

Based on the results of the aforementioned evaluation, facilities to be introduced in the Project are as follows.

- Construction of the Arno fishery infrastructure (hereafter referred to as Arno fishing base)
  - Multipurpose work building
  - Jetty for fish loading for Majuro on the ocean side
  - Slipway on the ocean side
  - Loading jetty on the lagoon side
  - Slipway on the lagoon side
  
- Construction of the Ine fishery infrastructure (hereafter referred to as Ine fishing base)
  - Multipurpose work building
  - Loading jetty on the ocean side
  - Slipway on the ocean side
  - Loading jetty on the lagoon side
  
- Construction of causeway between Arno and Ine
  
- Improvement of Majuro new channel

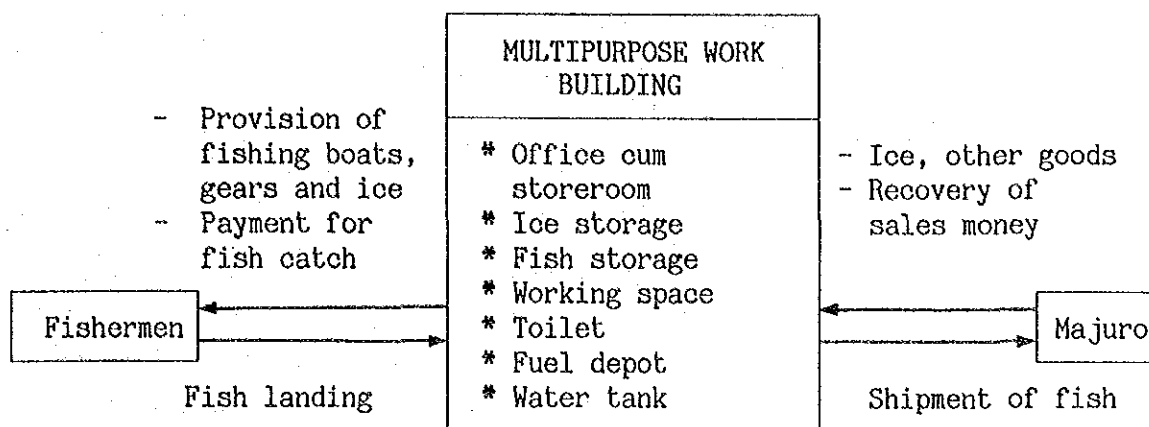
## (2) Function and scale of each planned facility

The purpose of each planned facility is to develop the fisheries infrastructure as well as to promote commercial fishery. Therefore it is necessary to establish the function and scale of each facility and to take into consideration the requirements necessary for achieving both objectives. In commercializing the fisheries sector the optimum quantity of fresh fish shipment from Arno has to be set and the required function and scale of the facilities will be decided according to this optimum quantity.

The optimum quantity of fresh fish shipment from Arno is, in other words, the quantity deducted from the total potential demand of fresh fish in Majuro, minus the fish catch by Majuro's fishermen. In this Project the potential demand of Arno fresh fish in Majuro is estimated at 772 kg per day based on several assumptions (For details refer APPX. 2.2.1).

### 1) Multipurpose work building

The main purpose of this facility is for storage and shipment of fresh fish and ice. The required functions are shown below.



The required floor space for each cold storage and working space are calculated according to the estimated daily average fish landing. The ratio in scale for both the Arno and Ine facilities is based on the population ratio of adult males (15-60 years old) in both islands. A detailed calculation of the required number of fishing boats, and the required floor space for cold storages and working space in both islands are given in APPX. 2.2.2 and APPX. 2.2.3.

The calculated requirements are as follows.

- (i) Required number of fishing boats to achieve projected fish catch of 772 kg/day

Arno fishing base	: 9 boats
Ine fishing base	: 7 boats
<hr/>	
Total	16 boats
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- (ii) Required capacity and floor space of cold storages

	Fish storage	Ice storage
Arno fishing base	2 tons (7.29 m <sup>2</sup> )	2 tons (4.86 m <sup>2</sup> )
Ine fishing base	1 ton (4.86 m <sup>2</sup> )	1 ton (3.24 m <sup>2</sup> )

(iii) Required working space

Arno fishing base : 52.5 m<sup>2</sup>  
Ine fishing base : 35.0 m<sup>2</sup>

2) Development of Arno fishing base infrastructure

(i) Jetty for fish loading for Majuro on the ocean side

- Function : It is important to enable the Majuro-Arno transport vessel to utilize the jetty at anytime. The jetty consists of a wharf and a groyne to break swells from the ocean. It is necessary to excavate the reef along the groyne to provide anchorage for vessels to approach and turn around.

- Scale

\* Length of wharf : The wharf will be basically utilized by fish transport vessel (length 11.0 m, draft 1.6 m), 9 fishing boats (length 7.0 m, draft 0.4 m) and copra transport vessels (same size as the fish transport vessel). Since the unloading time of fishing boats is negligible, the length of the wharf is designed in accordance with length of the transport vessel. The total wharf length has been set at 20 m, which is the standard dimension of small fishing boats given in the "Explanation on Standard of Specification of Port Facilities", published by the All Japan Fishing Port Association. (Refer to 5.3.1)

\* Crest height : The minimum required crest height has been determined at 0.25 m higher than H.H.W.L (+1.93). (Refer to 5.3.1)

\* Groyne length : Groyne will be extended to the length of

and crest width 100 m from the land, up to the reef edge to break swells from the ocean. Crest width is set at 5 m based on the crawler width of 3.5 m of heavy equipment (2.0 m<sup>3</sup> backhoe) which is used for the construction, and with an allowance of 1.5 m.

\* Anchorage depth : The anchorage will have sufficient  
and width depth to enable transport vessels (draft 1.6 m) to use it all the time, except one hour during the low tide, and with adequate depth to prevent the vessel's bottom from touching the sea bottom due to the vertical movement of the waves (0.5 m = one half of the designed wave height). Accordingly, the required depth is set as follows:

$$- 1.6 - 0.5 = - 2.1 \text{ m} \approx 2.0$$

The standard turning radius is 2-4 times the length of the vessel in calm water areas. In the Project, the occasional possibility of the influence of swells on the ocean side was taken into consideration, and the turning radius will be about 3 times the length of the transport vessel with some allowance. Accordingly, the required width of the anchorage is set as follows:

$$11 \text{ m} \times 3 = 33 \text{ m} \approx 30 \text{ m}$$

The anchorage will have adequate width to enable the transport vessel (length: 11 m) to turn around by itself.

#### (ii) Slipway on the ocean side

- Function : The function of this slipway is only to lift small fishing boats (7 m).

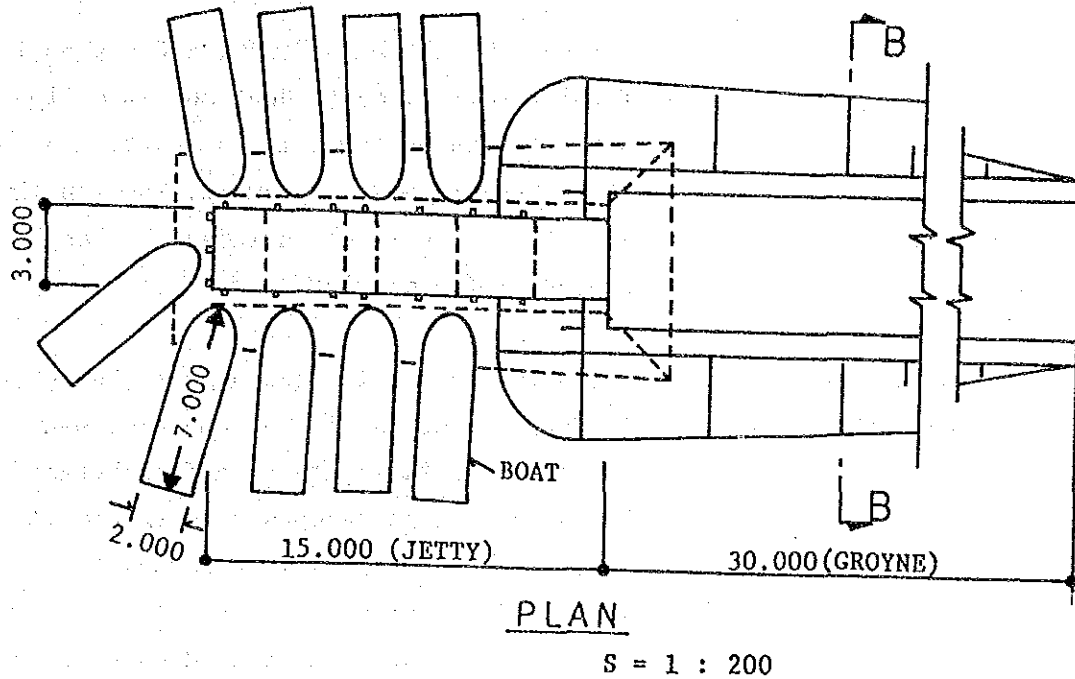
- Scale

- \* width : The required width is set at minimum width sufficient to lift one boat at a time since the number of fishing boats is limited. Since the width of fishing boats is 2.2 m, the width of the slipway is set at 5 m with an allowance.
- \* Inclination : Within the standard range for slipway, 1/6-1/10, the maximum inclination was set at 1/6, since the weight of fishing boats is comparatively light (less than 1 ton).
- \* Level of bottom edge : The level of the bottom edge is the same level as the existing reef of + 0.5 m. Consequently the slipway can be used only when the tide level is above mean sea level (M.W.L = + 0.97 m).

(iii) Landing jetty on the lagoon side

- Function : It is to be used for landing fish catch from small fishing boats and for mooring.
- Scale : Since the reef elevation is high (+0.5 m) and extends up to 300-400 m offshore, the fishing boat cannot approach the jetty unless the tide level is higher than the mean sea level. Accordingly, the length of the jetty will be on a minimum scale.
- \* Length of jetty : Thirty (30) m of the groyne portion will be constructed from the land to the slope end of the sea shore. The jetty will be extended by 15 m from the groyne to enable 9 small fishing vessels to be moored as shown below.

\* Width of jetty : There will a 3 m width sufficient for two rearcars to go back and forth.



(iv) Slipway on the lagoon side

- Function : The scale and function will be the same as the slipway on the ocean side.

3) Development of Ine Fishing Base Infrastructure

(i) Landing jetty on the ocean side

- Function : The jetty will provide small fishing boats access to the ocean and enable them to unload their fish catch directly to the wharf. The facility will consist of

a water passage from the reef edge, a groyne to break ocean swells, and a fish landing wharf.

- Scale

- \* Length of wharf : The length will be sufficient for a small fishing boat (7 m) to dock one at a time since its unloading time is short, and the number of boats is small. The length is set at 10 m which includes the length necessary for mooring.
- \* Length of Groyne and width of crest : The direction of the groyne will be set to form a sharp angle to cut off ocean swells to protect passage and anchorage. Therefore, it is necessary to extend it up to the reef edge. The length of the groyne is set at 90 m, which is equivalent to the volume of dredged rock obtained from dredging the water passage. The crest width is 5 m and is the same width as the Arno fishing base.
- \* Depth/width of water passage : The reef level at this point is high (+ 0.5 m). Accordingly the construction of a water passage for 24-hour operation is not suitable in terms of cost/benefits. The depth of the water passage is operative when it is above mean sea level (+ 0.97). When the draft of the fishing boat (0.4 m) and the vertical movement of the wave (0.5 m = one half of the designed wave height) is taken into consideration, the required water depth is about 1.0 m above mean sea level (+ 0.97 m). Accordingly, the bottom level of the water passage is:  
 $+0.97 \text{ m} - 0.4 \text{ m} - 0.5 \text{ m} = - 0.07 \text{ m} \approx \pm 0 \text{ m}$

Existing reef (+ 0.5 m) will be excavated to the level of - 0.5 m. The width of the passage at the reef edge will be about 30 m, which is 3 times the boat length taking into consideration space allowance for boat operation under rough conditions due to broken swells. A width of 15 m is set in the sheltered portion of the water passage by the groyne which is half the length at the reef edge. The turning radius of a small fishing boat is assumed to be about 2 times the boat length at this anchorage.

(ii) Slipway on the ocean side

- Function : The function will be the same as the slipway at the Arno fishing base on the ocean side.

(iii) Landing jetty on the lagoon side

- Function : The function and scale will be the same as the landing jetty on the lagoon side of the Arno fishing base.

4) Construction of causeway between Arno and Ine

- Function : To enable 24-hour traffic between Arno and Ine through the uninhabited Eneenerikku Island.

- Scale

\* Road extension : 150 m between Arno Island and Eneenerikku Island, and 250 m between Eneenerikku Island and Ine Island.



\* Road width : Since the traffic volume is limited, width is set at 4 m which is the minimum width to enable to and fro movement of vehicles.

#### 5) Improvement of Majuro new channel

- Function : A space allowance for the operation of boats passing the channel will be provided by widening the opening portion of the existing channel on the lagoon side. Furthermore the inner side of this opening portion of the channel will be dredged wider in the shape of an anchorage to reduce the energy of the waves. A groyne will also be constructed at the east side of the channel to shelter the newly excavated area from waves coming from east to southeasterly direction.

#### - Scale

\* Opening portion : The east side of the channel will to be widened by a width of 15 m (half the existing opening portion of 30 m width). The water depth will be - 2.0 m to - 3.0 m in order to reduce the breaking of waves.

\* Inner portion : The east side of the inner portion of the channel will be dredged wider by 30 m, (same width of the existing channel), in the shape of an anchorage. The water depth will be - 2.0 m.

\* Length/width : The groyne will be extended near to the reef side. The width of the groyne will

be 5.0 m and is based on the crawler width of the heavy equipment (3.5 m) used in the construction work. There is an allowance of 1.5 m. Furthermore at the top of the groyne, the concrete jetty will be extended (about 29 m length and 6 m wide) to protect the calm water area against swells from the ocean.

### 4.3 Contents of the Project

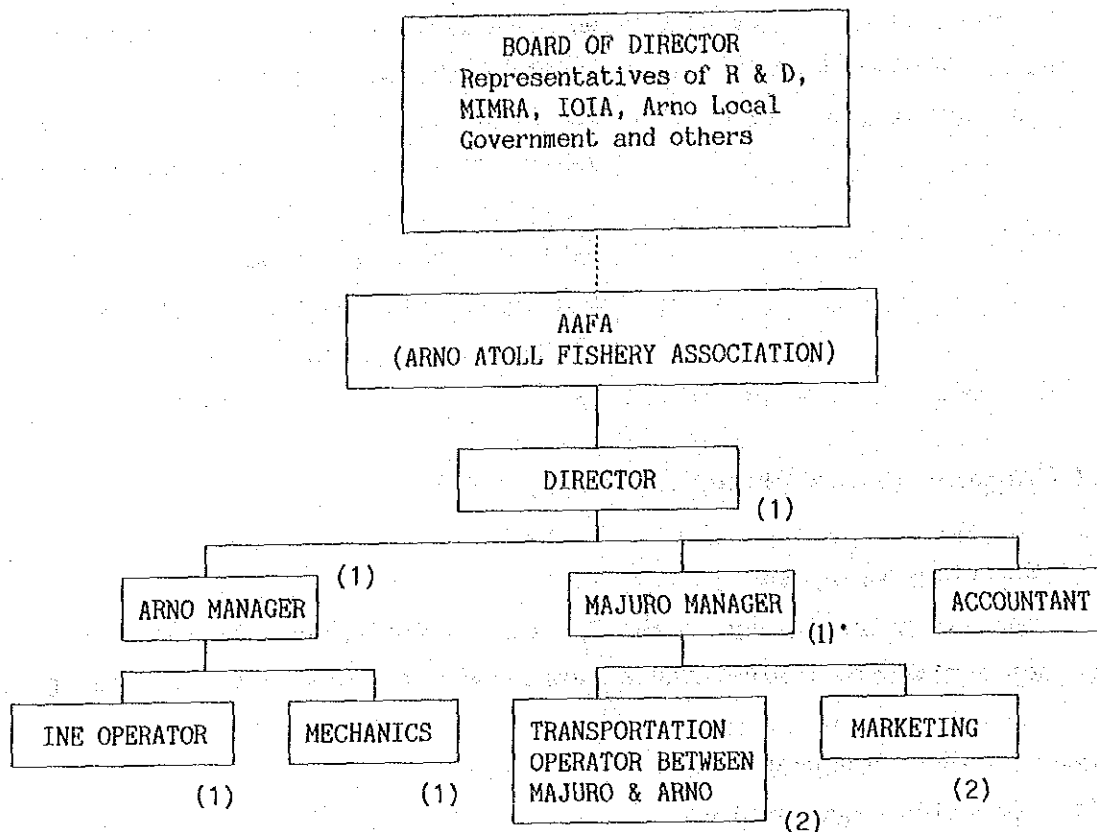
#### 4.3.1 Executing Agency

The executing agency of the Project is MIMRA, and all the work of the Project during its implementation shall be administered under this agency.

#### 4.3.2 Operation Organization

##### (1) Operation organization

Under the guidance of a Board of Directors consisting of representatives from relevant government agencies, a semi-public organization to be known as the Arno Atoll Fishery Association (hereafter referred to as AAFA) will be planned with the participation of people in the private sector related to fishery and MIMRA staff. The regulations for AAFA operations will be formulated by the Board of Directors and at least one staff member of MIMRA will participate as a staff member of AAFA in order to ensure smooth operation of its activities. The organization chart of AAFA is shown below.



Remarks: Figures in parentheses are the number of personnel and (\*) means concurrent with the director.

#### (2) Initial operating fund

Arno fishermen will be paid by cash for their fish catch. However, the collection of proceeds may be delayed for nearly one month. Therefore, provisions for the initial operation fund are necessary. This fund shall be provided by MIMRA.

#### 4.3.3 Outline of Facilities

The outline of the facilities is shown below.

(1) Construction of the Arno fishing base

Facilities	Contents/scale	Location	Purpose/condition
<b>1. Multipurpose Work Building</b>			
1) Multipurpose working space (with ice crusher)	Approx. 52.5 m <sup>2</sup>	Ocean side land section of southeast end of Arno Island	Collection, washing, sorting of fish, repair of fishing gear, meeting and training
2) Fuel drum depot (with wing pump)	Approx. 4 m <sup>2</sup>	- ditto -	Fuel supply for generator, fishing boats, vehicles
3) Ice cold storage	2-ton capacity	- ditto -	Short time storage (Max. 3 days)
4) Fish cold storage	2-ton capacity	- ditto -	Short time storage (Max. 3 days)
5) Machinery room	Approx. 12 m <sup>2</sup>	- ditto -	Generator (15KVA) and pumps
6) Office with storeroom	Approx. 24 m <sup>2</sup>	- ditto -	Storing equipment, resting room for night time work and office
7) Toilet & shower room	Approx. 7 m <sup>2</sup>	- ditto -	For shower, etc.
8) Water tank	Approx. 8 m <sup>3</sup>	- ditto -	Washing, toilet and shower
<b>2. Jetty for fish loading for Majuro</b>			
Length of groyne :	Approx. 100 m	Ocean side land section of southeast end of Arno Island	For transport vessel carrying fish to Majuro and for small fishing boats
width :	5 m		
Road length :	80 m		
width :	6 m		
(wharf :	20 m)		
Anchorage width :	30 m		
depth :	- 2.0 m		
3. Slipway width :	5 m	- ditto -	For lifting small fishing boats
4. Landing jetty		Lagoon side of southeast of Arno Island	Loading/unloading for small fishing boats
width :	3 m		
length :	40 m		
	(Jetty 15 m)		
5. Slipway width :	5 m	- ditto -	For lifting small fishing boats

Remarks: Facilities from 1)-7) will be in one building (approximately 120 m<sup>2</sup>).

## (2) Construction of the Ine fishing base

Facilities	Contents/scale	Location	Purpose/condition
1. Multipurpose Work Building			
1) Multipurpose working space (with ice crusher)	Approx. 35 m <sup>2</sup>	Ocean side of land section of center of Ine Island	Collection, washing, sorting of fish, repair of fishing gear, meeting and training
2) Fuel drum depot (with wing pump)	Approx. 2.5 m <sup>2</sup>	- ditto -	Fuel supply for generator, fishing boats, vehicles
3) Ice storage (with cooling unit)	1-ton capacity	- ditto -	Short time storage (Max. 2-3 days)
4) Fish storage (with cooling unit)	1-ton capacity	- ditto -	Short time storage (Max. 2-3 days)
5) Machinery room	Approx. 10 m <sup>2</sup>	- ditto -	Generator (15KVA) and pumps
6) Office with storeroom	Approx. 16 m <sup>2</sup>	- ditto -	Storing equipment resting room for night time work and office
7) Toilet & shower room	Approx. 4 m <sup>2</sup>	- ditto -	For shower, etc.
8) Water tank	Approx. 8 m <sup>3</sup>	- ditto -	For washing, toilet and shower
2. Loading jetty			
Length of groyne :	Approx. 90 m	Ocean side of center of Ine Island	Loading/unloading for small fishing boats
width :	5 m		
Road length :	55 m		
width :	6 m		
(wharf :	10 m)		
Anchorage width :	15-30 m		
depth :	- 0.5 m		
3. Slipway			
width :	5 m	- ditto -	For lifting small fishing boats
4. Loading jetty			
width :	3 m	Lagoon side of center of Ine Island	Loading/unloading for small fishing boats
	45 m		
	(Jetty 15 m)		

Remarks: Facilities from 1)-7) will be in one building (approximately 80 m<sup>2</sup>).

(3) Construction of the causeway between Arno and Ine

Facilities	Contents/scale	Location	Purpose/function
1) Causeway (east side)	Extension length : 250 m width : 4 m	Between Ine and Eneenerikku	Inland transportation
2) Causeway (west side)	Extension length : 150 m width : 4 m	Between Eneenerikku and Arno	- ditto -

(4) Improvement of Majuro new channel

Facilities	Contents/scale	Location	Purpose/function
1) Groyne (rubble mounted type)	Extension length : 80 m width : 5 m	Majuro channel on ocean side	Wave breaking
2) Jetty (concrete type)	Approx. length : 29 m width : 6 m	Extended portion of groyne	- ditto -
3) Channel widening	width : 15-30 m depth : -2 to -3 m	Majuro channel on ocean side	Improvement of traffic safety



## **5. BASIC DESIGN**





## 5. BASIC DESIGN

### 5.1 Basic Design Principles

The basic design of the facilities was based on natural conditions and construction conditions prevailing at the sites. The basic design principles are as follows.

- 1) The oceanic tropical climate, marine conditions and topography of coral reef were taken into consideration in the design, layout, structure and specifications of the facilities.
- 2) Construction work of the causeway requires large quantity of materials and the ocean side jetty requires large scale dredging. The dredged rocks in the jetty construction will be usefully utilized in the causeway construction. The designing and construction of the causeway and jetty should be made in conjunction with the rational operation schedule of the construction machinery.
- 3) The facilities to be provided will conform to existing operation capabilities and also the design and specifications have been simplified for easy maintenance.
- 4) The facilities have been planned to harmonize with the surroundings.

### 5.2 Basic Design Conditions

#### 5.2.1 Design Conditions of the Civil Structure

##### (1) Arno Atoll

##### 1) Design wave height ( $H_{1/3}$ )

	For structural design	For functional design
Average wind speed $V_{10}$ (m/sec)	15.0	10.0
Wave height $H_{1/3}$ (m)		
Ocean side	2.0	1.0
Lagoon side	1.0	0.8

2) Object of design condition

	Total Length	Gross tonnage	Draft length
Transport vessel	11.0 m	4.4 GT	1.60 m
Fishing boat	7.0 m	-	0.40 m

3) Water depth

	Draft length	Wave height	Water margin	Total
Transport vessel	1.60 m	0.50 m	-	2.00 m <sup>1)</sup>
Fishing boat	0.40 m	0.50 m	-	1.00 m

Remarks 1) : This is during the lowest tide when the boat has to wait about one hour on the ocean side.

4) Tide level

H.H.W.L.	+ 1.93 m
M.W.L	+ 0.97 m
L.L.W.L (Designed datum plane)	+ 0.00 m

5) Coral rock strength

Unconfined compressed strength 400-600 kg/cm<sup>2</sup> (assumption)

(2) Majuro atoll

1) Design wave height

Ocean side  $H_{1/3} = 2.0$  m

2) Tide level

H.H.W.L.	+ 1.80 m
M.W.L	+ 0.90 m
L.L.W.L (Designed datum plane)	+ 0.00 m

3) Coral rock strength

Unconfined compressed strength 800 kg/cm<sup>2</sup>

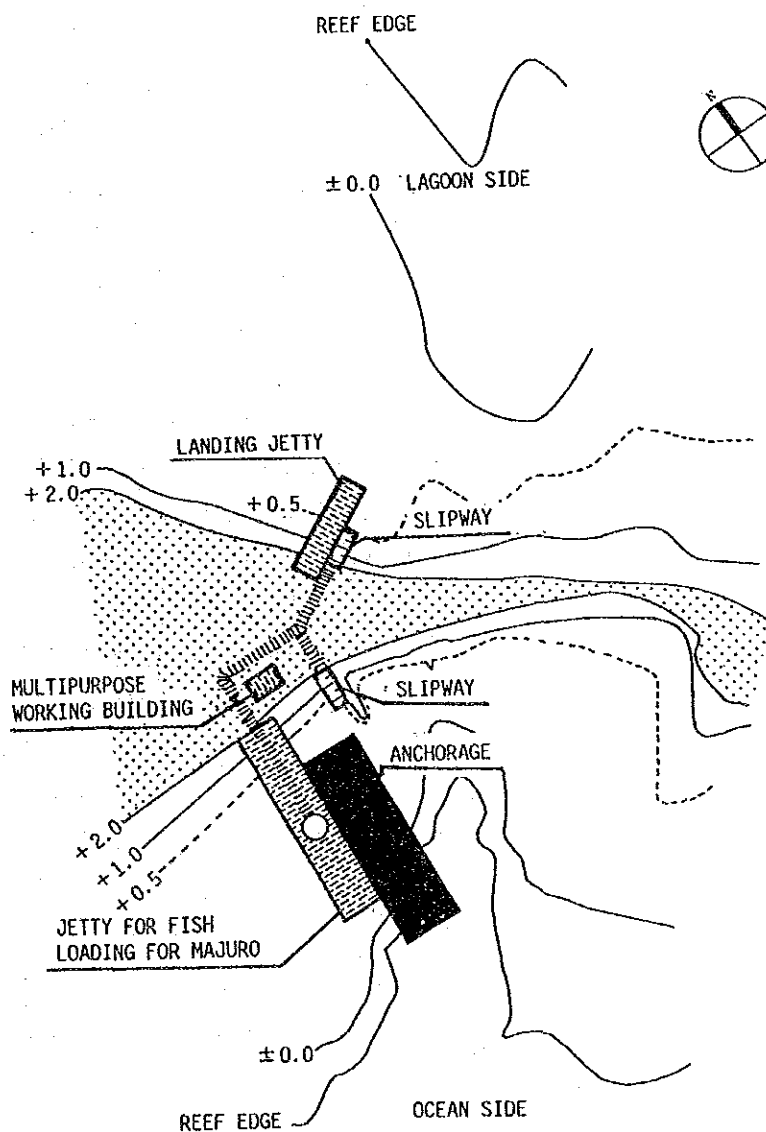
### 5.2.2 Design Conditions of the Building Structure

- 1) Soil - Coral sand and silty sand (bearing capacity of soil 5 tons/m<sup>2</sup>)
- 2) Earthquake - Earthquake force is not considered.
- 3) Wind speed - 60 m/sec (maximum instantaneous velocity)

### 5.3 Basic Plan of the Facilities

#### 5.3.1 Construction of the Arno Fishing Base

Each facility of the Arno fishing base is located on the ocean side reef land area and the coral reef on the lagoon side at the southeast edge of Arno island. When the land topography and purpose of the planned facility are taken into consideration, facility zoning will be done as shown in the figure below.



(1) Facilities on the ocean side

1) Jetty for fish loading for Majuro

i) Length of the wharf

The wharf is for fish transport vessel (total length 11.0 m; 4.4 GT; and draft 1.60 m). The total length was determined at 20 m based on the standard dimension of small fishing boats is shown below.

Wharf length	Wharf depth	Gross tonnage
20 m	2.0 m	10 GT
30 m	3.0 m	40 GT
40 m	4.0 m	110 GT

Source: "Explanation on Standard of Specification of Port Facilities" published by the All Japan Fishing Port Association

ii) Top level of the wharf

In small wharfs where the water depth is 4.5 m and the tidal fluctuation is within 3.0 m, the top level of the wharf is normally 0.5-1.5 m above high water level. However, due to construction costs and utility of wharf, the top level will be higher than the high water level of +1.93 by 0.25 m.

iii) Width of the anchorage

It is necessary to have a tractical diameter 2-4 times the length of the transport vessel for the vessel to turn by itself in calm sea conditions. The proposed site is comparatively calm, but the ocean side is influenced by some swells. For this purpose the tractical diameter will be kept in mid range of about 3 times the length of the transport vessel to make some allowance for these swells. Therefore the width of the anchorage is 30 m.

iv) Wharf structure

There are three types of wharf structures.

- a) Cellular block wharf
- b) Sheet pile wharf
- c) On-site concrete wharf

An on-site concrete wharf structure was selected based on the evaluation of the construction schedule and costs. The comparative results of the evaluation are shown in Table 5.1.

v) Groyne

The groyne will be extended almost to the coral reef edge. The total length of the groyne will be 100 m and the type of structure which has been selected is rubble mounted breakwater type due to the topographic condition of the reef. The top level will be as follows when the design tide level is +1.93 and design wave height is  $0.375H_{1/3}$ .

$$1.93 + 0.375 \times 2.0 = +2.68 \text{ m} \approx 2.70 \text{ m}$$

Furthermore the groyne width will be 5.0 m because the  $2.0 \text{ m}^3$  backhoe crawler used in the construction work (spread construction method) is 3.5 m wide, and an allowance of 1.5 m is given.

2) Slipway

The width of the slipway is 5 m and a maximum inclination of 1/6 was selected as the gradient slope to enable small fishing boats to be lifted from design with an inclination standard of 1/6-1/10. Since the level of existing reef is + 0.5 m, the level of the bottom edge of the slipway is also set + 0.5 m. Accordingly this slipway can be used only when the tide reaches above the M.W.L. (+ 0.97 m).

3) Boatyard

A boatyard for repair and emergency use is located beside the upper edge of the slipway.

(2) Facilities on the lagoon side

1) Landing jetty

The width of the jetty is 3.0 m to allow rearscars to go back and forth. The top level is determined at +2.5 m with an allowance of 2.0 m for the design tide plus 1/2 the design wave height.

$$\begin{aligned} &\text{Design tide} + \text{design wave height} \times 1/2 \\ &= 1.93 + 0.80 \times 1/2 = + 2.33 \approx 2.5 \text{ m} \end{aligned}$$

The structure of the jetty is an on-site concrete structure selected from three types of structures: cellular block, H-shaped steel pile, and on-site concrete. The comparative results of the evaluation are shown in

Table 5.2.

2) Slipway

It is the same as the slipway on the ocean side.

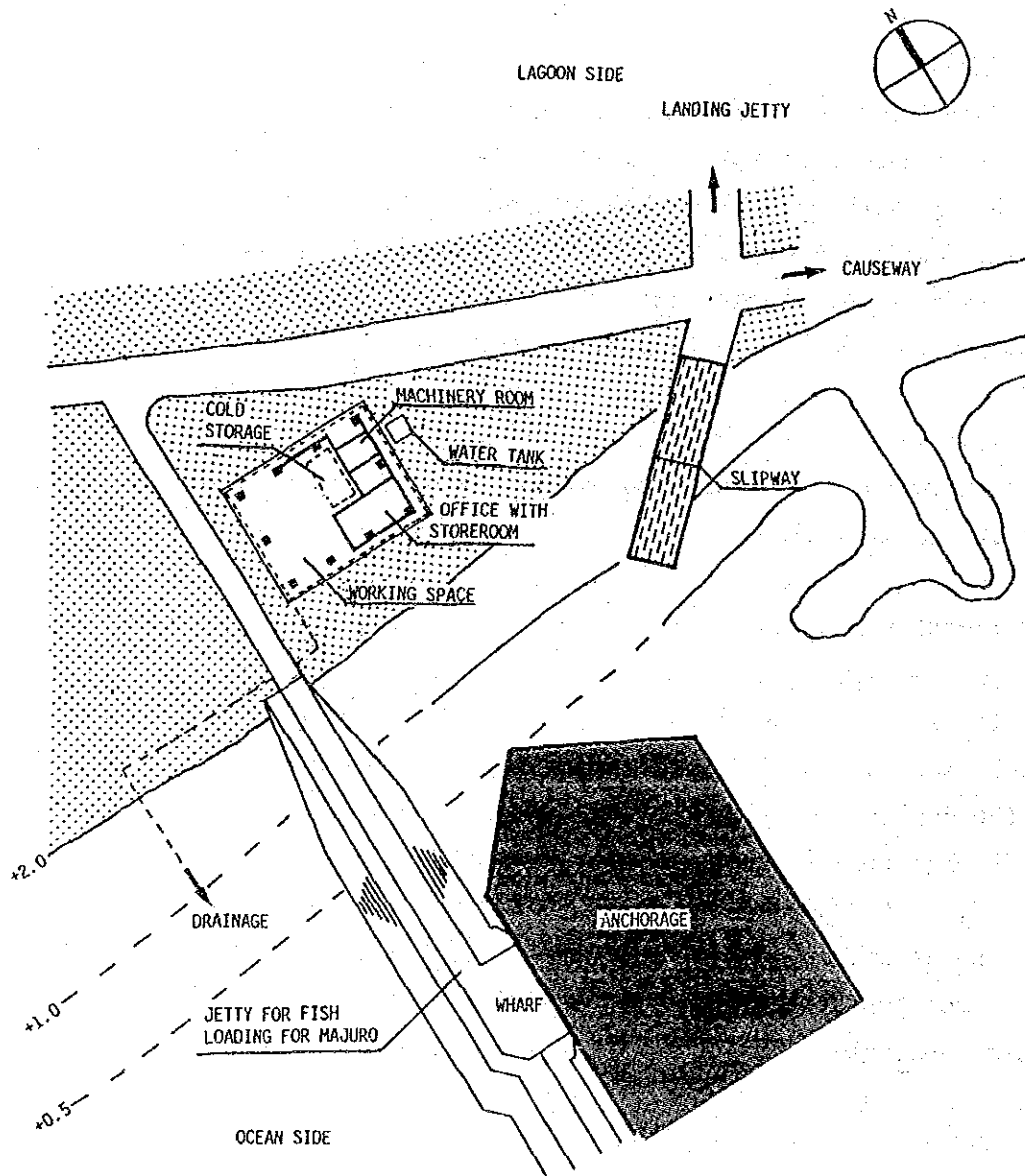
3) Boatyard

It is the same as the boatyard on the ocean side.

(3) Land facilities

1) Layout plan

The facilities on the site will be located on the east side of the approach entrance to the ocean side wharf. Multipurpose working space is located facing the road approaching the wharf for convenient handling of fish and ice. Machinery room and cold storage are located on the north side of the store to avoid direct sea winds. The layout plan of the building is shown below.



## 2) Floor plan

The facilities consist of the following.

Facilities	Purpose
Multipurpose working space	Collection of fish, washing and sorting of fish, repair of fishing gear, meeting area for fishermen, training
Fuel drums depot	For keeping diesel oil and kerosene, and service tank for generator
Ice cold storage	Short time storage of ice for fishing boats
Fish cold storage	Short time storage of fish to be transported to Majuro
Machinery room	Diesel generator and water pumps
Office with storeroom	For storing fishing gear, spare parts, and sales management of fish and resting room
Toilet and shower	For use by management staff
Water tank	For storing collected rain water

The working space will be located where both the slipway and ocean side wharf can be observed. At the same time the passage between wharf and working space should be short and simple. Ice storage, fish storage and storeroom face the working space for loading and unloading purposes. The water tank will be located at the gable side of the building to store rainwater collected by pipes from the gable end of the roof.

## 3) Section plan

In order to reinforce work efficiency such as the handling of fish, repairing fishing gear, etc., and in view of the oceanic tropical climatic conditions, the building will be single storied with a height of 3.0 m from floor to upper level beam.

## 4) Elevation plan

Since the building is composed of an open area (working space) and a walled area (machinery room, cold storage and storeroom), the open area and the walled area will be clearly separated.



5) Structural plan

Since the building is single storied and its carrying load is small, the layer of coral and silt sand is sufficiently able to support this load. Therefore the direct foundation method will be applied. The building structure will have a RC rigid frame and the roof truss will be wooden. Optimum span will be given to reduce the cross section of the wood. The main structure portion will use 4-week aged strength concrete of 3000 PSI (210 kg/cm<sup>2</sup>) and will apply a deform steel bar as the main steel bar.

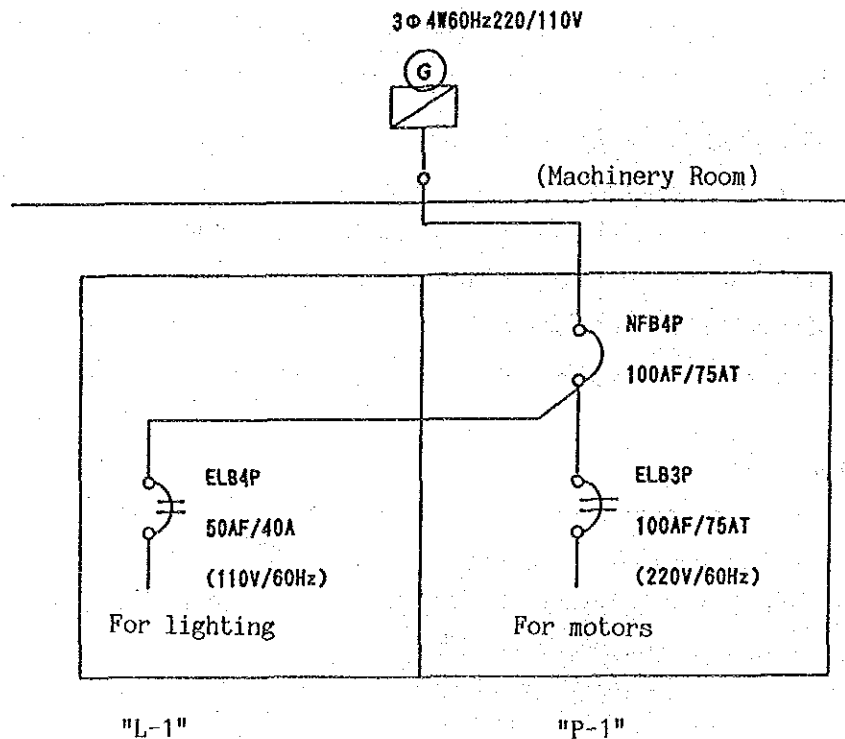
6) Mechanical and electrical services

i) Electrical service

(a) Main wiring

The diesel generator installed in the machinery room will supply the 220V, 60 Hz, 3 phase for motive power use, and 100V, 60 Hz, single phase for lighting.

The schematic diagram wiring is shown below.



(b) Motive power for machines

Motive power is distributed to cold storages for ice and fish, freshwater pressure pumps, submersible pump, etc.

(c) Lighting

Water proof, anti-corrosion, fluorescent lights will be installed due to salt pollution.

(d) Receptacle outlet

Water proof receptacle outlets will be installed in the multipurpose work space which may be exposed to rain. Indoor receptacle outlets will be the normal type of outlet.

ii) Cold storage

Both the cold storage for ice and fish will be the aluminium assemble type with a capacity of approximately 2 tons at  $-5^{\circ}\text{C}$  indoors. An air cooled packaged refrigerating unit will be installed on top of each cold storage.

iii) Plumbing and sanitary service

a) Seawater supply

A marine submersible pump will be fixed at the anchorage (- 2.0 m) facing the wharf in the ocean side jetty. Seawater is supplied to the multipurpose work space and is used for washing the floor, fish, etc.

b) Freshwater supply

Collected rain water stored in a water tank and used for washing fishing gear, toilet and shower will be supplied by a pressure pump.

c) Drainage

Sewage is treated in an infiltration sump installed in front of the toilet and drained into the reef on the west side of the ocean jetty through an open ditch.

d) Sanitary fixtures

The toilet bowl will be Japanese style and made of ceramic. Wash basin and shower will also be installed in the toilet room.

7) Material plan

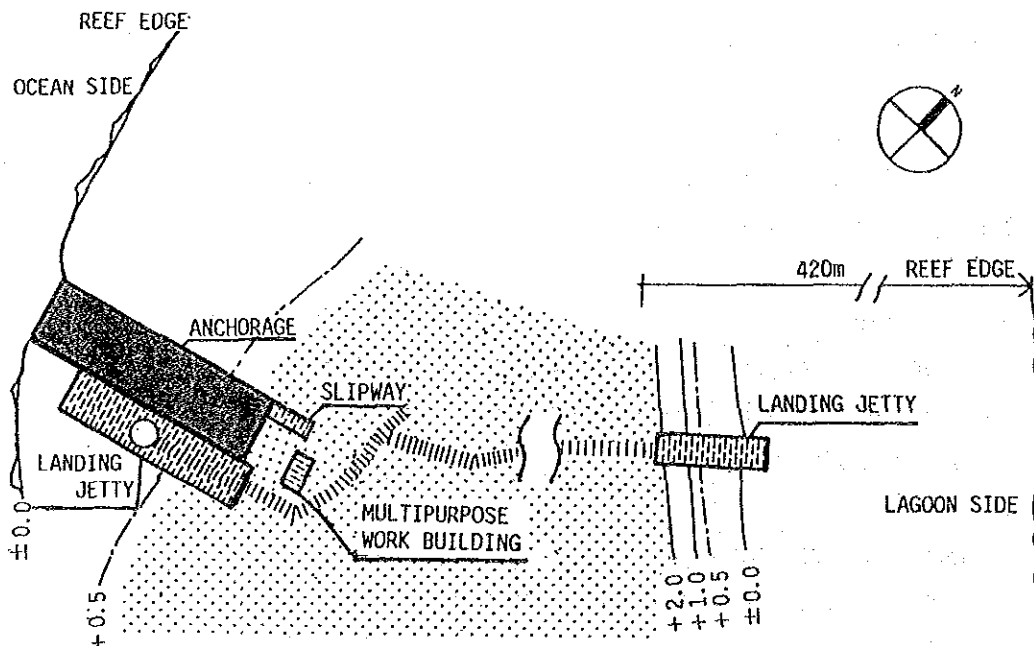
Section	Material items
(Exterior finish)	
(1) Roof	: Corrugated aluminium sheet
(2) Wall	: Exposed concrete block, paint finish
(3) Door/window	: Aluminium glass louver window, plywood flash door
(Interior finish)	
(1) Ceiling	: Plywood paint finish, hard wood paint finish
(2) Wall	: Exposed concrete block, paint finish
(3) Floor	: Concrete steel troweled

8) External work plan

Ocean side jetty, slipway, building and lagoon side jetty are all connected by a compacted, unpaved road 3 m wide.

5.3.2 Construction of the Ine Fishing Base

The facilities of the Ine fishing base are located on the ocean side coral reef near the old dilapidated jetty used for copra loading, which is located on the land and reef on the lagoon side in the central part of the island. In consideration of the land topography and purpose of the planned facilities, zoning will be done as shown in the figure below.



(1) Facilities on the ocean side

1) Landing jetty

i) Length of wharf

The length of the wharf for small scale fishing boats (total length 7.0 m and draft 0.4 m) is set at 10 m.

ii) Top level of wharf

The top level is set at + 2.2 m with the same considerations taken as in the Arno fishing base.

iii) Type of wharf structure

The type of structure to be adopted is on-site concrete structure as in the Arno fishing base.

iv) Width of anchorage

Since the anchorage is only for small scale fishing boats, the width of the anchorage is set at 15 m which is twice the total length of the fishing boat. However the width at a section of the reef edge will be set at 30 m which is about four times the length of a fishing boat (7.0 m) for safe boat operations under conditions of wave breaks.

v) Groyne

The length of the groyne is set at 90 m due to the topography of the coral reef. The top level of the groyne (+2.7) and the width of the crest (5.0 m) are same as the Arno fishing base.

2) Slipway and boatyard

The slipway and boatyard are the same as the Arno fishing base.

(2) Facilities on the lagoon side

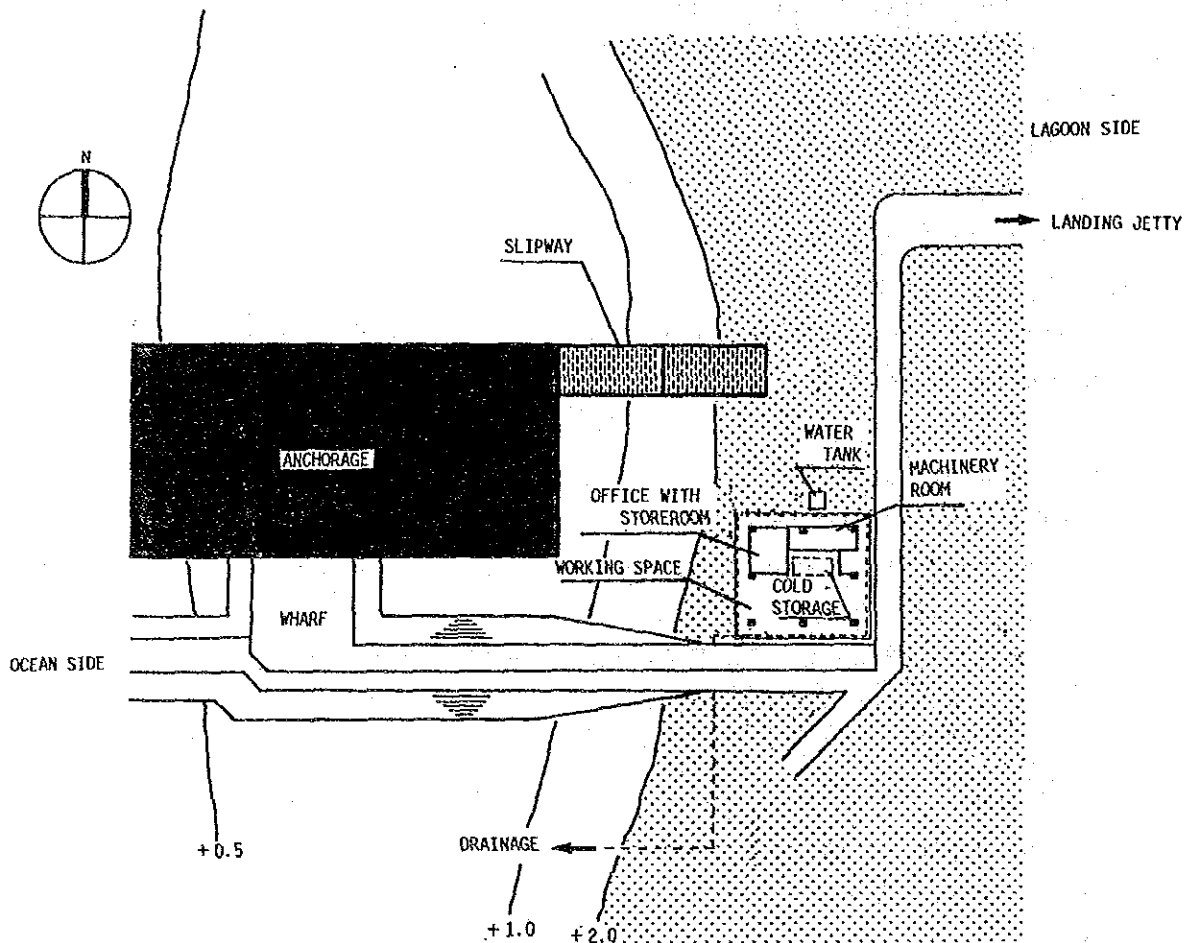
Only the landing jetty will be constructed on the lagoon side and the scale is the same as the Arno fishing base.

(3) Land facilities

1) Layout plan

Land facilities are located on the north side of the approach to the entrance to the ocean side jetty. The multipurpose work space is laid

out facing the road to the jetty, and the machinery room and cold storage are on the east side of the storeroom to avoid the direct sea winds. The layout of the building is shown below.



2) Floor plan, section plan, elevation plan, structural plan, material plan

This building and its land facilities have the same basic function as the the Arno fishing base, but only on a smaller scale. The main building will be constructed with the same ease, speed, and structure (column span, height, section of structure) as the facility at Arno fishing base. Room composition, eaves height, elevation, structure type, finishing material of the Ine facilities are the same as the land facilities at Arno fishing base.

3) Mechanical and electrical services

Electrical service facilities are the same as Arno fishing base. However both capacity of ice and fish cold storages are set at 1 ton each. Water supply and drainage are the same as Arno fishing base.

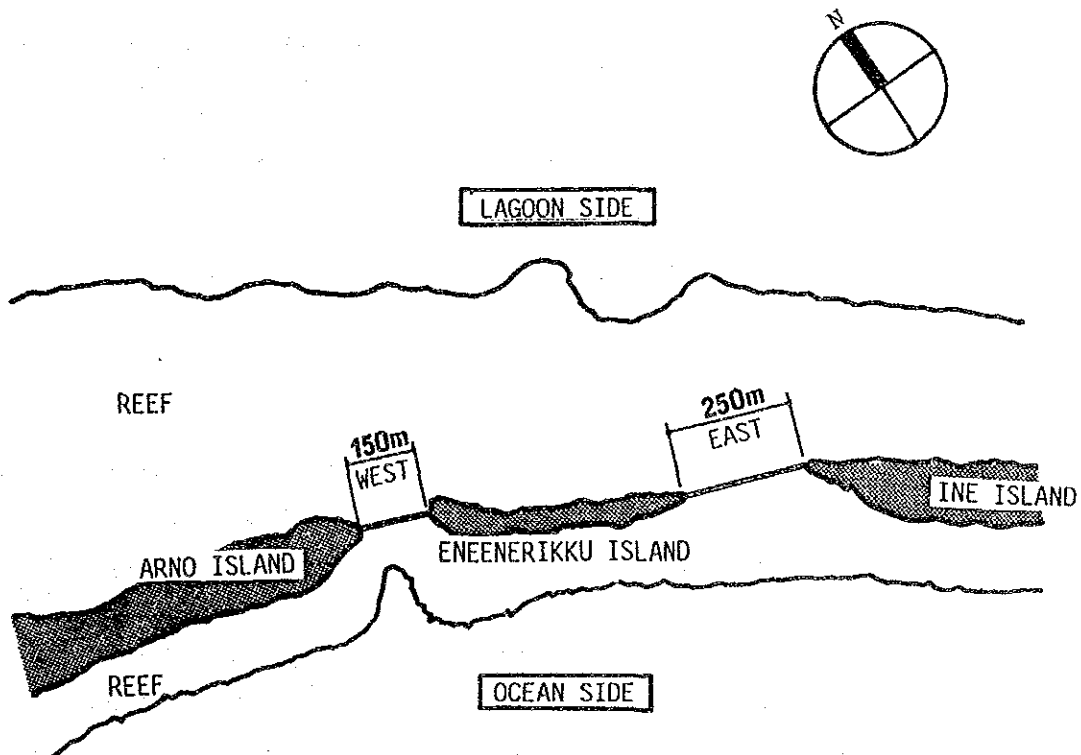
4) External work plan

Ocean side jetty, slipway, building and lagoon side jetty are all connected by a compacted, unpaved road 3 m wide leading to the main road of this island.

5.3.3 Construction of the Causeway Between Arno and Ine

(1) Total length of the causeway

Total length of the causeway between Arno Island and Eneenerikku Island is set at 150 m and the causeway between Ine Island and Eneenerikku Island is set at 250 m. The total length is 400 m as shown below.



(2) Effective width

Crest width of the causeway is set at 5 m due to the construction method (spread method). The effective width which allows two-way passage of light vehicles, is 4 m.

(3) Top level

The top level of the causeway is set at + 2.70 m which is the same as the groyne of landing jetty.

(4) Pavement

The random paving method has been adopted for the road surface due to the influence of the waves.

(5) Slope

The angle of this slope is the same as the sea wall and therefore set at 1 : 1.5.

(6) Structure type

The structure of the causeway will be of armor structure. The results of the comparative analysis of other alternatives in fabric foam is shown in the Table 5.3.

#### 5.3.4 Improvement of the Majuro New Channel

To improve the opening portion on the ocean side of the Majuro new channel.

(1) Construction of the groyne

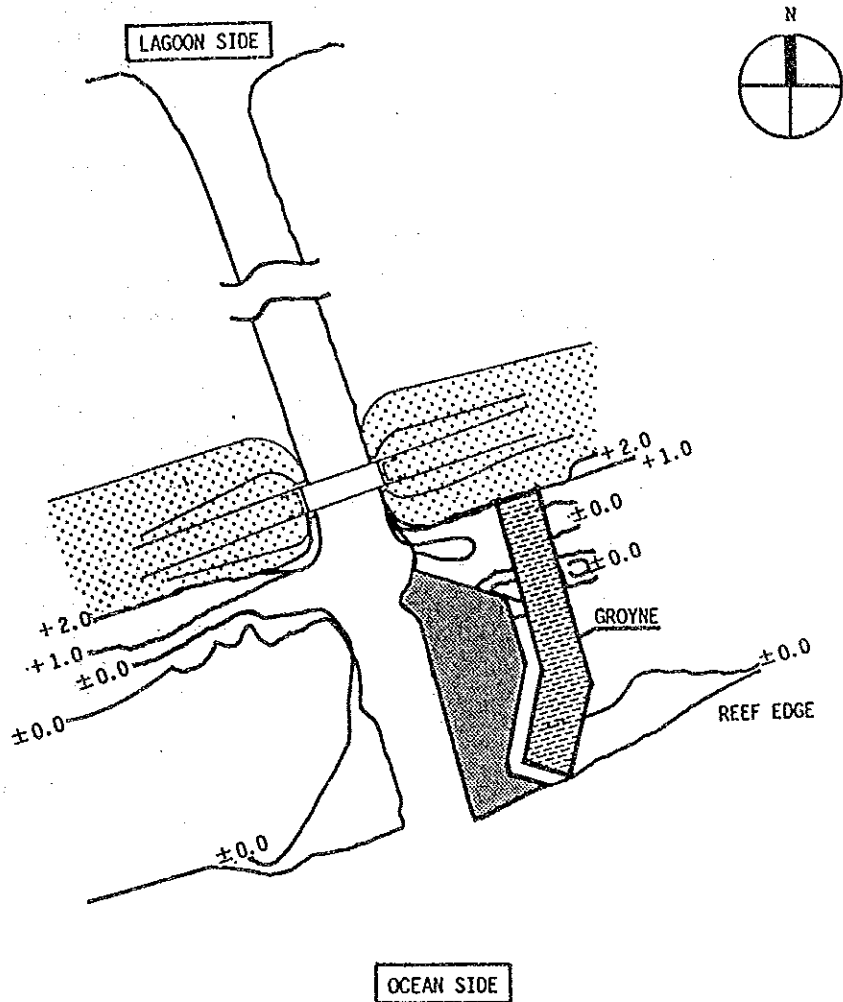
An armor stone mound groyne will be newly constructed adjacent to the west side of the existing channel. The top level will be + 2.7 m and the crest width will be 5.0 m to allow the construction machine to operate.

(2) Widening the opening portion at the reef edge

At the eastern part of the channel, 15 m width (half of opening portion of 30 m width) will be dredged. Design water depth will be - 2.0 m to - 3.0 m which is the same as that of the existing channel in order to reduce the wave breaks at the edge.

(3) Widening a part of the channel

The reef on the east side of the existing channel which is on the inner portion from the ocean side is to be widened 15 m more than the planned opening portion at the reef edge by width to gain the calm sea area. Design water depth is set at - 2.0 m. The improved portion of the new Majuro channel is shown below.



5.3.5 Environmental Impact and Countermeasures

The Environmental Protection Agency (EPA) of the Government of Marshall Islands has established the regulations for environmental protection measures related to civil works and issuing work permit for relevant constructions, Based on the regulations, the environmental impact to the surrounding area of the construction work in the Project has been evaluated and its results are summarized in the following table.



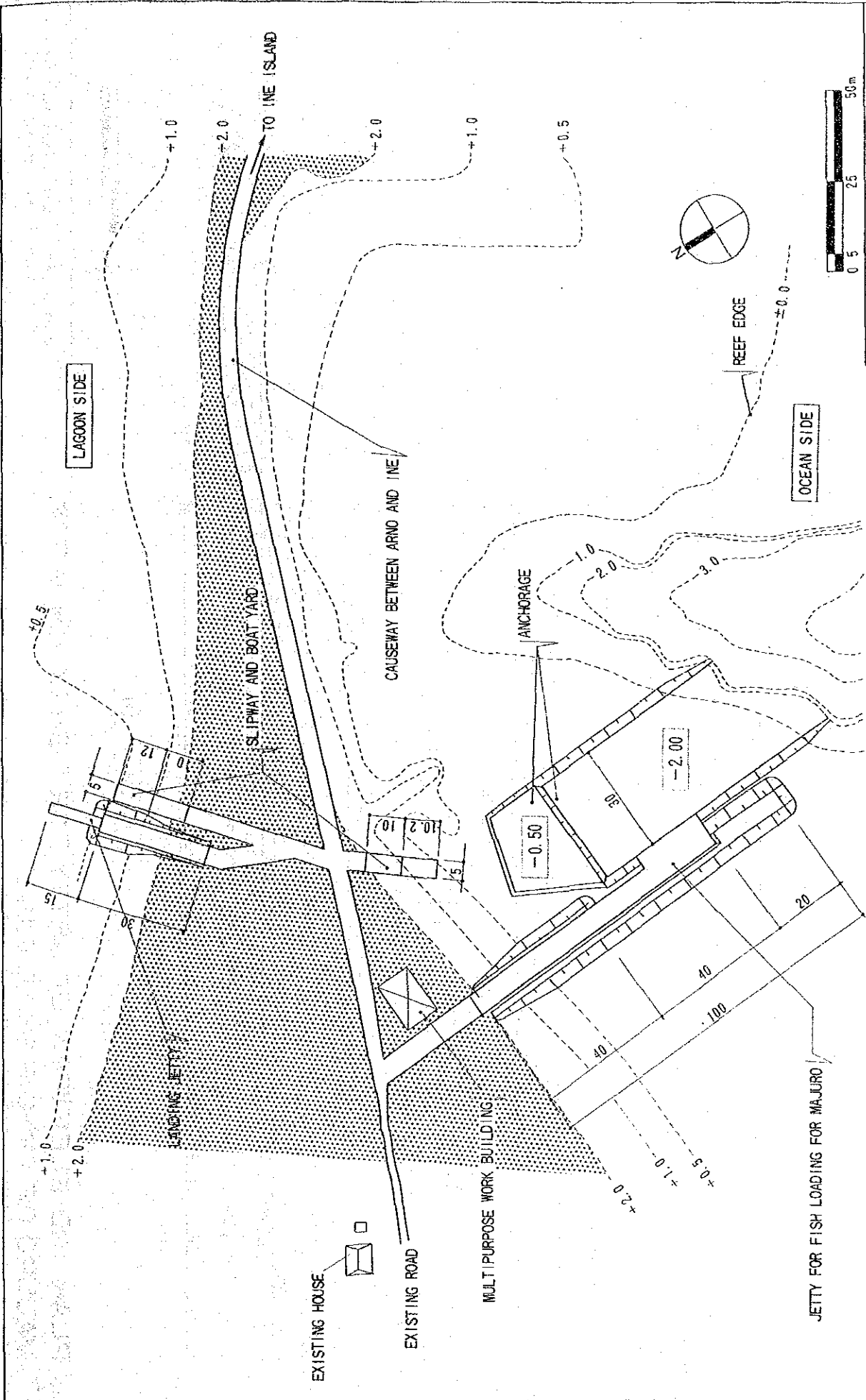
Construction	Expected Impact		Countermeasure	
	During Construction	After Construction	During Construction	After Construction
I) Arno Atoll				
1) Ocean side				
- Excavation for channel const.	Fatal damage of coral at reef edge by underwater blasting	-	No special measure taken (because limited range of damaged area in case of underwater blasting)	
- Groyne const.	Turbid due to excavation of blasted coral rock		To minimize volume of excavation by balancing requirement of channel scale	
- Slipway construction	Seepage of cement paste during concreting work		No special measure taken (Negligible small pollution derived from this work. Distance to living coral zone at reef edge is 100 m)	
- Building construction	-	Pollution of ocean side reef by waste water discharge		Installation of infiltration tank
2) Lagoon side				
- landing jetty construction	Seepage of cement paste during concreting	-	No special measure taken (Negligible small pollution derived from this work. Distance to living coral zone at reef edge is 400 m)	
- Slipway construction	Ditto	-	Ditto	-

Construction	Expected Impact		Countermeasure	
	During Construction	After Construction	During Construction	After Construction
3) Causeway Construction (Arno-Ine)	Turbid during filling work of coral sand	No more water passage between both sides	No special measure taken (existing coral reef on both sides are already covered with fine coral sand, additional impact not expected)	Drastic ecological impact not expected (living coral in reef edge is uniform all along coastal line of 30 km between Arno and Ine.)
II Majuro Atoll				
1) Widening existing channel	Fatal damage of coral at reef edge by underwater blasting	-	No special measure taken (limited range of damaged area in case of underwater blasting)	-
2) Groyne	Generation of turbidity, by excavation of blasted coral rock	-	To minimize volume of excavation by balancing requirement of channel	-

### 5.3.6 Basic Design Drawings of Facilities

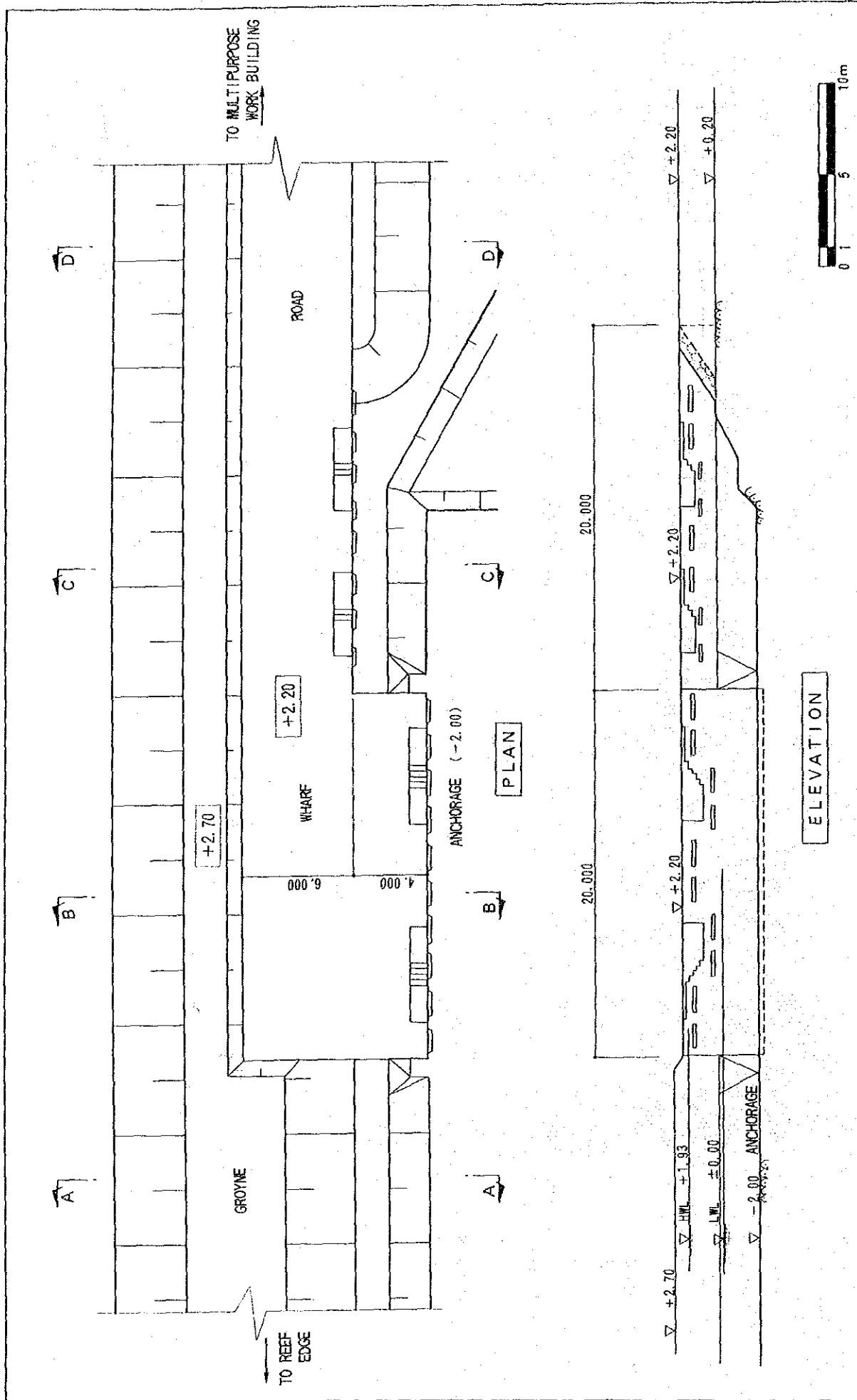
The basic design drawings of the facilities are shown as follows.

- (1) General Plan of Arno Fishing Base
- (2) Plan and Elevation of Jetty for Fish Loading for Majuro of Arno Fishing Base
- (3) Section of Jetty for Fish Loading for Majuro of Arno Fishing Base
- (4) Floor Plan, Elevation and Section of Multipurpose Working Building of Arno Fishing Base
- (5) General Plan of Ine Fishing Base
- (6) Plan and Elevation of Ocean Side Landing Jetty of Ine Fishing Base
- (7) Section of Ocean Side Landing Jetty of Ine Fishing Base
- (8) Floor Plan, Elevation and Section of Multipurpose Work Building of Ine Fishing Base
- (9) Plan, Elevation and Section of Landing Jetty of Arno and Ine Fishing Base
- (10) Plan and Section of Slipway and Boatyard at Arno and Ine Fishing Base
- (11) General Plan and Section of Causeway between Arno and Ine
- (12) General Plan and Section for Improvement of Majuro New Channel



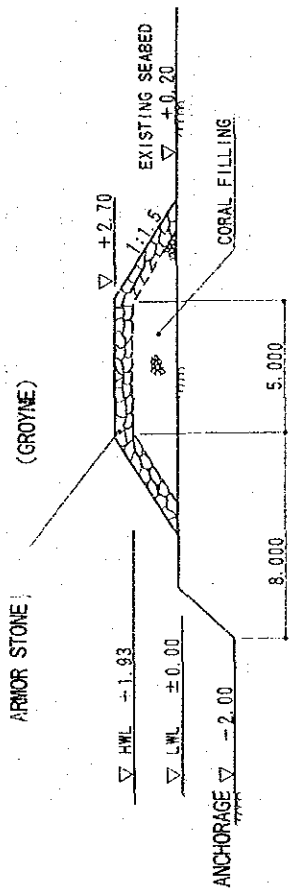
THE PROJECT FOR LOCAL FISHERY DEVELOPMENT  
IN THE REPUBLIC OF THE MARSHALL ISLANDS

① GENERAL PLAN OF ARNO FISHING BASE

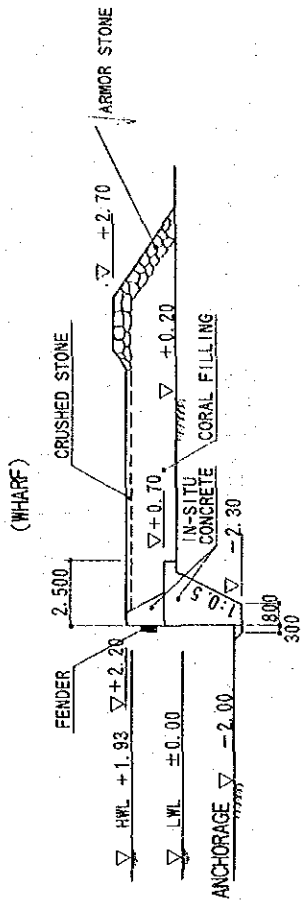


② PLAN AND ELEVATION OF JETTY FOR FISH LOADING FOR MAJURO OF ARNO FISHING BASE

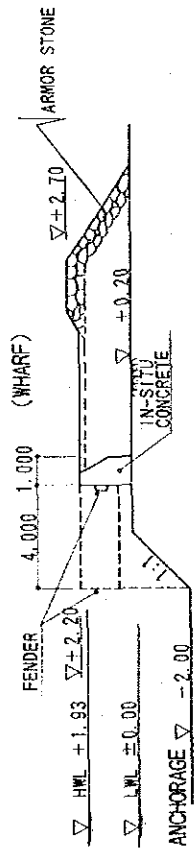
THE PROJECT FOR LOCAL FISHERY DEVELOPMENT IN THE REPUBLIC OF THE MARSHALL ISLANDS



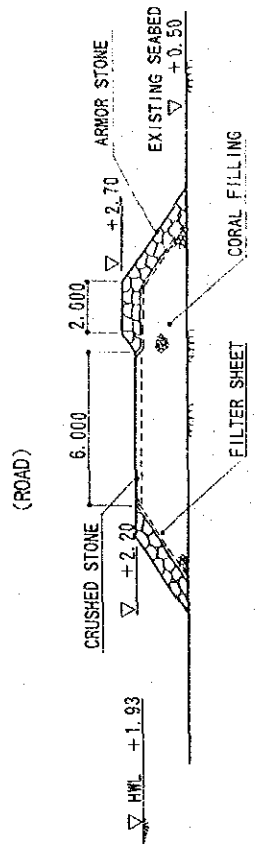
SECTION A-A'



SECTION B-B'



SECTION C-C'

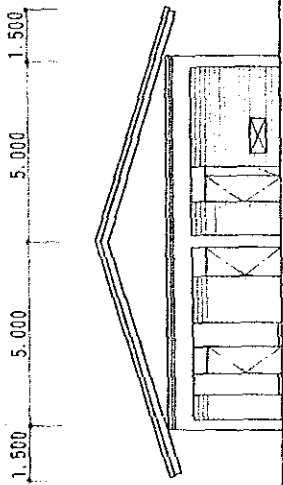


SECTION D-D'

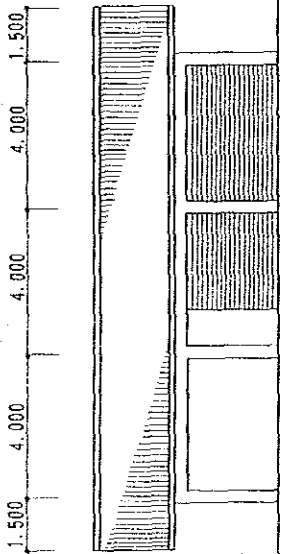


③ SECTION OF JETTY FOR FISH LOADING FOR MAJURO OF ARNO FISHING BASE

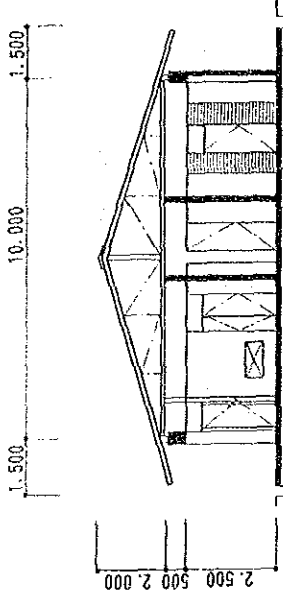
THE PROJECT FOR LOCAL FISHERY DEVELOPMENT IN THE REPUBLIC OF THE MARSHALL ISLANDS



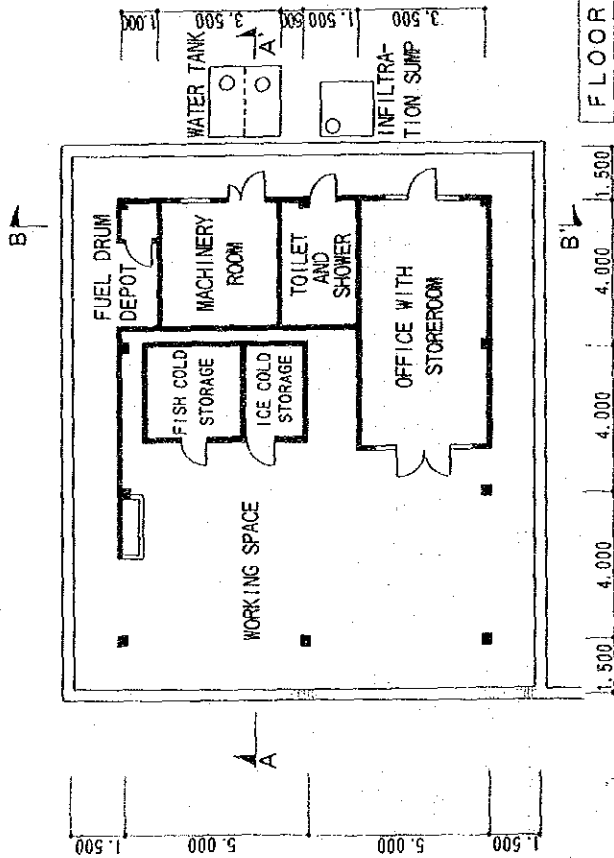
EAST ELEVATION



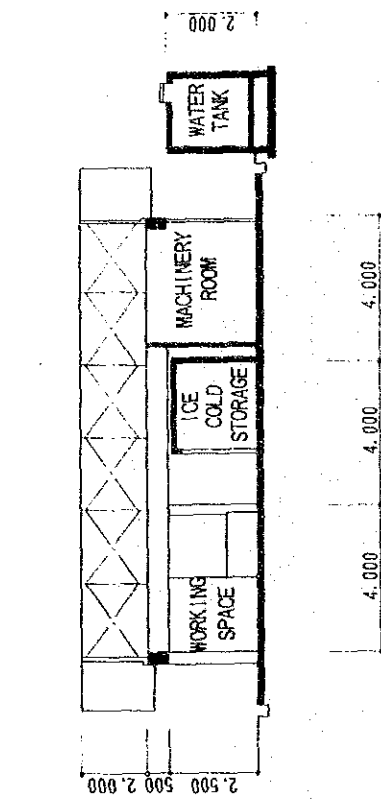
SOUTH ELEVATION



SECTION B-B'



FLOOR PLAN



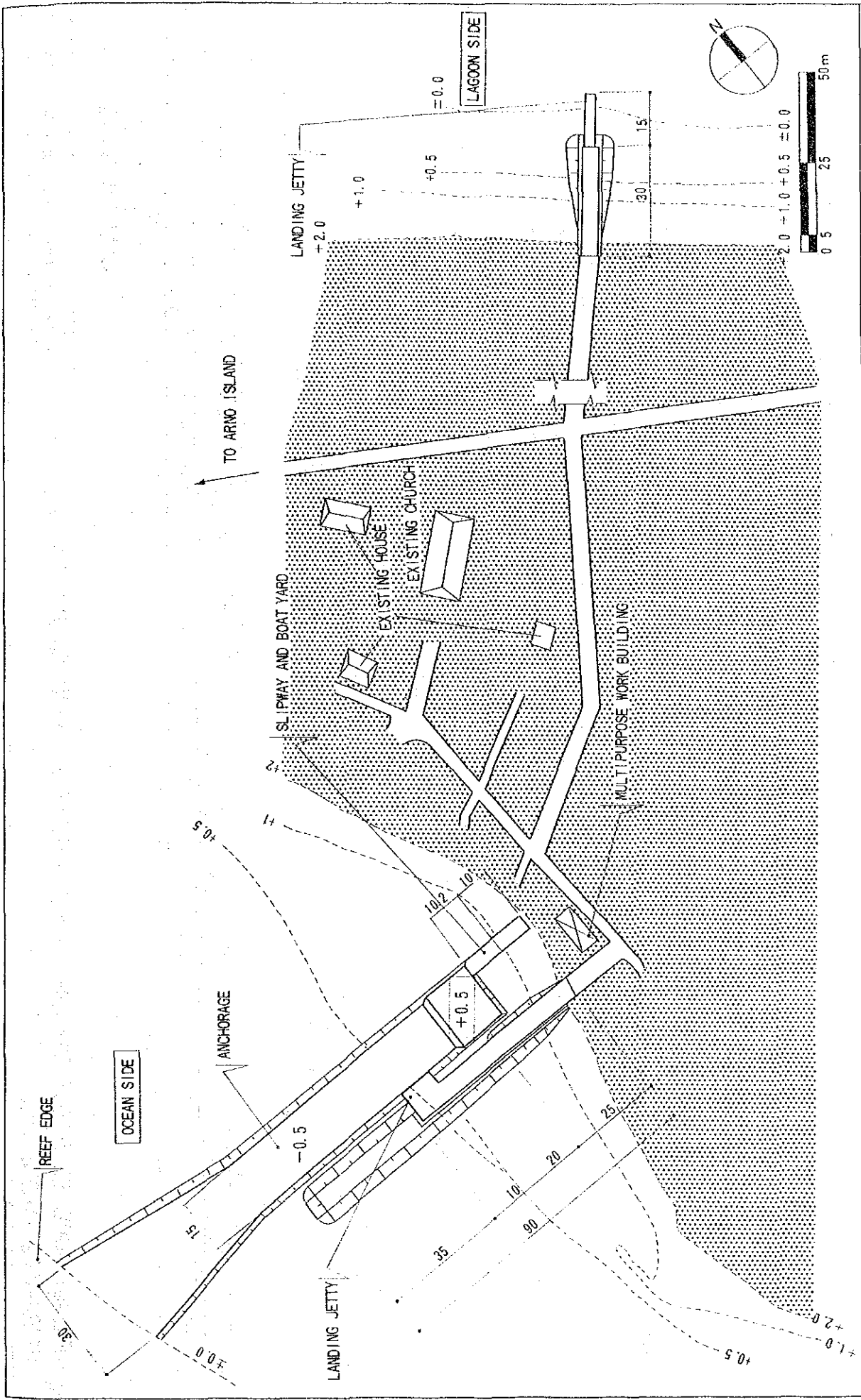
SECTION A-A'



**FLOOR PLAN, ELEVATION AND SECTION OF MULTIPURPOSE WORK BUILDING OF ARNO FISHING BASE**

④

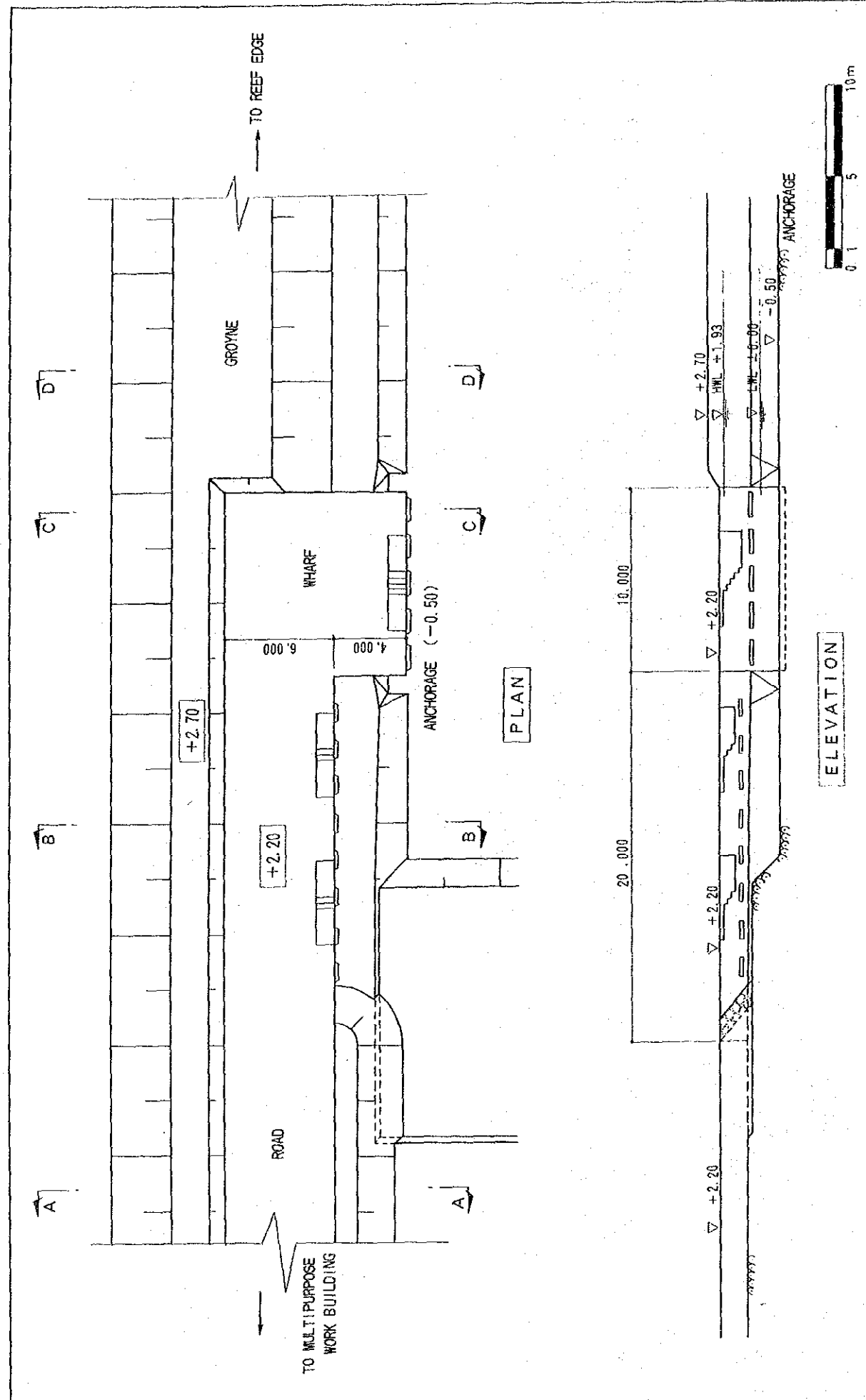
THE PROJECT FOR LOCAL FISHERY DEVELOPMENT IN THE REPUBLIC OF THE MARSHALL ISLANDS



THE PROJECT FOR LOCAL FISHERY DEVELOPMENT  
IN THE REPUBLIC OF THE MARSHALL ISLANDS

⑤ GENERAL PLAN OF INE FISHING BASE

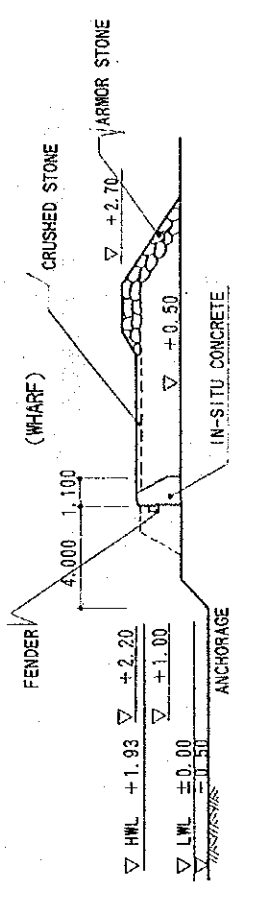




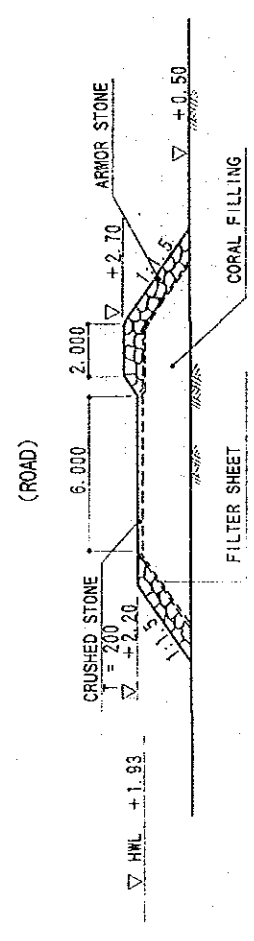
THE PROJECT FOR LOCAL FISHERY DEVELOPMENT  
IN THE REPUBLIC OF THE MARSHALL ISLANDS

**PLAN AND ELEVATION OF OCEAN SIDE LANDING JETTY OF INE  
FISHING BASE**

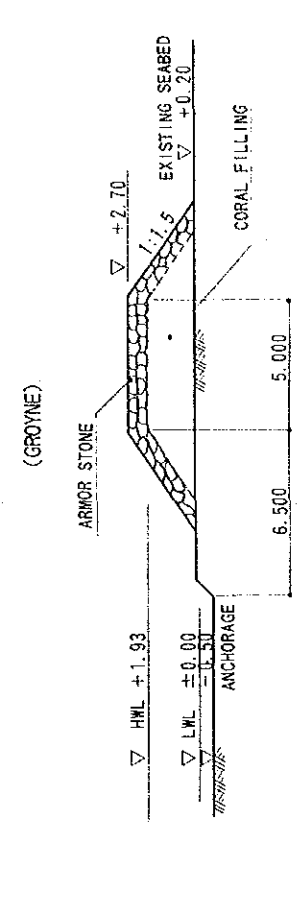
⑥



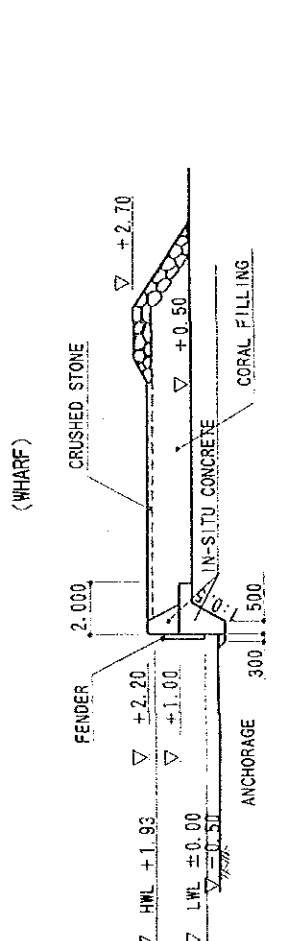
SECTION B-B



SECTION A-A



SECTION D-D

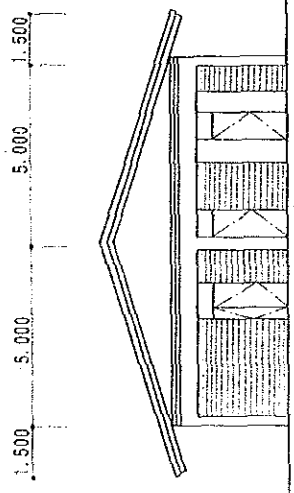


SECTION C-C

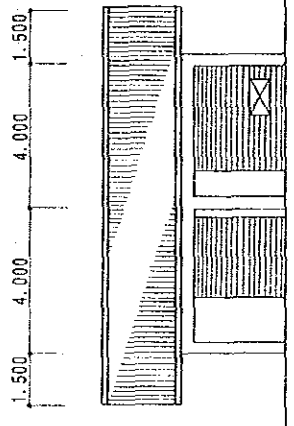


THE PROJECT FOR LOCAL FISHERY DEVELOPMENT  
IN THE REPUBLIC OF THE MARSHALL ISLANDS

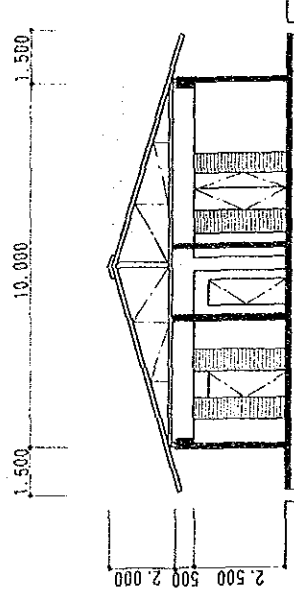
7 SECTION OF OCEAN SIDE LANDING JETTY OF INE FISHING BASE



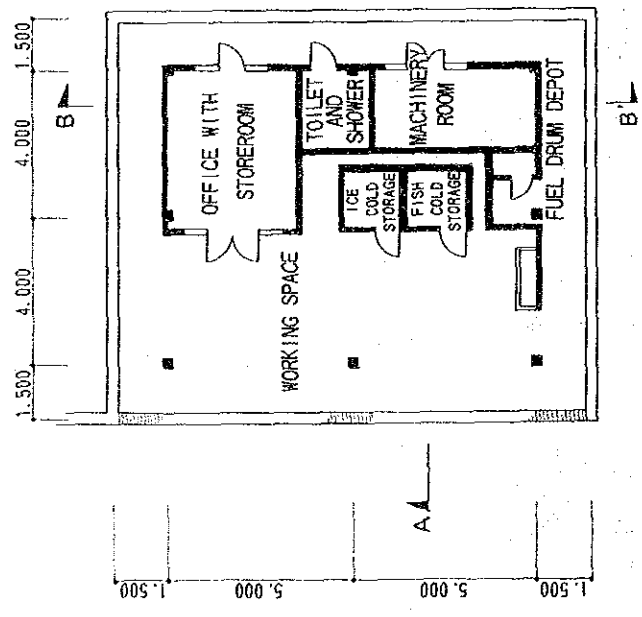
NORTH ELEVATION



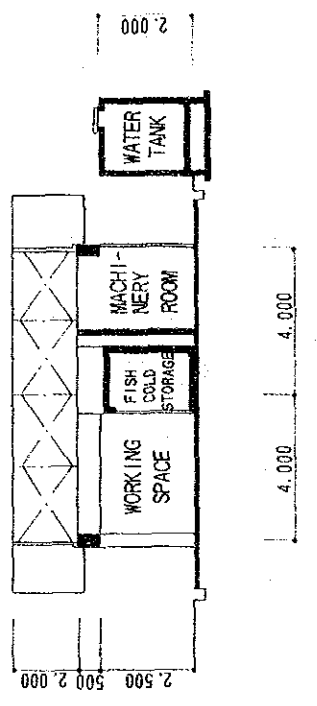
EAST ELEVATION



SECTION B-B



FLOOR PLAN

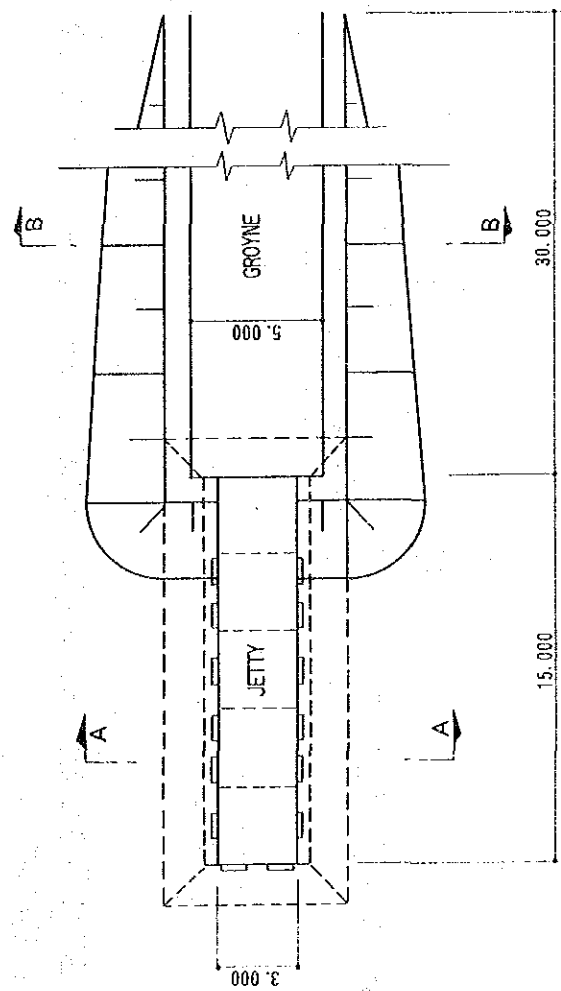


SECTION A-A

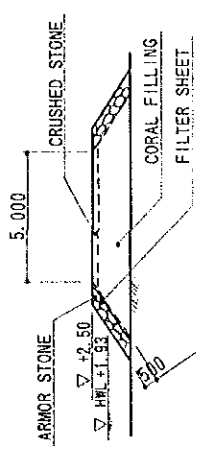


**8** FLOOR PLAN, ELEVATION AND SECTION OF MULTIPURPOSE WORK BUILDING OF INE FISHING BASE

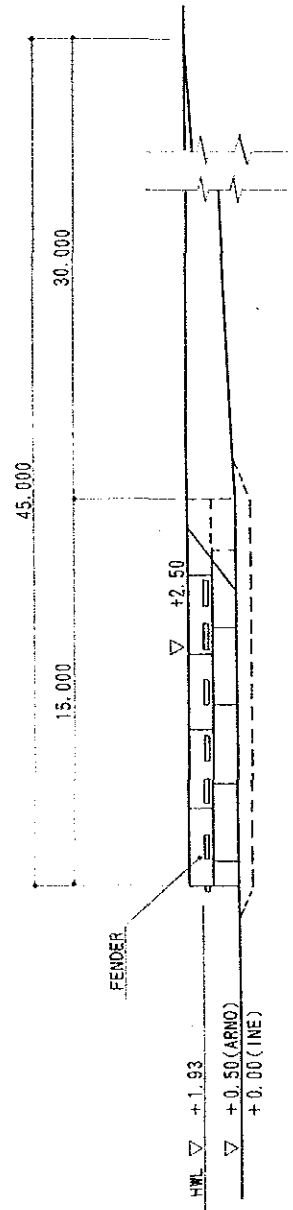
THE PROJECT FOR LOCAL FISHERY DEVELOPMENT  
IN THE REPUBLIC OF THE MARSHALL ISLANDS



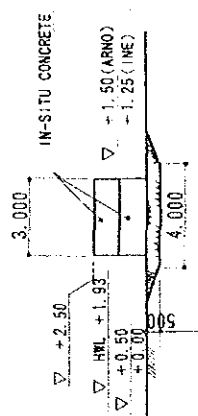
PLAN



SECTION B-B



ELEVATION

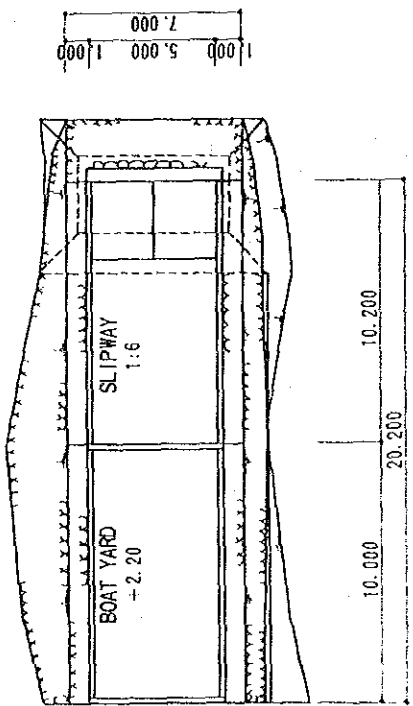


SECTION A-A

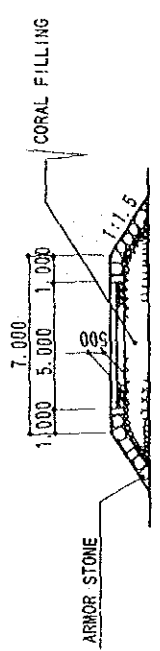


9 PLAN, ELEVATION AND SECTION OF LANDING JETTY AT ARNO AND INE FISHING BASE

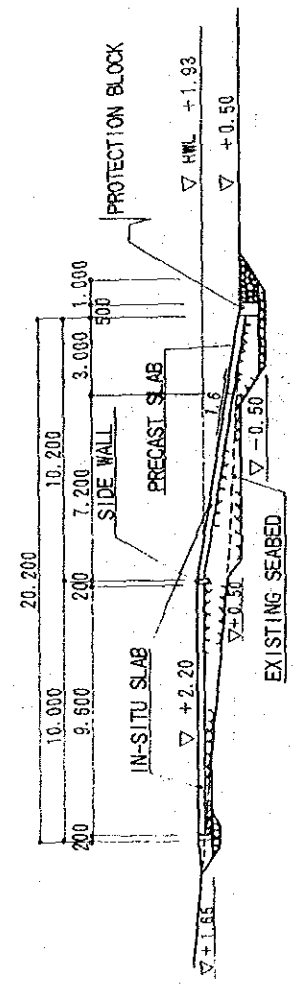
THE PROJECT FOR LOCAL FISHERY DEVELOPMENT IN THE REPUBLIC OF THE MARSHALL ISLANDS



PLAN



TYPICAL SECTION

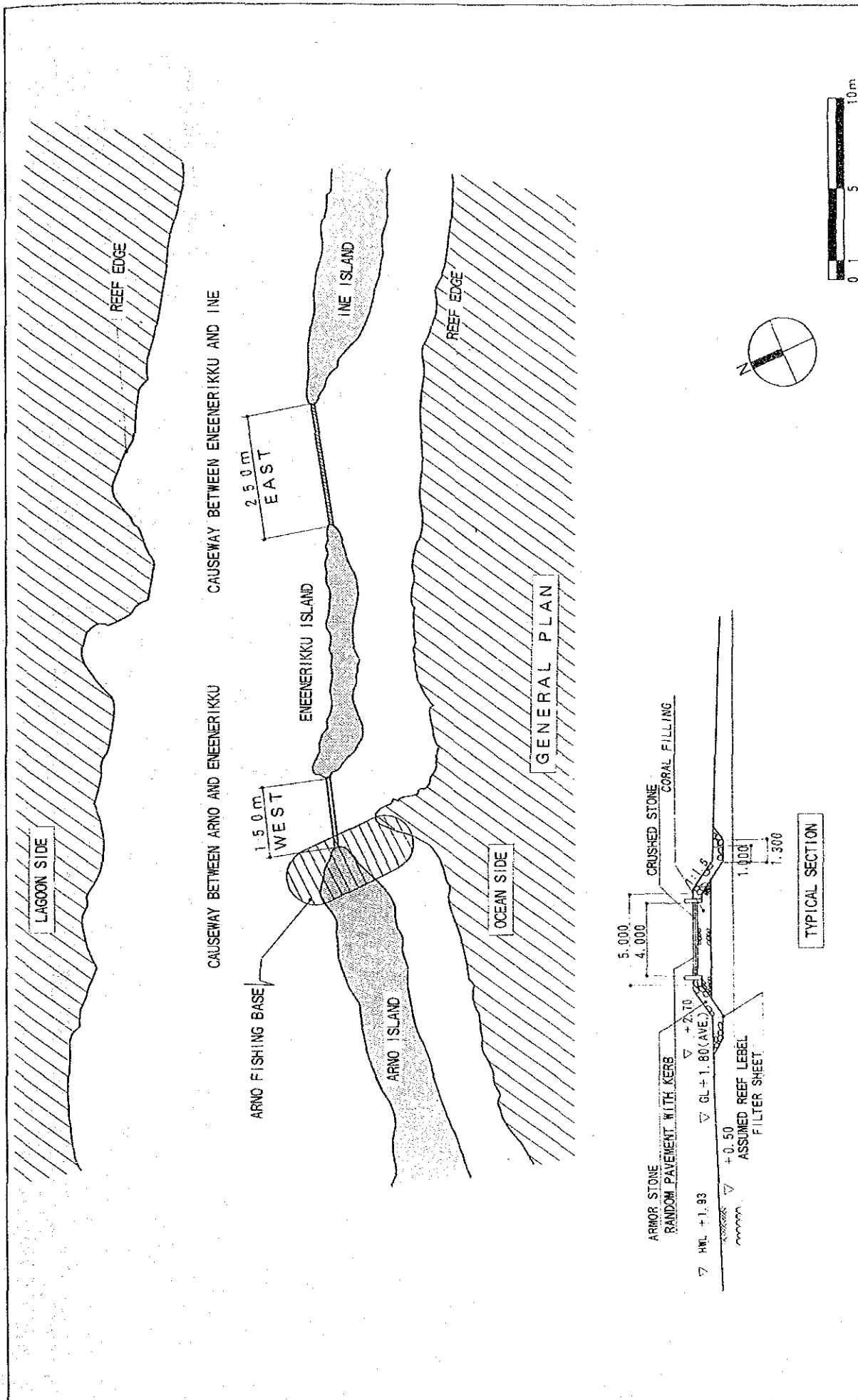


LONGITUDINAL SECTION

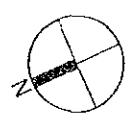


PLAN AND SECTION OF SLIPWAY AND BOAT YARD AT ARNO AND  
INE FISHING BASE

THE PROJECT FOR LOCAL FISHERY DEVELOPMENT  
IN THE REPUBLIC OF THE MARSHALL ISLANDS

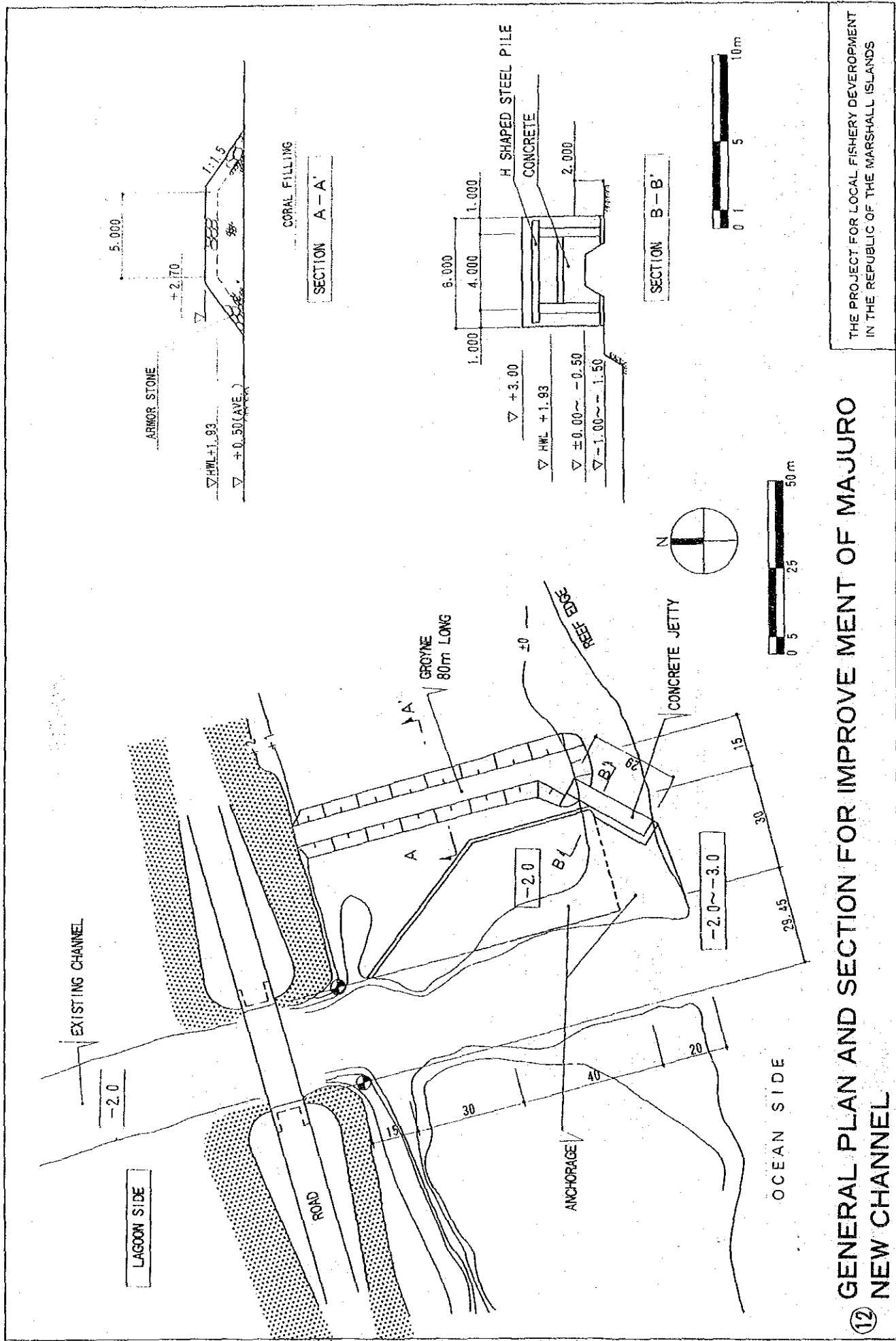


THE PROJECT FOR LOCAL FISHERY DEVELOPMENT  
IN THE REPUBLIC OF THE MARSHALL ISLANDS



**GENERAL PLAN AND SECTION OF CAUSEWAY BETWEEN ARNO AND INE**

(11)



THE PROJECT FOR LOCAL FISHERY DEVELOPMENT  
IN THE REPUBLIC OF THE MARSHALL ISLANDS

**GENERAL PLAN AND SECTION FOR IMPROVE MENT OF MAJURO  
NEW CHANNEL**

## **6. IMPLEMENTATION PLAN OF THE PROJECT**





## 6. IMPLEMENTATION PLAN OF THE PROJECT

### 6.1 Organization for Implementation of the Project

Marshall Islands Marine Resources Authority (MIMRA) in the Ministry of Resources and Development shall be responsible for the implementation of this Project. Preceding the implementation of the Project, the Government of Japan and the Government of the Marshall Islands will sign an exchange of notes. The detail design and supervision of the construction will be undertaken by Japanese consultants and the construction works will be undertaken by a Japanese construction firm on contract with the Government of the Marshall Islands, respectively. The consultant's contract and constructor's contract will be verified by the Japanese Government prior to the commencement of the Project.

MIMRA shall arrange matters in order to smoothly implement and complete the Project in cooperation with the Ministry of Public Works, Environmental Protection Authority, and other authorities of the Government of the Marshall Islands.

### 6.2 Undertaking of Both Governments

The undertaking of the Government of Japan and the Government of Marshall Islands for the construction work of this Project is indicated below.

Work Items	Japan	Marshall Islands
1. Securing of land		0
2. Clearing of site		0
3. Construction of road within the site	0	
4. Construction of buildings		
1) Construction of the Arno fishing base	0	
2) Construction of the Ine fishing base	0	
3) Construction of the causeway between Arno and Ine	0	
4) Improvement of the Majuro new channel	0	
5. To bear the commission to Japanese foreign exchange bank for the banking services based on the B/A (Banking Arrangement)		0
6. Import/custom clearance		
1) Transportation cost to Marshall Islands	0	
2) Tax exemption/custom clearance		0
3) Transportation within Marshall Islands	0	
7. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into Marshall Islands and stay therein for the performance of their work		0
8. To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant		0
9. To bear all the expenses other than those to be borne by the Grant, that are necessary for the transportation and the installation of the equipment		0
10. Proceedings for the construction and related approvals		0

## 6.3 Construction Plan

### 6.3.1 Construction Principle

The following are the construction principles keeping in mind that the Project is to be implemented by the Grant Aid of the Japanese Government.

- (1) Project sites are Arno Atoll (Arno and Ine islands) and Majuro Atoll, and the distance among the project sites are far. Therefore the suitable construction period shall be set to utilize the construction machinery efficiently and rationally.
- (2) Construction consists of civil work in the sea and architectural work on land. Since several kinds of complicated construction work will be necessary, an effective construction schedule shall be set up.
- (3) Skilled labour, building materials, construction machinery, electric and water supply necessary for the construction are quite difficult to obtain in Arno Atoll. Hence these items should be acquired and transported from Majuro. For this purpose, an construction plan having rational management schedule should be formulated.
- (4) To maintain a cordial relationship through consultation between the MIMRA, Consultant and Contractor

### 6.3.2 Items to be Considered on Construction

The following items for construction should be considered.

- (1) Construction labour and safety
  - Acquire and transport construction labour, material, and machinery from Majuro to Arno safely and on time
  - Safety measures shall be considered during construction work at the coral reef edge where swells break.
  - Safe handling and storage of dynamite
  - Prevention of accidents to neighboring facilities and third parties during blasting of dynamite. (Permit and participation of police is required.)
- (2) Construction techniques
  - Acquire necessary quantity of armour stone for groyne edge
  - Prevention of movement and deformation of the underwater form
  - Quality control of underwater concreting works
  - Quality of stone masonry of slope

- Prevent erosion of filled sand
- Prevent scour of causeway coral sand

### 6.3.3 Construction and Supervision Plan

#### (1) Construction Plan

The following considerations will be taken for the construction plan.

##### 1) Dredging work

Dynamite blasting will be carried out prior to dredging because the unconfined compression strength of coral rock in the planned dredging area is 400-600 kg/cm<sup>2</sup> in Arno atoll and about 800 kg/cm<sup>2</sup> in Majuro new channel. In the next stage the blasted rock and sand will be dredged by a large scale backhoe and transported to the planned location by dump trucks. These dredged rocks which are used for armour stones and surefooting stone must be 300-500 kg/piece. The dredging will be carried out after formulating optimum blasting plans to get the stones with the necessary weight and size.

##### 2) Construction work of groyne

Construction work in the oceanside of Arno and in the Majuro new channel will apply the method of extending temporary scaffolding from the land side. A rational schedule for dredging and groyne construction should be formulated because the dredged rocks obtained from dredging are used as materials for the groyne. Construction work shall be carried out at the same time.

##### 3) On-site concrete work

Construction of oceanside wharf and lagoon jetty will be carried out by underwater concreting with underwater form. Slipway construction work will be carried out under dry conditions during low tide. Quality control of concrete for underwater should be strictly maintained.

#### (2) Supervision Plan

The following considerations are to be taken for the supervision plan.

1) For smooth implementation of construction there should be sufficient consultation and discussion among the consultants, MIMRA, and other

relevant authorities from the detailed design stage.

2) Prior to construction, the consultants will examine the construction plan presented from the construction firm and judge precisely the appropriateness of work schedule, the safety of the work and quality control of materials, etc.

3) A rational construction schedule should be formulated through sufficient discussion related to the temporary work plan, operational plan of construction machinery, and labor management plan, since the construction sites are located in several different places.

#### 6.3.4 Procurement of Construction Machinery and Materials

Construction materials and machinery required for architectural and civil works and their transportation method are indicated below.

Items	Japan	Marshall Islands	Transport Method	Remarks
1. Construction machinery				
1) 2 m <sup>3</sup> backhoe	0		ship	Not available in Marshall Is.
2) Giant breaker	0		ship	- ditto -
3) Others		0		Available in Marshall Is.
2. Materials for civil works				
1) Filter sheet	0		ship	Not available in Marshall Is.
2) Cement, steel		0		Imported and stocked in Marshall Is.
3. Architectural materials		0		Imported and stocked in Marshall Is.
4. Upgrading materials	0		ship	Not available in Marshall Is.

## 6.4 Implementation Schedule

The implementation schedule is divided into three phases: detail design, tender, and construction of marine and land facilities.

### (1) Detail design

Tender documents will be formulated based on basic design which consists of documents on detail design, technical specifications, structure design, budgetary schedule, etc. Discussion on the detail design shall be held closely with the concerned agency of the Government of Marshall Islands at the initial, intermediate and final stages, respectively. The final documents shall be applied to tender after verification by the Government of the Marshall Islands.

### (2) Tender

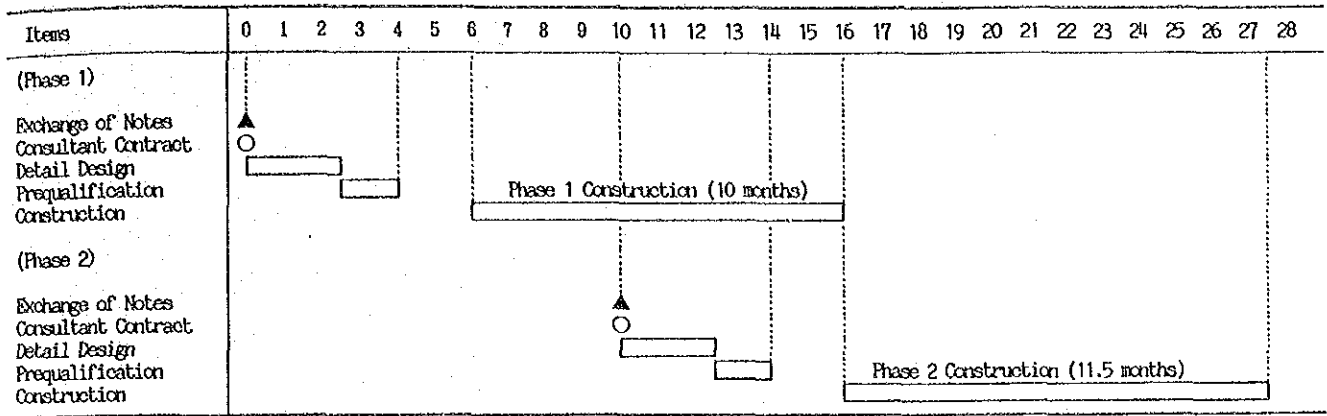
After the detail design work, the pre-qualification of tender participants will be conducted through the announcement of tender in Japan. The executing agency shall invite participating firms for tender based on the result of pre-qualification and conduct tendering in the presence of witnesses. The lowest tenderer will be the successful bidder and will sign a contract for the construction with the Government of the Marshall Islands, if the firm's tender is judged to be appropriate.

### (3) Construction works

The construction works will commence after the signing of the construction contract and its verification by the Government of Japan. Optimum construction schedule will be set up by examining the actual schedule, temporary works, procurement of materials and construction cost, etc. of each construction work item.

Construction period will be divided into two phases, and the contents of each phase and overall implementation schedule are shown in the following table and figure, respectively.

Phase	Contents
Phase 1	Construction works of marine and land facilities in Arno and Ine, Construction of causeway between Arno and Ine
Phase 2	Improvement of Majuro new channel



### 6.5 Portion of Project Cost by Government of the Marshall Islands

The portion of the construction cost to be borne by the Government of Marshall Islands is estimated to be US\$2,714. The portion of each phase is shown below.

Phase 1	US\$2,714
Phase 2	-
<b>Total</b>	<b>US\$2,714</b>





## **7. OPERATION AND MAINTENANCE PLAN**



## 7. OPERATION AND MAINTENANCE PLAN

### 7.1 Operation and Maintenance Organization

The executing agency, MIMRA shall be responsible for the operation and maintenance of all facilities provided in this Project, except for the Majuro new channel which will be undertaken by the Public Works Authority. As for the operation budget, the necessary budget arrangement will be allotted from the development budget of the current 5-year plan. In case of lack of budget, additional amount has to be supplemented from the national special budget through the request of MIMRA. planned in the recurrent budget by MIMRA.

A semi-public organization is planned to be established composing of 7-10 staff members for the operation of each fishing base and sales of fish catch related to Arno fishery. A Board of Directors consisting of representatives of Ministry of Resources and Development, Ministry of Outer Islands Development, MIMRA, etc. will be established for the operation. The operation regulations for the semi-public organization will be formulated by this board and at least one staff member of MIMRA will participate as a staff member in order to ensure public role of their activities and the private sector participation ensures effective operation and management. sector to participate based on the rules of operation provided by the Board of Directors headed by the Director of MIMRA.

### 7.2 Operation and Maintenance Plan

#### (1) Maintenance of facilities

All the facilities in this Project are basically maintenance free with the exception of the causeway, fishing base building and facilities.

The causeway should be periodically maintained because it is random paved. Maintenance costs such as the repainting of the building, maintenance of the generator, the cooling units of cold storage, the water pumps, etc. are required for the operation of the fishing base. The required amount of operation and maintenance cost is indicated in APPX.

2.2.5. The total amount of the operation and maintenance cost of the Project is estimated at about US\$5,645; and annual reserves for replacement for the facilities are estimated at about US\$42,475. This cost has to be

the burden of the organization executing the commercialization project of Arno fishery. However MIMRA will manage this project with the outer island fishery development budget in the initial stage of the Project. (US\$1.74 million has been budgeted during the plan period of the First Five Year Development Plan). At the stage when the operation is successfully implemented, the reserves for replacement will be under the jurisdiction of MIMRA and the replacement of facilities will be done by MIMRA. The maintenance of the causeway will be managed by MIMRA itself from the initial stage, since the causeway will be used not only for fisheries but also for other traffic purposes after construction.

(2) Trial calculation of financial balance for commercialization of Arno fishery

The balance of annual income and expenditures of commercialization of Arno fishery has been calculated and, shown as an example based on the conditions described in Section 4.2 and APPX. 2.2.1-3. (For details refer APPX. 2.2.5). In the calculation, the retail price of fish from Arno in Majuro is assumed to be US\$1.94/kg which is the same price as that of imported canned mackerel/sardine. The competition from the canned fish market is a factor in deciding the retail price of fresh fish. Therefore the sales price to the retailers in Majuro is US\$1.74/kg deducting the retailers' margin of US\$0.20/kg from the retailers' sales price. According to the result of the calculation, the total operation cost including fishing boats is US\$0.81 per one kg of fish. Assuming that the difference between the sales price and operation cost per one kg of fish shall be allocated to the fishermen's income, the per capita income of Arno fishermen will be US\$5,467 (US\$456/month). This is equivalent to the salary of a marine research specialist of MIMRA in the middle income class.

## **8. EVALUATION OF THE PROJECT**



## 8. EVALUATION OF THE PROJECT

### 8.1 Benefits of the Project

This project is included in the Outer Islands Development Project which has the highest priority in the the fishery development policy of the Government of Marshall Islands. The ultimate purpose of the project is to remove the present constraints in fishery such as lack of wharf facilities, distribution facilities, fishermen training facilities and fish transport system, and to modernize the fishery. The purpose is also to supply a stable protein source to Majuro and to give incentive to decrease the import and increase the export of fishery products. Greater development efforts are expected in this project with the establishment of a foundation for the outer islands fishery development.

The benefits of the project are as follows.

#### (1) Direct benefits

##### 1) Increase of fish catch at Arno and a supply of protein to Majuro

The fish catch at Arno and consumption of that fish in Majuro are expected to increase when the following are improved under the project.

##### (i) Improvement of fishing boat operation efficiency under the consolidation of infrastructure for fishery

Under the Project, jetties will be constructed where fishing boats can load or unload not only on the lagoon side but also on the ocean side. Slipway and road within the base will be constructed to easily carry the fishing boats between the lagoon side and the ocean side depending on the sea condition. Presently the fishing boats can operate only when the sea is calm and the tide is at medium level. When the project is completed, the above problems will be solved and the operating efficiency of fishing boats will be extremely high, and thereby increase of fish catch are expected.

##### (ii) Increase of fresh fish consumption in Majuro

Under this Project fresh fish caught at Arno will be transported and sold in Majuro. The fresh fish will be preserved in cold storage to maintain quality and the retail price will be set



equivalent to the price of canned mackerel and sardine. Therefore the fish is expected to be sold entirely to the consumers in Majuro. This will contribute to the protein supply of the people in Majuro whose population is increasing 6 percent per annum, and to decrease imported canned mackerel and sardine. The sales price of fish will be set at the same GIF price of canned fish. Consequently about 50 percent of imports (119 ton/year: US\$222,500/year) is expected to decrease regardless of consumer preference.

2) Increase of value added of fish with the establishment of fish transportation and marketing facilities

With the establishment of Arno and Ine fishing base, the ice for chilling fish will be supplied stably and the fish will be preserved at - 5°C after catching. At present fish is consumed within the day or dried because there is no storage as mentioned previously. Under this project the quality of the fish is preserved for about seven days. Value added of fresh fish from Arno will increase as a commercial product.

3) Time saving on transportation between Arno and Majuro

The transport vessels have been plying the reef under risky conditions by following the tide level and waiting for right time. After the construction of loading jetty on the ocean side of Arno Island, and causeway, considerable time can be saved in transport at least between Majuro and integrated area of Arno and Ine.

4) Increase of fish catch by the improvement of the Majuro new channel

With the improvement of the channel, safe passage will be upgraded and fishermen can concentrate on fishing without worrying about the time spent passing through the channel. Night fishing will also increase. This will contribute to the increase in fish catch.

(2) Indirect benefits

1) Modernization and activation of fishery depend on the following factors.

- Propagation of planned fishery
- Increase in opportunity of cash income for fishermen

2) Increase in the income of the people in Arno, strengthening of self-support among fishermen, and diversification of income source through fishery training.

3) Development of the unexploited fish resources

4) To provide incentive to develop future export of fishery products

5) To provide incentive to develop industries created by material and personnel exchanges between Arno and Ine through the constructed causeway

## 8.2 Justification of the Project

MIMRA, the executing agency for the project, is responsible for the development of fisheries resources which is the greatest natural resource of the country. The government is also planning to put effort on the development. MIMRA has a short history and few results. Nevertheless the government has allocated a comparatively large budget to this small agency with a staff of 25. It is also possible to supplement the budget from the government's special fund when the budget falls short.

It is projected that the estimated maintenance cost of the facilities of this Project can be realized from MIMRA's budget, since the amount is not large.

The establishment of a fishing base under this Project contributes to the modernization of Arno fishery, development of unexploited fish resources, and an increase of protein supply to Majuro. Furthermore, it may play a role in decreasing imports of canned fish. The project is expected to contribute to increasing the opportunities for earning cash income among the Arno people, to activate fishery and to promote future fishery export through the commercialization of Arno fishery.

While some of the coral or reef edge will be destroyed by dynamite blasting during the construction works, the area affected will be small. Hence the ecosystem in and outside the coral reef will not be affected.

Consequently, based on the above justification, the implementation of the project is appropriate.



## **9. CONCLUSIONS AND RECOMMENDATIONS**



## 9. CONCLUSIONS AND RECOMMENDATIONS

### 9.1 Conclusions

The project will play a role to remove constraints that are hampering the development of fisheries in the Marshall Islands. The project is expected to contribute greatly to the promotion of outer island fishery through the activation and modernization of fishery, increase domestic protein supply, decrease imported fishery products, and increase opportunity to export fishery products in future. Consequently it is justifiable for the Government of Japan to implement the Project under Japanese grant aid.

### 9.2 Recommendations

In order to implement and operate the project smoothly and efficiently it is recommended that the Government of Marshall Islands arrange the following important matters.

(1) The Government of Marshall Islands should allocate local construction costs and initial operation cost. The basic concept of the organization of the operation system for commercialization is indicated in this study. However, detailed operation schedule and cooperation with the MIMRA as the executing agency, shall be determined before implementation.

(2) Commercial fishery activity in Arno atoll is the first undertaking to promote coastal fishery development among the outer islands. For the Project to succeed, it is necessary to fix the price of fish caught in Arno at the same price as imported canned fish, so that fish can be sold in Majuro. This price will be very cheap compared to the present retail price. Therefore it is necessary to explain to the fishermen who want to participate in this initial undertaking that their income will be increased, in order to obtain their cooperation.

(3) An essential element in Arno fishery commercialization is to preserve fish quality. Therefore MIMRA will be responsible for the provision of a stable supply of ice, an appropriate cold storage system, a sales system, and will educate fishermen on the need to preserve fish. It is especially

important to set up a close cooperative system and to extend the effects of the technical cooperation currently implemented by OFCF to this Project.

APPENDIX

APPENDIX 1

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## APPENDIX 1



## Appendix 1

### 1.1 Members the Basic Design Study Team

#### 1) Basic Design Study

---

Name	Speciality (Present Department)
1) Satoshi KAMISE	Team Leader (Deputy Director, Construction Division, Fishing Port Department, Fishery Agency)
2) Masaki HOSHINA	Grant Aid Cooperation (Grant Aid Cooperation Division, Ministry of Foreign Affairs)
3) Tamotsu TOMIYAMA	Fishery Development Planner (System Science Consultants Inc.)
4) Mikio HIGAI	Civil Engineer (System Science Consultants Inc.)
5) Kyoichi SUGIYAMA	Architect & Mechanical Engineer (System Science Consultants Inc.)
6) Hiroshi FUTAMI	Fishing Vessel & Fishing Gear (System Science Consultants Inc.)
7) Masao OKUDA	Natural Condition Survey (System Science Consultants Inc.)
8) Soichi TAKAI	Cost Estimation (System Science Consultants Inc.)

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#### 2) Draft Report Explanation

---

Name	Speciality (Present Department)
1) Satoshi KAMISE	Team Leader (Deputy Director, Construction Division, Fishing Port Department, Fishery Agency)
2) Kenji Ishiwata	Project Coordinator Kanagawa International Fisheries Training Centre, (Japan International Cooperation Agency)
3) Tamotsu TOMIYAMA	Fishery Development Planner (System Science Consultants Inc.)
4) Mikio HIGAI	Civil Engineer (System Science Consultants Inc.)

---

## 1.2 Study Team Survey Itinerary

### 1) Basic Design Study

DATE	ITINERARY	DESCRIPTION
1. Feb. 27 (Mon)	Narita - Guam	Departure of Team (excluding Architect & Mechanical Engineer and Cost Estimator); overnight stay at Guam
2. Feb. 28 (Tue)	Guam - Majuro	Courtesy call to Japanese Consulate General in Agana; Arrival in Majuro
3. Mar. 1 (Wed)	Majuro	Site survey (Majuro channel, Fishing base, etc.); courtesy call to Minister of Foreign Affairs
4. Mar. 2 (Thu)	Majuro	Courtesy call to Minister of Resources and Development and Minister of Interior and Outer Island Affairs; Explanation of the Inception Report
5. Mar. 3 (Fri)	Majuro - Arno	Site survey (Arno Atoll, Proposed new water channel site, Dodo atoll, etc.)
6. Mar. 4 (Sat)	Arno	Site survey (Malelu atoll, Ine atoll and proposed causeway, etc.)
7. Mar. 5 (Sun)	Arno - Majuro (Arno)	Site survey (Ine atoll, proposed new water channel, etc.) Commencement of the survey of the natural conditions by the respective team members and continued till March 21.
8. Mar. 6 (Mon)	Majuro	Meeting of team members and discussion with expert of OFCF.
9. Mar. 7 (Tue)	Majuro (Narita - Guam)	with the government of Marshall Islands Departure of Architect & Mechanical Engineer and Cost Estimator

DATE	ITINERARY	DESCRIPTION
10. Mar. 8 (Wed)	Majuro (Guam - Majuro)	Meeting with the government of Marshall Islands; Preparation of minutes of discussion Arrival of Architect & Mechanical Engineer and Cost Estimator
11. Mar. 9 (Thu)	Majuro	Signing of minutes of discussion and party by the Team Leader
12. Mar. 10 (Fri)	Majuro - Guam Majuro	Departure of Japanese government members of the team Collection of data by team members of consultants
13. Mar. 11 (Sat)	Majuro	Collection of data by team members of consultants
14. Mar. 12 (Sun)	Majuro	Analysis of data
15. Mar. 13 (Mon)	Majuro - Arno	Fishery survey (Arno)
16. Mar. 14 (Tue)	Arno	Fishery survey (Arno, Dodo)
17. Mar. 15 (Wed)	Arno - Majuro	Fishery survey (Malelu, Ine)
18. Mar. 16 (Thu)	Majuro	Collection of data and reports
19. Mar. 17 (Fri)	Majuro	Collection of data and reports
20. Mar. 18 (Sat)	Majuro	Collection of data and reports
21. Mar. 19 (Sun)	Majuro	Analysis of data
22. Mar. 20 (Mon)	Majuro	Meeting of team members and conference with staff of Marine Resources Authority
23. Mar. 21 (Tue)	Majuro (Arno - Majuro)	Collection of data and reports (Planning Office, Marine Resources Authority, etc.) Return of Natural Condition surveyor from Arno

DATE	ITINERARY	DESCRIPTION
24. Mar. 22 (Wed)	Majuro  (Majuro - Guam)	Collection of data and reports (Custom Office, Public Works Office, etc.); site survey of Majuro Channel by Natural Condition Surveyor till March 25. (Departure of Civil Engineer and Fishing Vessel & Fishing Gear Expert.)
25. Mar. 23 (Thu)	Majuro	Collection of data and reports (MFGA, Majuro Fishermen, etc.)
26. Mar. 24 (Fri)	Majuro	Collection of data and reports (Environmental Agency, Public Works Office, etc.)
27. Mar. 25 (Sat)	Majuro  -- Ine - Majuro	Collection of data and reports (Private construction firms, etc.) Site survey of Ine Atoll again
28. Mar. 26 (Sun)	Majuro - Guam	Depart Majuro
29. Mar. 27 (Mon)	Guam - Narita	Arrival in Japan

2) Draft Report Explanation

DATE	ITINERARY	DESCRIPTION
1. May 22 (Mon)	Narita - Guam Guam - Majuro	Departure of Team; Courtesy call to Japanese Consulate General in Agana; Arrived in Majuro
2. May 23 (Tue)	Majuro	Courtesy call to Director of Marine Resources and meeting with the staff
3. May 24 (Wed)	Majuro	Courtesy call to Secretary of Foreign Affairs and Minister of Resource Development; Explanation of draft report
4. May 25 (Thu)	Majuro	Explanation of draft report
5. May 26 (Fri)	Majuro	Preparation and discussion on draft of minutes of discussion
6. May 27 (Sat)	Majuro	Preparation and discussion on minutes of discussion
7. May 28 (Sun)	Majuro	Meeting of team members
8. May 29 (Mon)	Majuro	Signing of minutes and party by the Team Leader
9. May 30 (Tue)	Majuro - Guam	Departed Majuro
10. May 31 (Wed)	Guam - Narita	Courtesy call to Japanese Counsel Office in Agana; Return to Japan



### 1.3 Name of Members Contacted

#### 1) Basic Design Study

Organization	Position	Name
- Related Japanese Personnel		
1. Consulate General Office, Agana	Counsel General Counsel	Masao Wada Tetsuyuki Yokoyama
2. JICA	JICA Expert (Majuro)	Takashi Fujisaki
3. OFCF	OCFC Expert (Majuro) OCFC Expert (Majuro) OCFC Expert (Majuro)	Shozo Hiwatashi Katsuji Fujita Kohichi Sakonju
- Authorities concerned in Marshall Islands		
4. Office of President	President	Amata Kabua
5. Ministry of Foreign Affairs	Minister	Tom Kuiner
6. Ministry of Resources and Development	Minister Secretary	Brenson Wase Donald Capelle
7. Ministry of Interior and Outer Islands Affairs	Minister Secretary Chief of Outer Islands Affairs	Kunar Abner Witten Philipppo Danay Jack
8. Ministry of Public Works	Minister Cost Inspector Budget Officer	Amsa Jonathan Jackie Kijrik Gordon Madison
9. Office of Chief Secretary	Asst. Attorney General Chief Planner	Johnsay Riklon Jewon Lemari
10. Marshall Islands Marine Resources Authority	Director Acting Director	Steve Muller Capital Bani
11. Marshall Islands Development Authority	Asst. Manager	Danny Wase
12. Environmental Protection Authority	Managing Director	Robert Kelen
13. Ministry of Social Services	Chief of Food Services	Zed Zedhkeia
14. Others	Senator of Arno Iroij	Leikman Robert Rillang Tarkim

2) Draft Report Explanation

Organization	Position	Name
- Related Japanese Personnel		
1. Consulate General Office, Agana	Counsel General Counsel	Masao Wada Tetsuyuki Yokoyama
2. JICA	JICA Expert (Majuro)	Takashi Fujisaki
3. OFCF	OCFC Expert (Majuro) OCFC Expert (Majuro) OCFC Expert (Majuro)	Shozo Hiwatashi Katsuji Fujita Kohichi Sakonju
- Authorities concerned in Marshall Islands		
4. Ministry of Foreign Affairs	Secretary	J.B. Kabua
5. Ministry of Resources and Development	Minister Secretary	Brenson Wase Donald Capelle
6. Ministry of Interior and Outer Islands Affairs	Minister	Kunar Abner
7. Office of Chief Secretary	Asst. Attorney General	Johnsay Riklon
8. Marshall Islands Marine Resources Authority	Director Acting Director Fisheries Officer	Steve Muller John Bungitak Capital Bani
9. Environmental Protection Authority	Managing Director	Robert Kelen
10. Others	Senator of Arno Professional Engineer	Leikman Robert David Ackley

1) Basic Design Study

MINUTES OF DISCUSSION  
ON  
THE PROJECT FOR LOCAL FISHERY DEVELOPMENT  
IN  
THE REPUBLIC OF THE MARSHALL ISLANDS

The response to the request of the Government of the Republic of the Marshall Islands, the Government of Japan decided to conduct a basic design study on the Project for Local Fishery Development and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Republic of the Marshall Islands the study team headed by Mr. Satoshi Kamise, Deputy Director, Construction Division, Fishing Port Dept., Fishery Agency, Ministry of Agriculture, Forestry and Fisheries, from February 27 to March 27, 1989.

The team had a series of discussions on the project with the officials concerned of the Government of the Republic of the Marshall Islands headed by Honorable Brenson S. Wase, Minister of Resources & Development, and conducted a field survey in Majuro Atoll and Arno Atoll.

As result of the study, both parties agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the project and subject to approval by both Governments.

        
Mr. Satoshi Kamise  
Team Leader  
Basic Design Study Team  
Japan International  
Cooperation Agency

89.3.9  
Date

       3-9-89  
Hon. Brenson S. Wase  
Minister of Resources & Dev.  
Government of the Republic of  
the Marshall Islands

Attachment

## 1. Objective of the Project

The Objective of the Project is to activate the local fishing communities for ensuring effective and efficient operation of fishing and promote the commercialization of fish caught by constructing facilities and providing equipment.

## 2. Executing Agency

The Marshall Islands Marine Resources Authority under the Ministry of Resources & Development is responsible for the administration and implementation of the Project as well as the management of the facility.

## 3. Request of the Government of the Marshall Islands

The contents of the Project required by the Government of the Republic of the Marshall Islands are listed in Annex I. The team will convey the request of the Government of the Marshall Islands to the Government of Japan that the latter will take the necessary measures to cooperate by providing the items listed in Annex I within the scope of the Japan's Grant Aid Program.

## 4. Project Site

The site of the Project is located at Majuro Atoll and Arno Atoll as shown in Annex II.

## 5. Undertaking of the Government of the Marshall Islands

The Government of the Marshall Islands will take necessary measures listed in Annex III on condition that the Grant Aid of the Government of Japan would be extended to the Project.

## 6. Understanding of Japan's Grant Aid System

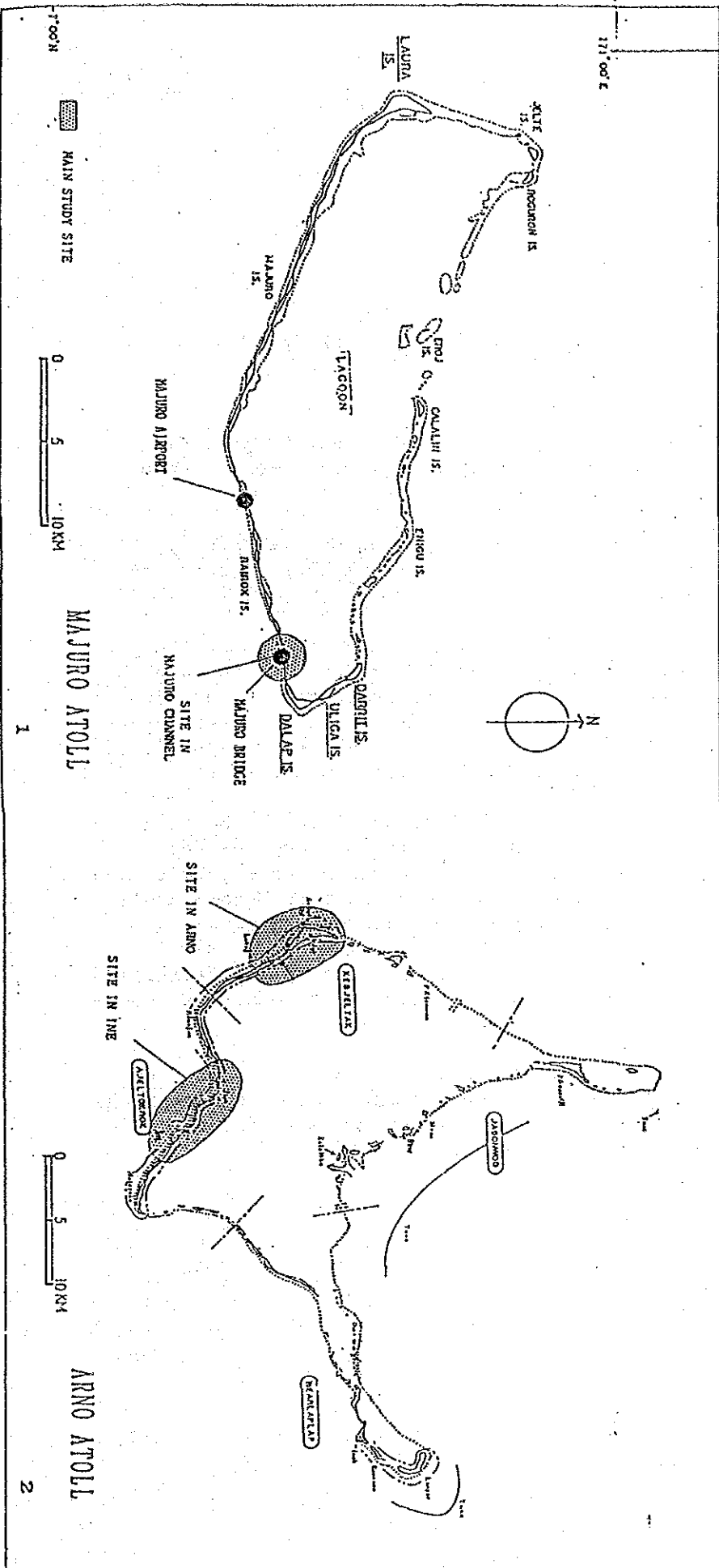
The Marshall Islands side has understood Japan's Grant Aid System explained by the team which includes a principle of use of a Japanese Consulting Firm and a Japanese Firm for the construction.

(3p)

ANNEX I

1. Equipment for Fish Catch
  - 1) Fishing vessel
  - 2) Fishing gear
  - 3) Others
  
2. Supporting Facilities
  - 1) Storage for ice and fish
  - 2) Water tank
  - 3) Fuel supply facility
  - 4) Lighting
  - 5) Others
  
3. Infrastructure
  - 1) Jetty and pier
  - 2) Slipway
  - 3) Causeway
  - 4) Improvement of the Majuro channel
  - 5) Multipurpose working space
  - 6) Others





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ANNEX III

## UNDERTAKING OF THE GOVERNMENT OF THE MARSHALL ISLANDS

1. To take administrative procedure necessary by providing available facilities and equipment prior to commencement of the construction.
2. To provide facilities for distribution of electricity, water supply and other incidental facilities at least to the Majuro site.
3. To ensure prompt unloading and custom clearance at the port of disembarkation at Majuro and to secure that the Japanese nationals shall not be subject to any custom duties, internal taxes and other fiscal levies imposed in the Republic of the Marshall Islands, with respect to the supply of materials and services under the verified contracts.
4. To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the verified contract entry permits, work permits and visas as may be necessary for the entry into Majuro Atoll and stay therein for the performance of their work.
5. To maintain and use properly and effectively the facilities and equipment purchased under the grant, for the execution of their work.
6. To bear all the expenses other than those to be borne by the grant, including operation and maintenance cost for the facility and equipment and necessary expenses for the Banking Arrangement Commission.

(7)

(12)

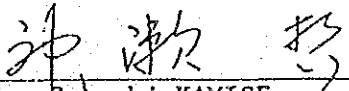
MINUTES OF DISCUSSIONS  
ON  
THE LOCAL FISHERY DEVELOPMENT PROJECT  
IN  
THE REPUBLIC OF THE MARSHALL ISLANDS


In response to the request made by the Government of the Republic of the Marshall Islands for grant aid for the Local Fishery Development Project (herein after referred to as "the Project"), the Government of Japan decided to conduct a basic design study on the Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Republic of the Marshall Islands the team headed by Mr. Satoshi KAMISE, Deputy Director, Construction Division, Fishing Port Department, Fishery Agency, Ministry of Agriculture, Forestry and Fisheries, from 27th February 1989 to 27th March 1989.

As a result of the study, JICA prepared a Draft Report and dispatched a team headed by Mr. Satoshi KAMISE, Deputy Director, Construction Division, Fishing Port Department, Fishery Agency, Ministry of Agriculture, Forestry and Fisheries to explain and discuss it with the relevant officials of the Government of the Republic of the Marshall Islands from 22nd to 31st May 1989.

Both parties had a series of discussions on the Report and agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

29th May 1989

  
Mr. Satoshi KAMISE  
Leader of the Draft Final Team  
Japan International Cooperation  
Agency

  
Donald F. Capelle  
Secretary, Resources & Dev.  
Government of the Republic  
of the Marshall Islands



## ATTACHMENT

1. The Government of the Republic of the Marshall Islands side has in principle agreed to the basic design proposed in the draft final report and appropriate amendments as shown in ANNEX I will be incorporated in the Final Report.
2. The Government of the Republic of the Marshall Islands side has understood Japan's grant aid system and confirmed the necessary measures to be taken by the Marshall Islands side for the realization of the Project shown in ANNEX II.
3. The Government of the Republic of the Marshall Islands has confirmed that within its limited resources, the necessary budget including an adequate number of personnel with sufficient knowledge and experience will be provided for the effective operation and maintenance of the Project.
4. The Final Report (10 copies in English) will be submitted to the Government of the Republic of the Marshall Islands side by 31st August 1989.

ANNEX I:

1. The Government of the Republic of the Marshall Islands side agreed with the implementation schedule as summarized below:

Phase I : Construction of fishing bases (supporting facilities and infrastructure) in Arno Island and Ine Island

Phase II : Improvement of the Majuro New Channel

2. Both sides agreed to the following modifications:

- (1) Multipurpose Working Building

- 1) Aluminum or stainless steel fasteners to be applied for fixing the aluminum roof
- 2) Pumps with stainless steel shaft and wetted parts will be supplied
- 3) Interior floor finishing is to be concrete mortar
- 4) Electric motors to be protected by a proper coverage method against salty water/wind
- 5) Adequate spare parts for mechanical and electrical equipments will be provided

- (2) Improvement of the Majuro New Channel

- 1) A beacon light is to be installed to the ocean side and to the lagoon side of the channel

ANNEX II:

## UNDERTAKING OF THE GOVERNMENT OF THE REPUBLIC OF THE MARSHALL ISLANDS

1. To take administrative procedure necessary by providing available facilities and equipment prior to commencement of the construction. Especially, the highest priority to be taken for arrangement of transportation of construction materials and machines to Arno Atoll.
2. To provide facilities for distribution of electricity, water supply and other incidental facilities at least to the Majuro site.
3. To ensure prompt unloading and custom clearance at the port of disembarkation at Majuro and to ensure that the Japanese nationals shall not be subject to any custom duties, internal taxes and other fiscal levies imposed in the Republic of the Marshall Islands, with respect to the supply of materials and services under the verified contracts.
4. To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the verified contract entry permits, work permits and visas as may be necessary for the entry into Majuro Atoll and stay therein for the performance of their work.
5. To maintain and use properly and effectively the facilities and equipment purchased under the grant, for the execution of their work.
6. To bear all the expenses other than those to be borne by the grant, including operation and maintenance cost for the facility and equipment and necessary expenses for the Banking Arrangement Commission.