Unloading 60 Each
Rope-woven mat, for loading/unloading 1 to 2 ton skipjack


-2.0
-1.0
-1.0
-1.0
-0.5
-3.0
-2.0
-1.0
-1.0
-1.0
-0.5
0.70
0.90
1.00
0.80
0.70
0
50 m
CALMNESS STUDY
WAVE HEIGHT 2.3 m
PERIOD 5.0 sec.
DIR. WNW



CALMNESS STUDY

WAVE HEIGHT	0.8 m
PERIOD	3.3 sec.
DIR.	WNW



CALMNESS STUDY

WAVE HEIGHT	0.8 m
PERIOD	3.3 sec.
DIR.	N W

JICA