4.3 Design of Basic Fishery Facilities

4.3.1 Lelu Site

Facilities in the Lelu site are planned in an area sheltered from waves by a shallow reef flat and the Lelu island. The existing fishery facilities are located at the northeastern end of an old runway. New facilities planned in the project will be located in the central section of the runway as shown in Fig. 4.3. The northwestern end of the runway is better location for berthing facilities in view of ship maneuvering however subsoil conditions are extremely poor and therefore not selected through economical and technical consideration. A hatchery of giant clam is planned between the existing fishery facilities and the new facilities and it is confirmed that there is no problem in land uses of both projects.

(1) Wharf

A wharf is designed based on the Japanese Design Standards; Technical Standard of Port Facilities, Design Standard of Fishing Port and Manual of Fishing Port Planning.

Design ships

The following boats owned by the Marine Resources Division and the Kosrae Island Fishing Cooperative Association will used the wharf proposed in the project.

1) Bonito Test Fishing Boat "Mutunte"
   LOA 16.0m Beam 3.5m Draft 1.8m

2) Training/Fishing Boat "MRD Hope"
   LOA 11.1m Beam 2.6m Draft 1.2m

3) Patrol/Research Boat "Marine Hunter"
   LOA 9.3m Beam 2.5m Draft 0.9m

4) Yanmer 25' FRP Boat (2 Nos.)
   LOA 8.0m Beam 1.9m Draft 0.8m

5) Yamaha FRP Boat (2 Nos.)
LOA 6.6m Beam 2.2m Draft 0.9m

6) Catamaran Boat (2 Nos.)
LOA 7.6m Beam 2.7m Draft 0.75m

7) Small FRP Skiff
LOA 4.0m Beam 1.5m Draft 0.5m

Length of wharf

As will be mentioned in a following section, an apron height of the wharf is designed as D.L. + 2.5 m and this height prohibits an efficient operation of smaller ships listed above at a low tide. This difficulty could be solved by providing a stairway in front of the wharf. These smaller ships can be advantageously moored in a new mooring facility for the catamaran boats or at the existing floating pontoon.

Thus, the required wharf length to berth "Mutunte" and "MRD Hope" alongside the wharf with a ship-to-ship clearance of 15% of LOA plus space for a stairway at the eastern end of the wharf (approx. 2.5m) is calculated as follow;

Required wharf length = (16.0 + 11.1) x 1.15 + 2.5 = 34m

Berthing arrangement is shown in Fig. 4.4.

Depth of wharf

A depth of the wharf is designed as the maximum draft of the ship plus a keel clearance. The maximum draft is that of "Mutunte" 1.8 m and if 0.7 m is taken as a keel clearance according to the Japanese Design Standard, the required depth of the wharf is calculated as 2.5 m. A water area in the proposed construction site of the wharf has been already deepened by dredging to D.L. - 3-4 m and the design depth of the wharf is determined as D.L. -3.0 m.

Apron height

According to the Japanese Design Standard, a height of the wharf is determined as D.L. + 2.5 m by adding a clearance of 0.7 m to H.H.W.L. D.L. + 1.8 m.

Design of wharf

Design conditions of the wharf are as follow.

(1) Wharf and external force

1) Design ship; "Mutunte"

2) Dimension of Wharf

Length	34.0 m
Depth	D.L. -3.0 m
Height	D.L. +2.5 m
Apron Width	10 m

3) Surcharge, etc.

Normal condition	1.0 t/m^2
Seismic condition	0.5 t/m^2
Berthing velocity	0.5 m/sec
(for ship smaller than 100 DT)	

(2) Tide, soil, etc.

1) Tide

H.H.W.L.	D.L. +1.84 m
L.L.W.L.	D.L. +0.00 m

2) Earthquake

Horizontal Seismic Factor Kh=0.1

3) Subsoil conditions

A bearing stratum is at an elevation of approximately D.L. -30 m inclining toward the northwestern end of the runway and an intermediate layer is poor silty sand with N value 2-4.

(3) Materials

1) Unit weight

Steel	7.85 t/m^3
Reinforced concrete	2.45 t/m^3
Concrete	2.30 t/m^3
Sea water	1.03 t/m^3

2) Concrete

Design strength	6ck=240 kg/cm^2
Allowable bending	6ca=90 kg/cm^2
Compression	

3) Steel

Allowable bending tension	1,400 kg/cm^2
Allowable bending compression	1,400 kg/cm^2
Shearing stress	800 kg/cm^2

(4) Structural type of wharf

Sub-soil conditions in the proposed construction site are very poor with a bearing stratum lying deep at about D.L. -30 m. The intermediate layer is very soft silty sand with N value 2-4. Structural types adoptable to this sort of a poor soil condition are an open type pipe pile, a sheet pile bulkhead type and a floating pontoon type. A sheet pile bulkhead type requires large construction equipment and a large scale replacing work of poor sub-soil including the existing runway. A long term non-uniform settlement is a frequently experienced problem to this type. A floating pontoon does not require heavy construction equipment but is higher in mobilization and assembly costs. And it is not convenient for a car access and handling heavy cargos and is difficult in a maintenance work.

Two existing wharfs in Lelu and Okat are constructed in the similar soil condition and an open type pipe pile type is adopted at both sites. Through consideration of sub-soil conditions, construction methods, construction costs, etc., the open type pipe pile is selected and a standard cross section is shown in Fig. 4.5.

Ancillary facilities

An arrangement of ancillary facilities is shown in Fig. 4.6.

- Rubber fender
  Rubber fenders of 100h x 300w x 2500l are installed at intervals of 3 m.

- Bollard
  6 bollards are installed at intervals of 6 m.

- Curbing
  Curbings are installed between bollards to secure safety of vehicles working on the wharf apron.

Width of apron

A width of a wharf apron is designed at 10 m according the Japanese Design Standards of Fishing Port.

Fuel tank

Ships which use the planned wharf requiring diesel oil have the following capacities of fuel tanks.

Ship's Name	Fuel Tank
Mutunte	1600 l
MRD Hope	800 l
Marine Hunter	140 l
Yanmer DA 25	80 x 2 = 160 l
Total	2,700 l

All the above ships are operated twice a week in average and a service frequency of fuel supply by a tank lorry is once a week. A capacity of a fuel tank is calculated by assuming 20% allowance at the end of one week services as below.

Required tank capacity = 2,700 x 2 x 1.2 = 6,450 = 6.5 kl

A sketch of the full tank is shown in Fig. 4.7.

Approach channel and turning basin

The approach channel to the wharf is wide and deep enough and no dredging work is required. The water area in front of the wharf is small and requires a dredging work.

(2) Mooring facility for catamaran boats

A layout of mooring facilities is shown in Fig. 4.8. Part of an area planned for the mooring facilities has already been dredged and reclaimed.

Structural type

A tidal range at the construction site is relatively large and a fixed type is not advantageous for a small boat in mooring and loading/unloading operations. A floating pontoon type is presently used in Lelu and Okat and is selected for the mooring facilities for the catamaran boats in this project.

Design ship

The mooring facilities of pontoon type are to be used by the catamaran boats and the other small boats. The dimensions of the catamaran boats are described in the previous section.

Design depth

A mooring basin is to accommodate the catamaran boats and the other small boats owned by the Marine Resources Division and the required depth is calculated as 1.25 m (draft 0.75 m + clearance 0.5 m).

Required length of mooring facilities

There are 30 catamaran boats in the Lelu district and the mooring facilities are designed long enough to accommodate all the catamaran boats and the other small boats. A layout of the mooring facilities is shown in Fig. 4.8. The catamaran boats are moored lengthwise at stern with ship-to-ship clearance of 1.0 m. A total required length of pontoons is calculated as 70 m. A structural type of floating FRP pontoon unit is the same as that of the existing ones.

Fixing method

Two types of fixing floating pontoons are presently in use namely an anchor chain and a pile. An anchor chain type allows movement of a pontoon when a horizontal force acts on it especially at low tide. A pile type is selected and used with a bracing steel reinforcement on pile tops to secure stability of piles driven into poor sub-soil.

Access bridge

As shown in Fig. 4.9, an access bridge is fixed by hinges on a landside end while a roller on the other end on pontoon. The bridge is aluminum made and 1.0 m wide and 8.5 m long.

Fuel tank

Similarly as the fuel tank of diesel oil, a required capacity of a fuel tank supplying gasoline to the catamaran boats is calculated using the data obtained through a interview survey to catamaran boat owners.

Required capacity of fuel tank = 30(boats) x 16.5(gall) x 4(day/week)
x 3.7853(l/gall) x 1.2 = 8,9941 = 9.0 kl

A sketch of the fuel tank is shown in Fig. 4.7 and its structure is the same as that of the gasoline tank.

(3) Slipway

A structure of a slipway for the catamaran boats is shown in Fig. 4.10. A slope of the slipway is 1/6 and concrete paved with a toe elevation D.L. -0.5 m and a top elevation D.L. +2.5 m. The catamaran boats can be uphauled by a manual winch at a mean water level and the other small boats except "Mutunte" can be uphauled at a higher tide.

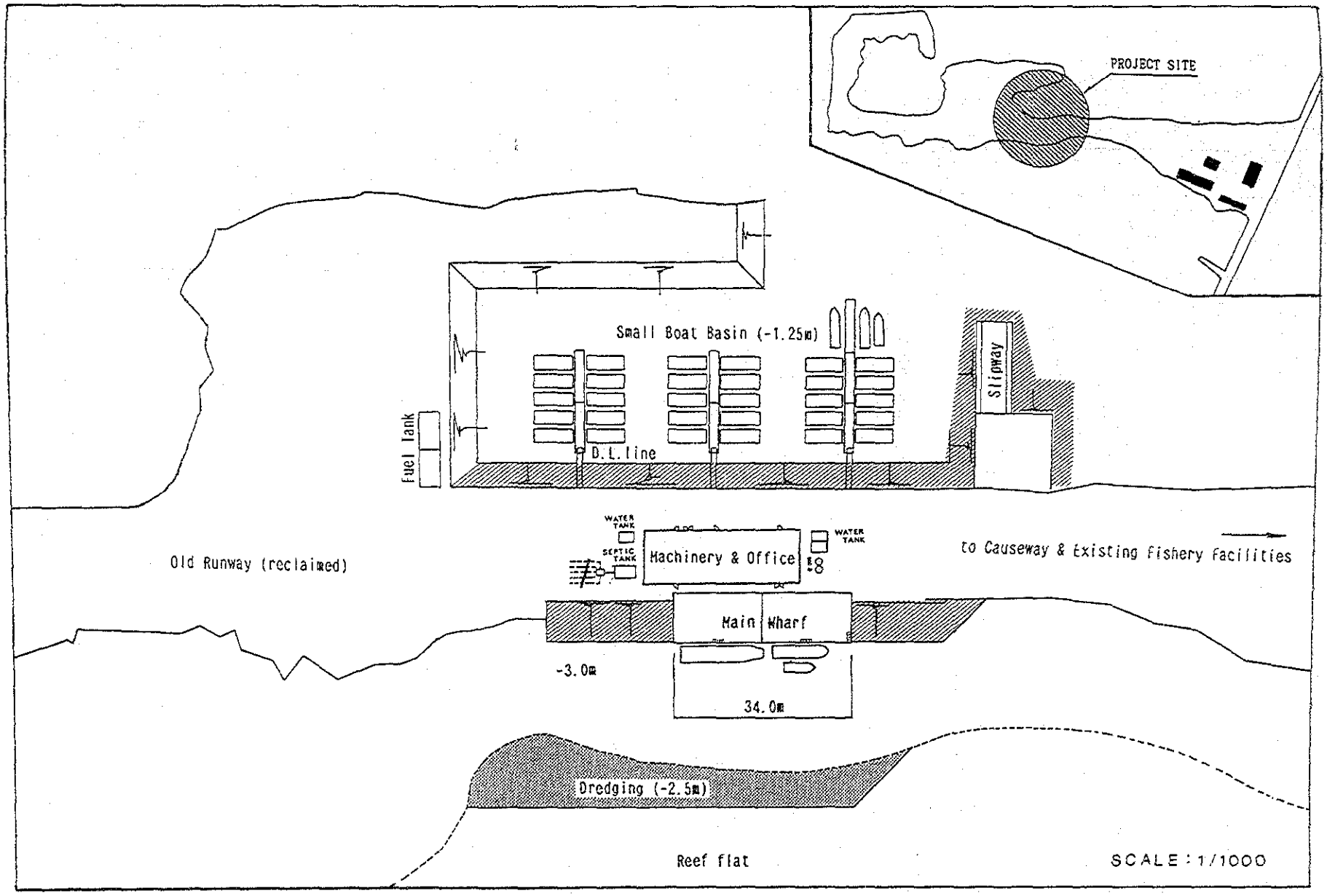


Fig.4.3 Layout of Fishery Facilities, Lelu

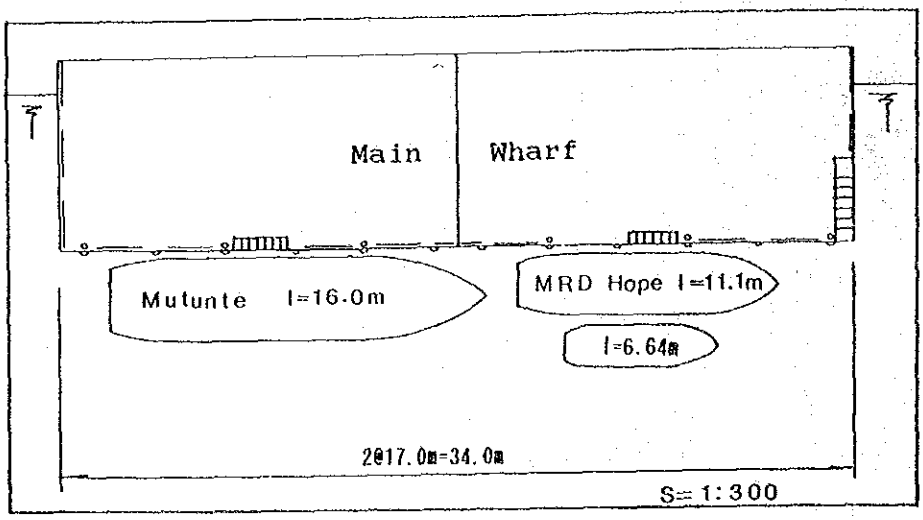


Fig.4.4 Mooring Arrangement

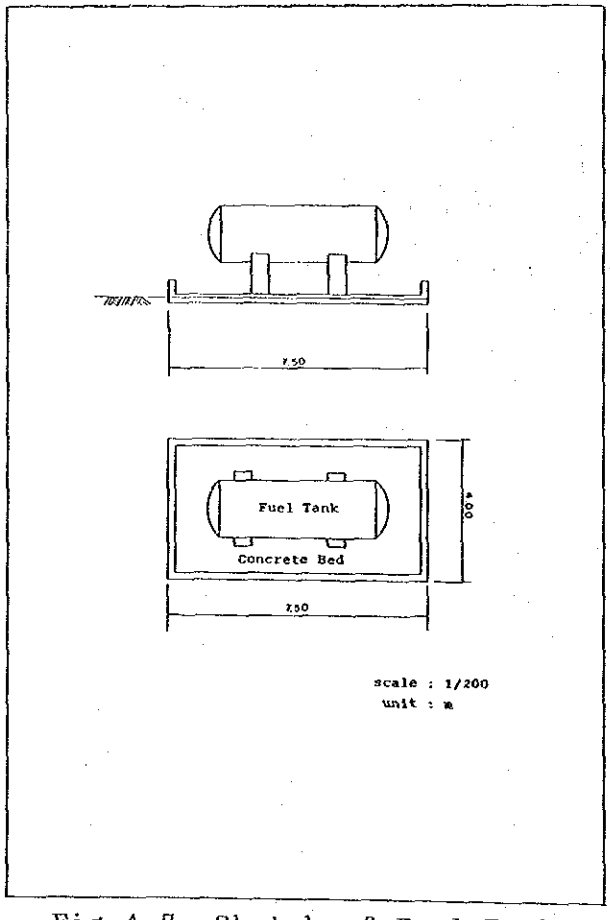


Fig.4.7 Sketch of Fuel Tank

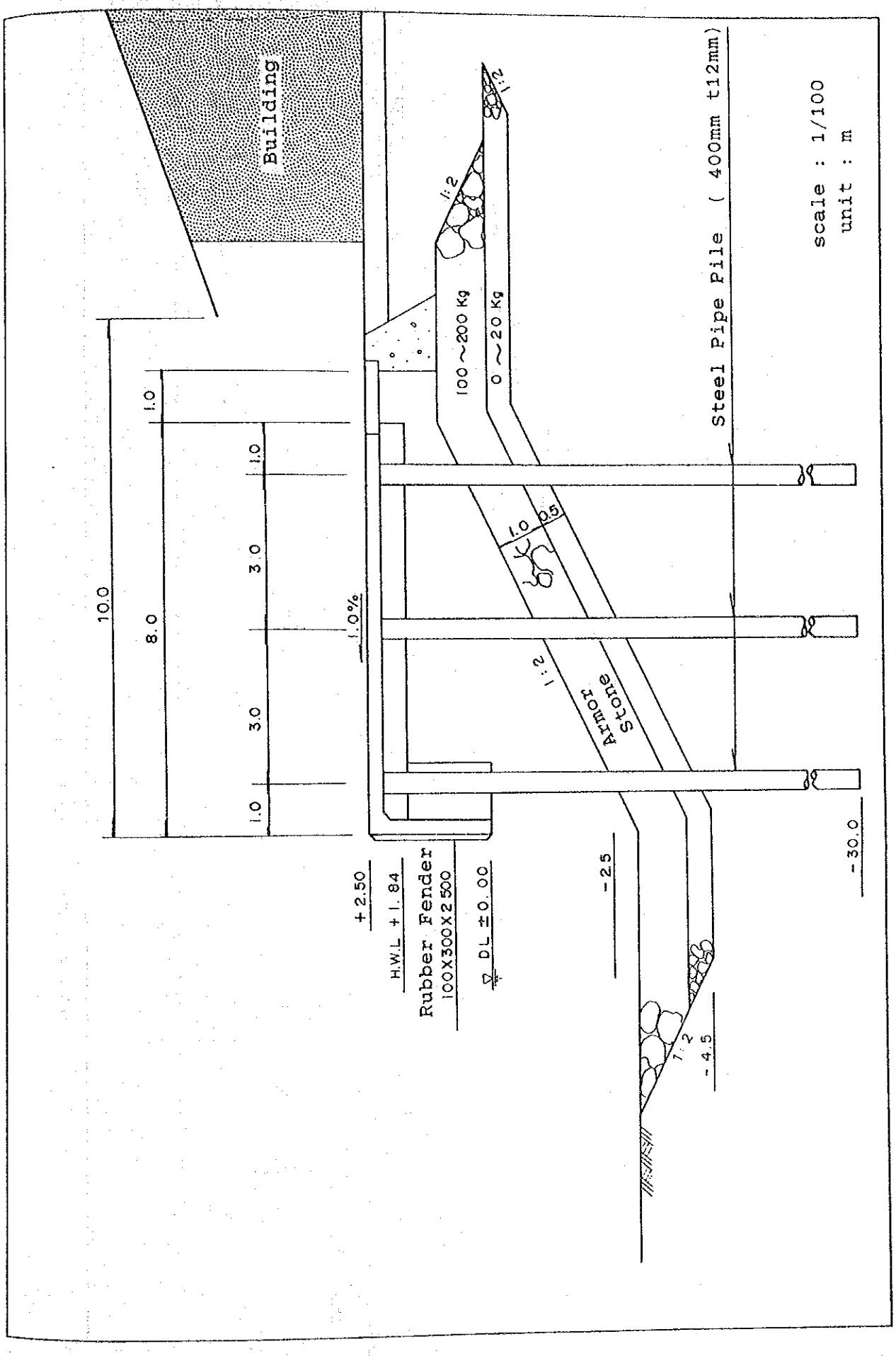


Fig.4.5 (1) Standard Cross Section of Main Wharf

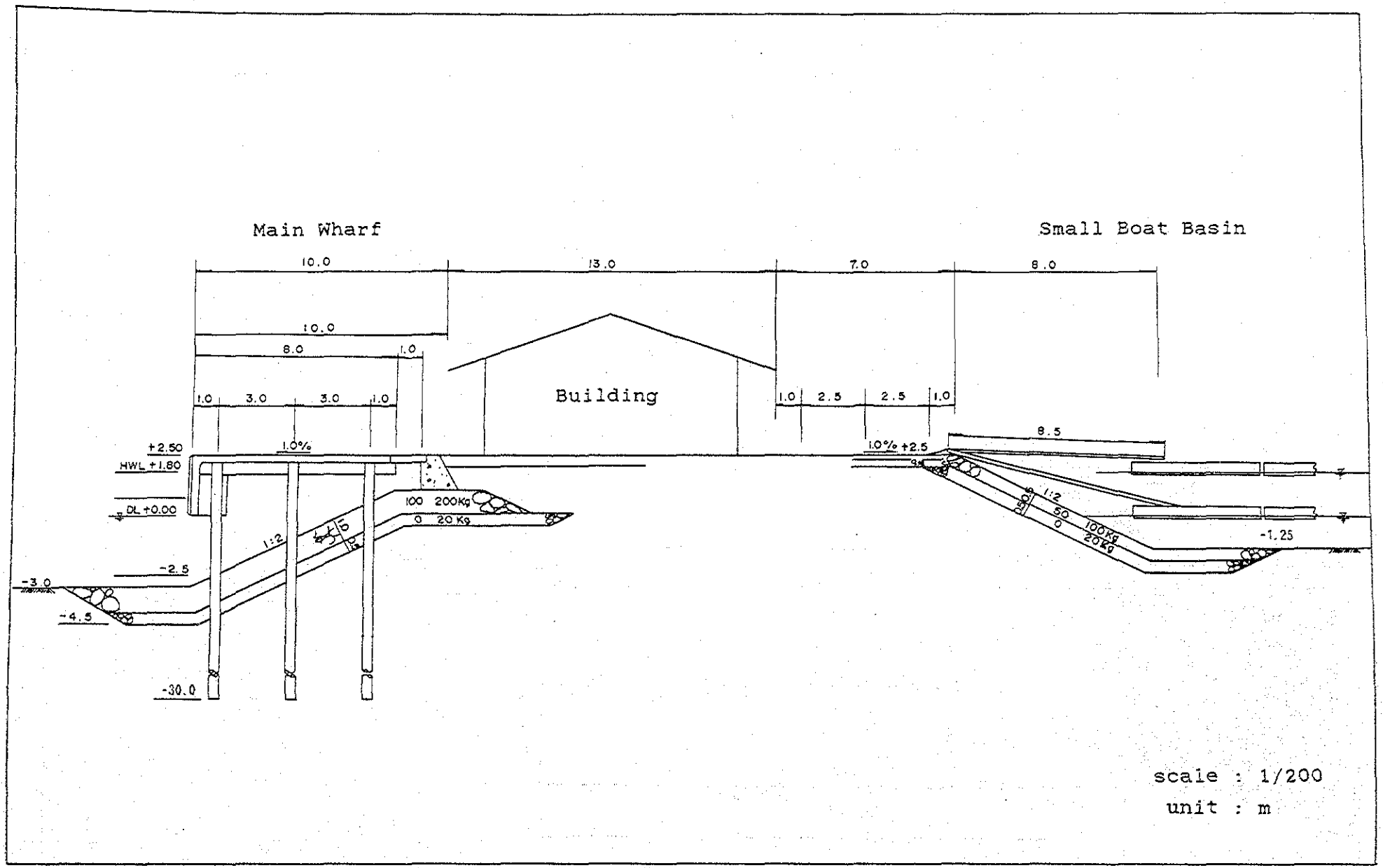


Fig.4.5 (2) Standard Cross Section,
Main Wharf , Building & Small Boat Basin

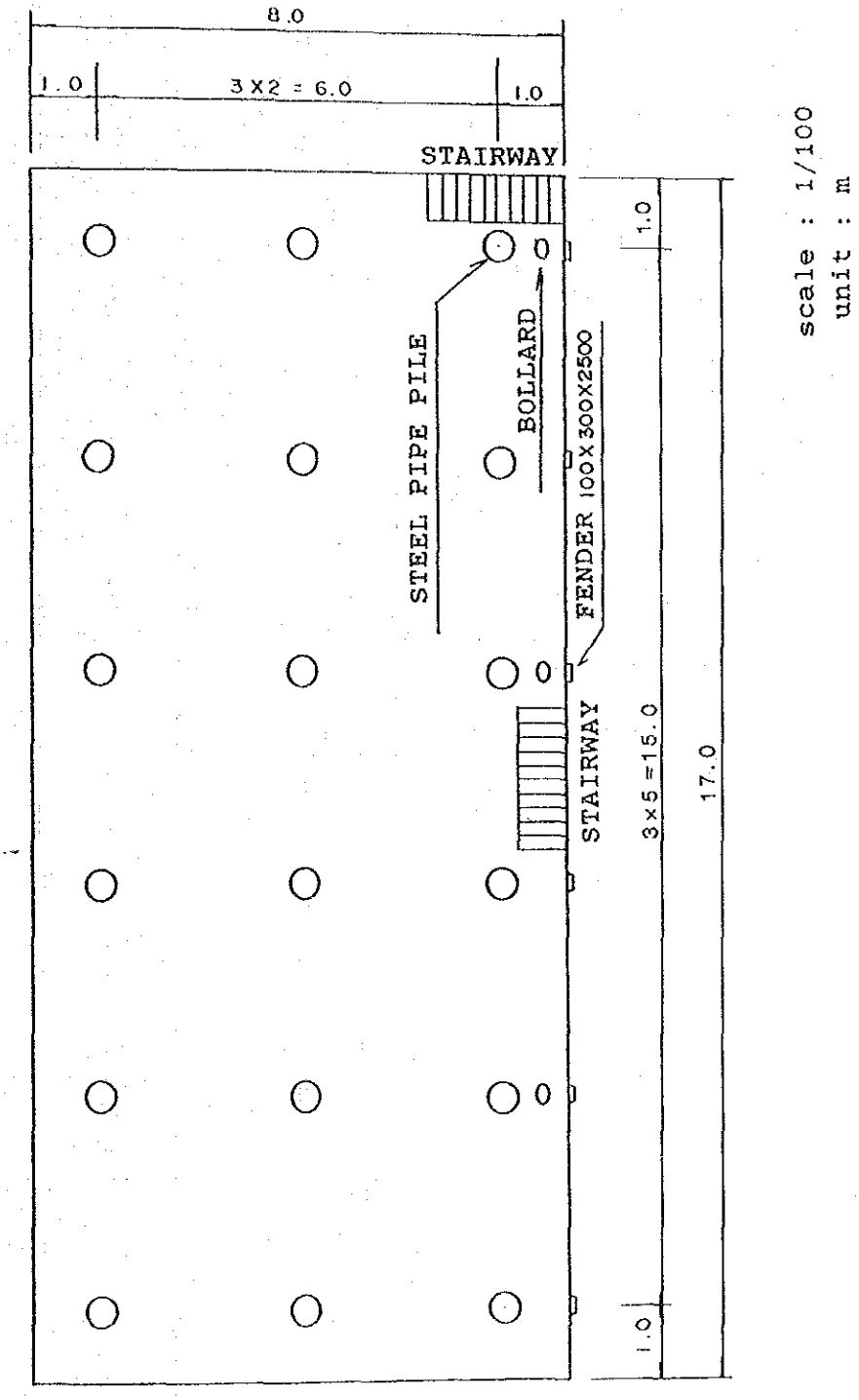


Fig.4.6 Arrangement of Auxiliary Facilities

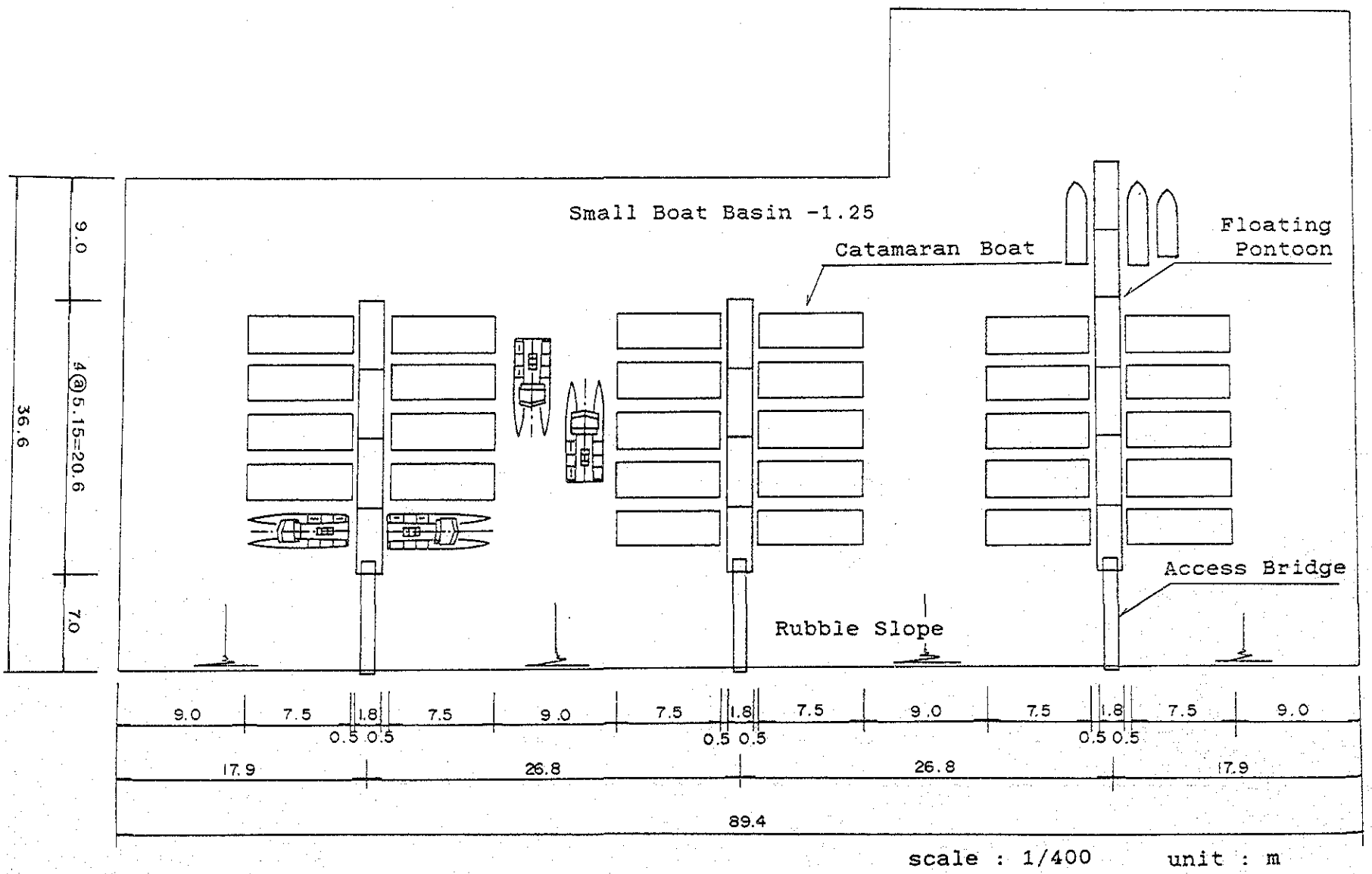


Fig.4.8 Layout of Small Boat Basin

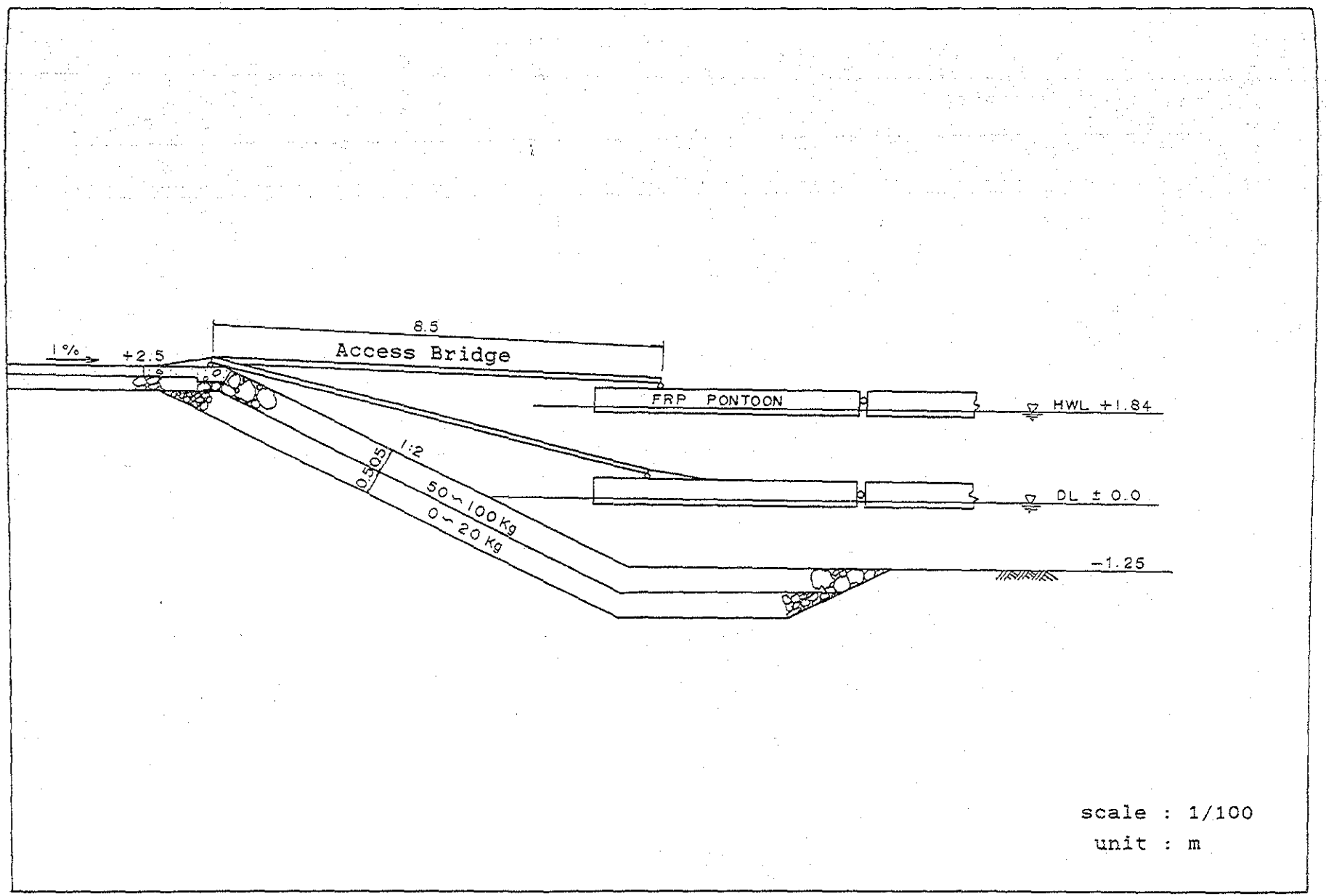


Fig.4.9 Access Bridge and Small Boat Basin

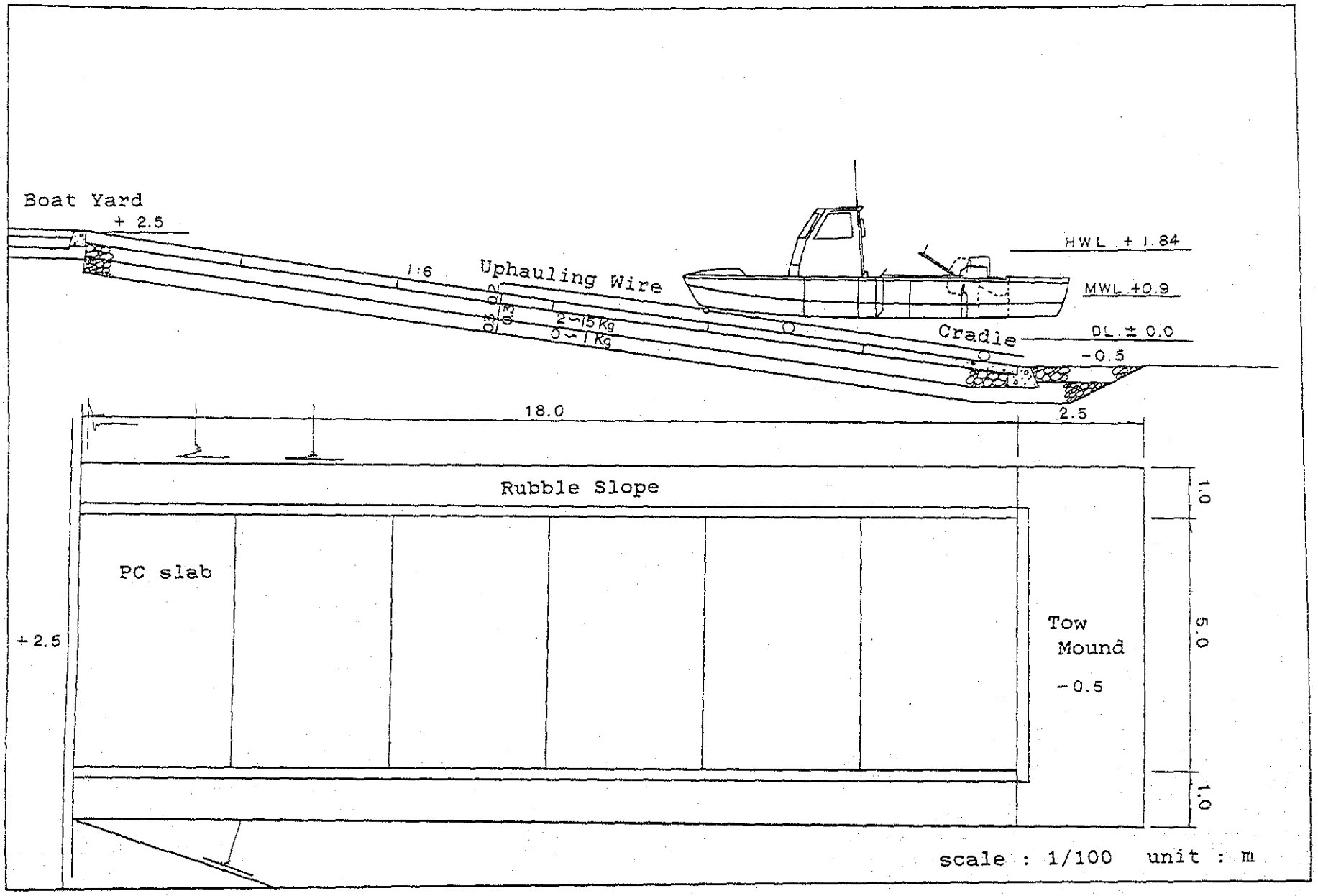


Fig.4.10 Cross Section of Slipway

4.3.2 Utwe Site

Mooring facilities

The project site in Utwe is sheltered from waves by a reef flat and an L shaped causeway extended from a circumferential road as shown in Fig. 4.11. A layout of a mooring basin for the catamaran boats is shown in Fig. 4.12. The basin and the floating pontoon are designed and arranged for 20 catamaran boats distributed in Utwe in the same way as those in Lelu.

Approach channel and mooring basin

The existing approach channel is wide and deep enough for a traffic of the catamaran boats. A part of the mooring basin is not deep enough requiring a dredging work. The dredged soil will be used as a filling material for a repair work of the existing causeway. The existing causeway is badly damaged by waves penetrating into a reef flat at high tide. A further damage will lead to a disturbance of the mooring basin by waves and therefore the existing causeway is planned to be restored and protected by a rubble slope for a section of 150m from the circumferential road.

Fuel tank

A fuel tank of the same structure as that planned in Lelu is to be constructed along the circumferential road. A capacity of the tank is 6.0 kl suppling gasoline to 20 catamaran boats working in the Utwe district.

4.3.3 Okat Site

As shown in Fig. 4.13, the project site in Okat is along the road to a new international airport and is sheltered from offshore waves. The project area has already been dredged and reclaimed for the purpose of constructing mooring facilities like those planned in this study.

Mooring facilities

A layout of the mooring facilities is designed as the same as that in Utwe as shown in Fig. 4.14. The existing reclaimed area is not protected with a rubble slope and is being scoured by small wind waves. The slope surrounding the basin is to be protected with a stone revetment. The existing 10 m long FRP pontoon will be used in a mooring basin in the Lelu site.

Approach channel and mooring basin

The existing mooring basin is deep and wide enough for 20 catamaran boats working in Okat and connected to the existing small boat channel which is also already dredged to outer sea. Therefore any dredging work will not be required in the Okat site.

Fuel tank

A fuel tank is of the same structure as that planned in Utwe.

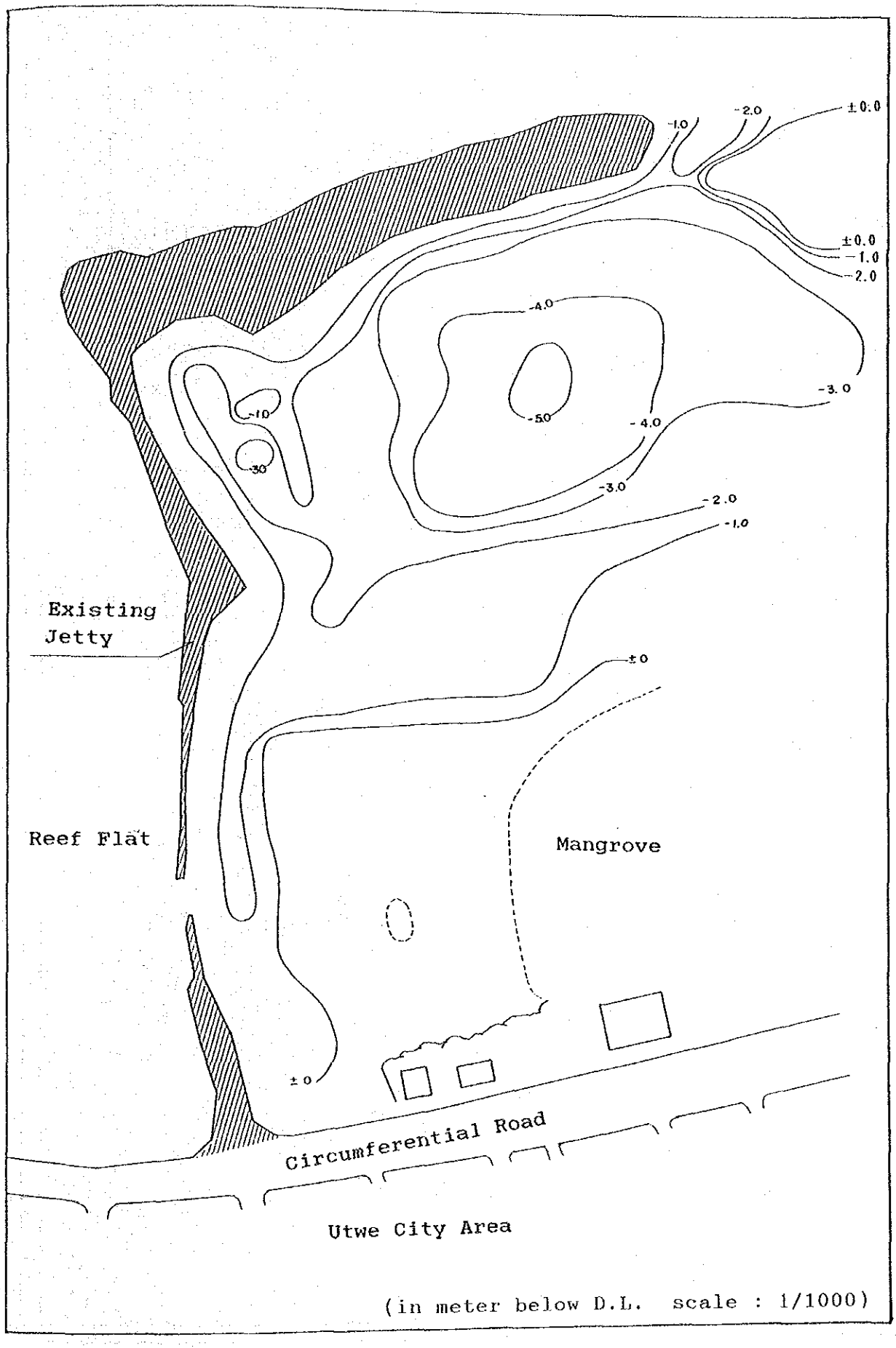


Fig.4.11 Bathymetric Chart, Utwe

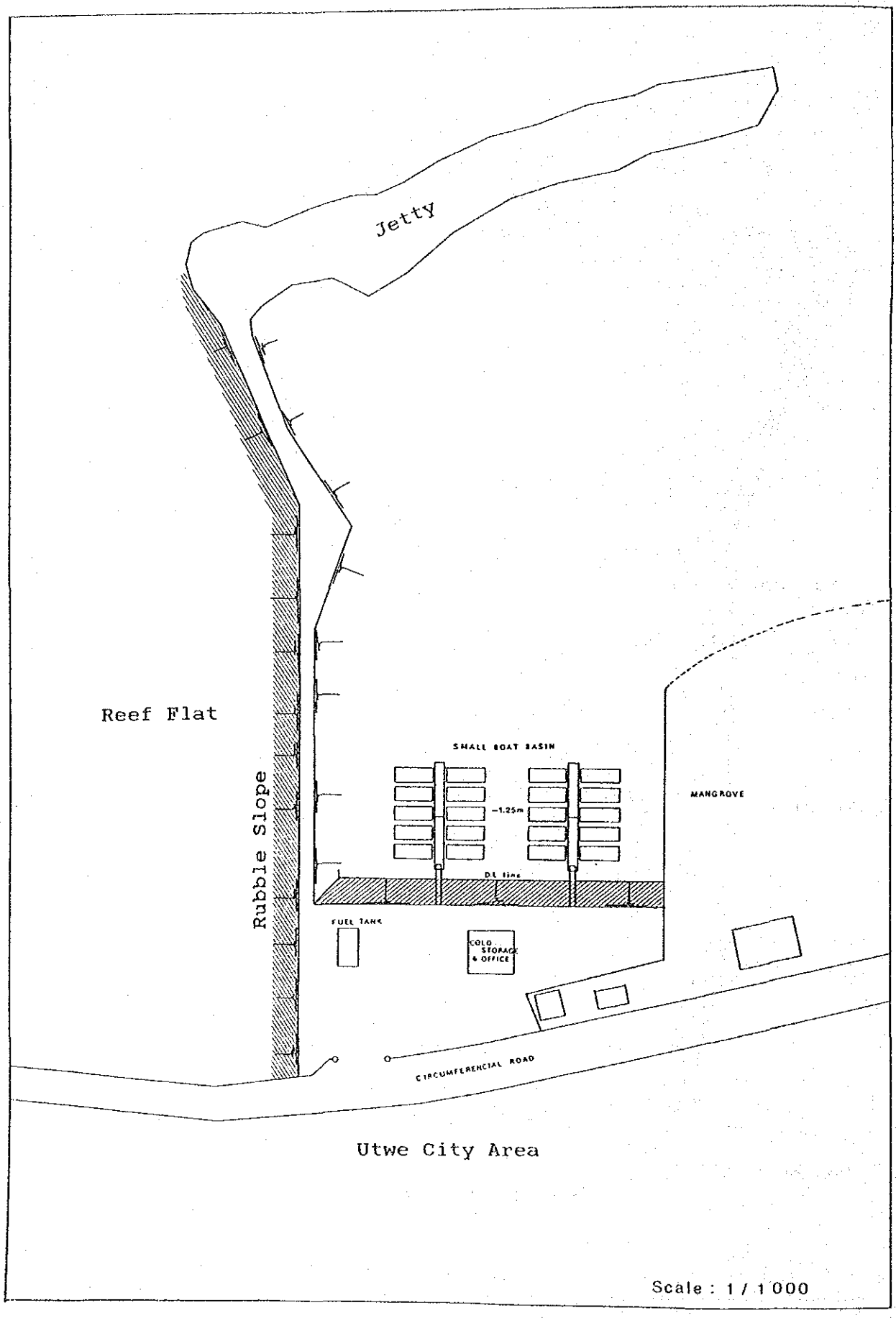
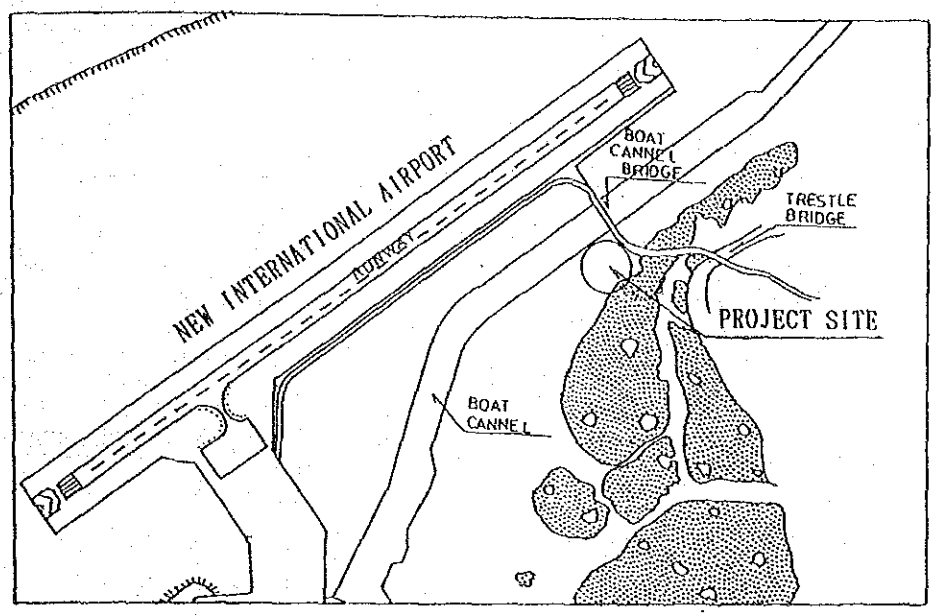


Fig.4.12 Layout of Small Boat Basin, Utwe



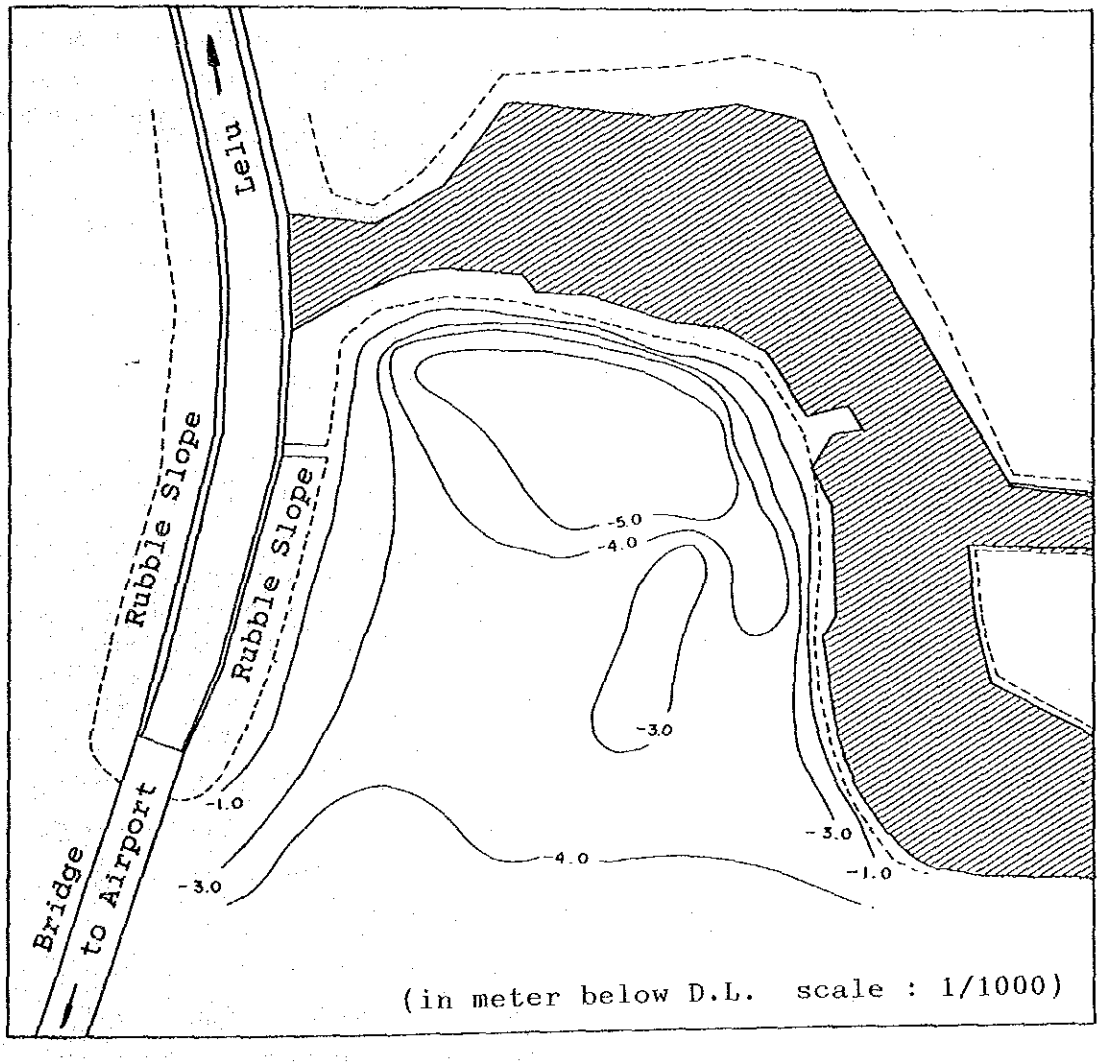


Fig.4.13 Bathymetric Chart, Okat

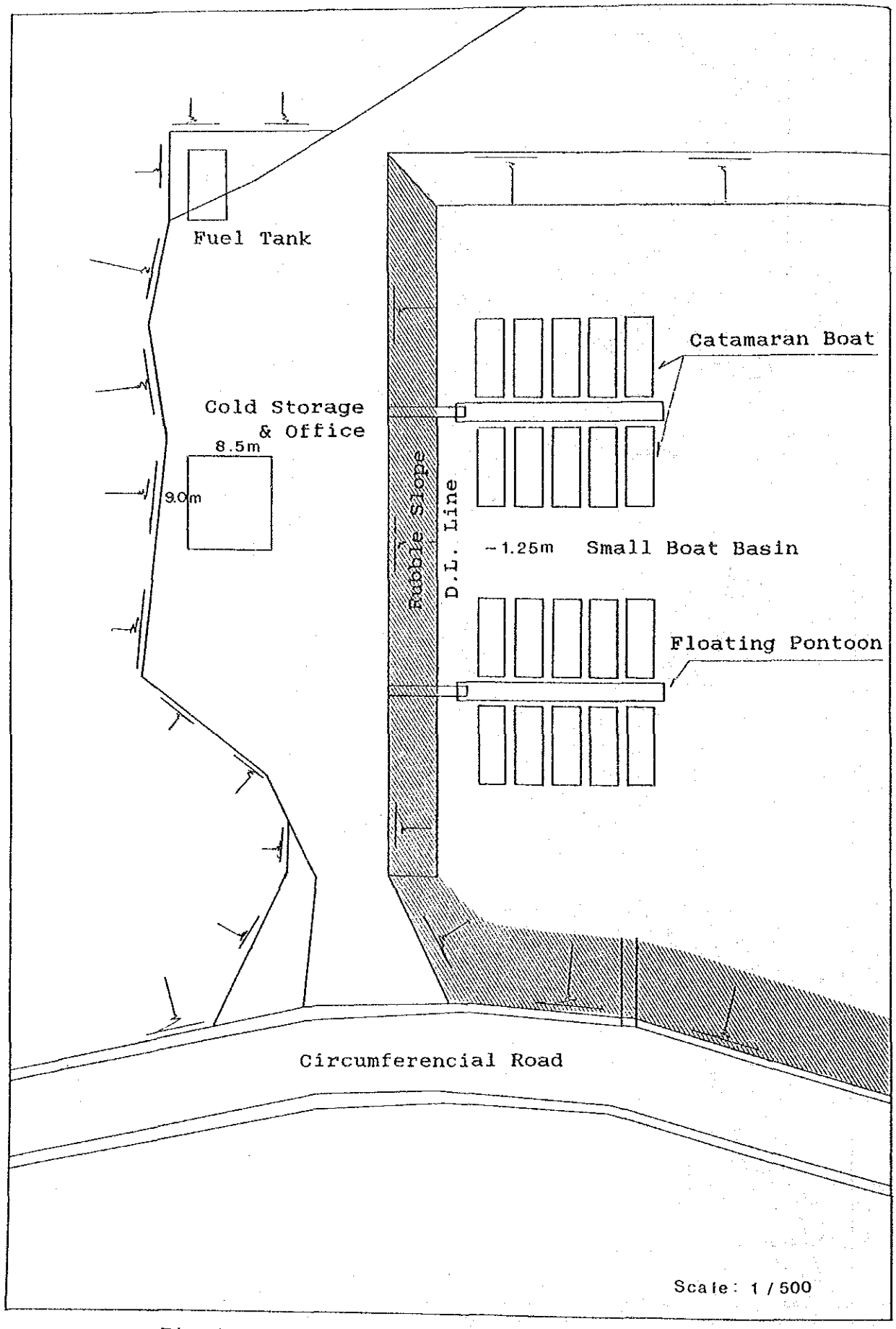


Fig.4.14 Layout of Small Boat Basin, Okat

4.4 Design of the Distribution Facilities

4.4.1 Forecast of Fish Catch in the Kosrae State

(1) Forecast of fish catch by the catamaran boats (1991)

According to the results of interview surveys conducted to local fishermen, an average daily fish catch of a catamaran boat is assumed at 35kg. Assuming 200 annual average working days, an annual fish catch by a catamaran boat is calculated as below:

35 kg/day x 200 days/year = 7,000 kg/year = 7 t/y
7 t/y x 70 boats = 490 t/y

A fish catch is expected to continually increase, because of an increase in income resulting from improvement in fishing techniques and resulting encouraging effect to fishermen, participation of younger people in a fishing occupation, etc.

(2) Forecast of fish catch by FRP boats

Fish catch by FRP boats is calculated in the same way as the above:

30 FRP boats x 30 kg/day x 200 days/year = 180,000 kg/year

(3) Forecast by fish catch of the pole and line and long line fishing training boat

i) Forecast of fish catch by pole and line skipjack fishing.

Test fishing by the boat was carried out from 18th April to 28th November 1987. According to a logbook, the boat made 78 trips of 101 days out of a total 110 days period. Net fishing days were 81, while the rest of 20 days were spent for installing fish aggregating devices, 7 days (6 trips), down time, 4 days due to a generator trouble (3 trips), and repair works, 9 days for shortage of manpower for operating stick-held dip net, a fuel system trouble, etc.

Fish catch recorded during the 81 net fishing days of the 78 trips consists of 6,886 pounds (3,100 kg) of skipjack and tuna. The same amount of fish catch by pole and line fishing is assumed in this forecast.

ii) Forecast of fish catch long line tuna fishing

The period of pole and line skipjack fishing is 101 days, and a period of long line tuna fishing calculated by assuming 4 working days a week for half the remaining 264 days.

132 days / 7 days/week x 4 days/week = 75.4 days

Assuming that each long line fishing gear set consists of a unit of 60 baskets with 5 hooks a basket, two long line fishing sets are equipped on the boat consisting of 120 baskets with 600 hooks. The Marine Resources Division already possesses 2 sets of longline fishing gear purchased before, and 2 sets newly provided under this project will be kept as spare units.

- Catch rate

Yellow fin tuna:	1.3 fish/100 hooks x 600 hooks = 7.8 fishes	
Big eye tuna :	0.6 fish/100 hooks x 600 hooks = 3.6 fishes	

- Fish Catch

Yellow fin tuna :	7.8 fishes x 40 kg/fish = 312kg	
Big eye tuna :	3.6 fish x 60 kg/fish = 216kg	
Total	528kg	

The catch rates and the fish weight are based on data of the SPC and Japan.

Assuming that each trip takes 2 days, a total number of trips and a total annual fish catch are calculated as below:

76 day / 2 = 38 trips

528 kg/trip x 38 trips = 20,064 kg

(4) Catch of mangrove crab

Volume of export of mangrove crabs amounts to 1,200 kg in 1988 and if a local consumption in the island is assumed to be the same as the export amount, a catch of mangrove crab is calculated as 2,400 kg/year.

(5) Forecast of a total fish catch

A total fish catch in the Kosrae State is forecast at 695.5 t/year, by summing all the above figures.

4.4.2 Examination of Design Conditions

A layout, structure, etc. of distribution facilities and buildings will be planned by examining the required functions and scale of each facility.

(1) Examination of design conditions

Design criteria are established based on the results of the site survey as follows;

1) Design criteria

Atmospheric temperature	:	31° C
Relative humidity	:	85 %
Rainfall	:	5,000 mm/year
Ground bearing capacity	:	5 tons/m^2
Water to be used	:	Untreated city water
Electric power	:	AC 220V/120V, 3 phase, 4 wire, 60Hz

2) Applicable design standards

Although the FSM basically follows the American Standards, the State Government has not any particular standards to be specially applied to this project. As the Government has agreed that all the design works may be based on the Japanese Standards, the

following Japanese Standards are applied in this study.

* The Building Standards Act of Japan
* The Japan Industrial Standards (JIS)
* Standards of the Japanese Electro-Technical Committee (JES)
* Standards of the Japan Electrical Manufacturers' Association (JEM)
* Standards of the Japanese Electric Cable Makers' Association (JEC)

(2) Distribution volume of fishery products

1) An annual fish catch in the Kosrae State, in 1991 when the facilities planned under this Project will open, is forecast in 4.4.1. Distribution volume of fish through each facility is estimated by assuming that landing volumes of fish at each station is proportionate to numbers of fishing boats in three sites. Further, of an average daily fish catch of the catamaran boats and the FRP boats, it is assumed that 10 % is consumed by fishermen's family, and 40 % through a conventional neighborhood route, which means that a total of 50 % is consumed in each locality. Accordingly, fishery products to be distributed through the facilities under this project account for 50 % of the total catch and are summarized in the following excluding catches by the training boat and of mangrove crab.

2) No. of fishing boats in each site

Fishing port / Description	Total	Lelu	Utwe	Okat
Catamaran boat	70 (100%)	30 (42.8%)	20 (28.6%)	20 (28.6%)
FRP boat	30 (100%)	14 (46%)	8 (27%)	8 (27%)
Total	100	44	28	28

3) Forecast of annual fish catch and distribution volume, 1991

Port	Total		Lelu		Utwe		Okat	
Classification / Description	Catch	Distribution	Catch	Distribution	Catch	Distribution	Catch	Distribution
Catamaran boat	490.0	245.0	210.0	105.0	140.0	70.0	140.0	70.0
FRP boat	180.0	90.0	84.0	42.0	48.0	24.0	48.0	24.0
Total	670.0	335.0	294.0	147.0	188.0	94.0	188.0	94.0

A volume to be distributed through the Lelu distribution center is not only fish catch landed at Lelu but fish collected and transported from the Utwe and Okat stations totaling at 335 t. The project facilities will be planned based on the above figures.

4) Volume of fresh fish for export

Fish species for export mainly consist of bottom fish and tuna and these are included in the distribution volume of fish catch shown in the above table. Its breakdown is detailed below.

a) 22 fishermen have received a training program of bottom fishing arranged by the Marine Resources Division. These fishermen are assumed to catch 35 kg of bottom fish a day on average. A number of fishing days is assumed as 75 days a year by considering tidal current and wind direction.

35 kg x 22 boats x 75 days = 57,750 kg

Assuming that 50 % of the above will be exported, a volume of exportable bottom fish is 28.9 t per year.

b) Tuna

According to the results of the site survey, it can be reasonably assumed that about 4 % of a total fish catch is exported. The total volume of annual tuna export is calculated as follows;

Tuna Export = (670 - 57.8) x 0.04 = 24.5 t

c) Total Export

A total volume of export is calculated as below:

a) + b) 28.9 + 24.5 = 53.4 t

5) Total volume of fish processed in the fish processing plant

A volume of fish processed in the fish processing plant is calculated as below:

Daily raw fish volume	500 kg/8 hr
Annual Working Days	200 days
Total annual volume	0.5 x 200 = 100 t/y

Of the total volume of 100 t for processing, 55 t are assumed to be supplied as fresh fish and 45 t as frozen fish.

6) Forecast of flow and tonnage of fish in 1991

Forecast of flow and tonnage of fish in 1991 is illustrated in Table 4.1.

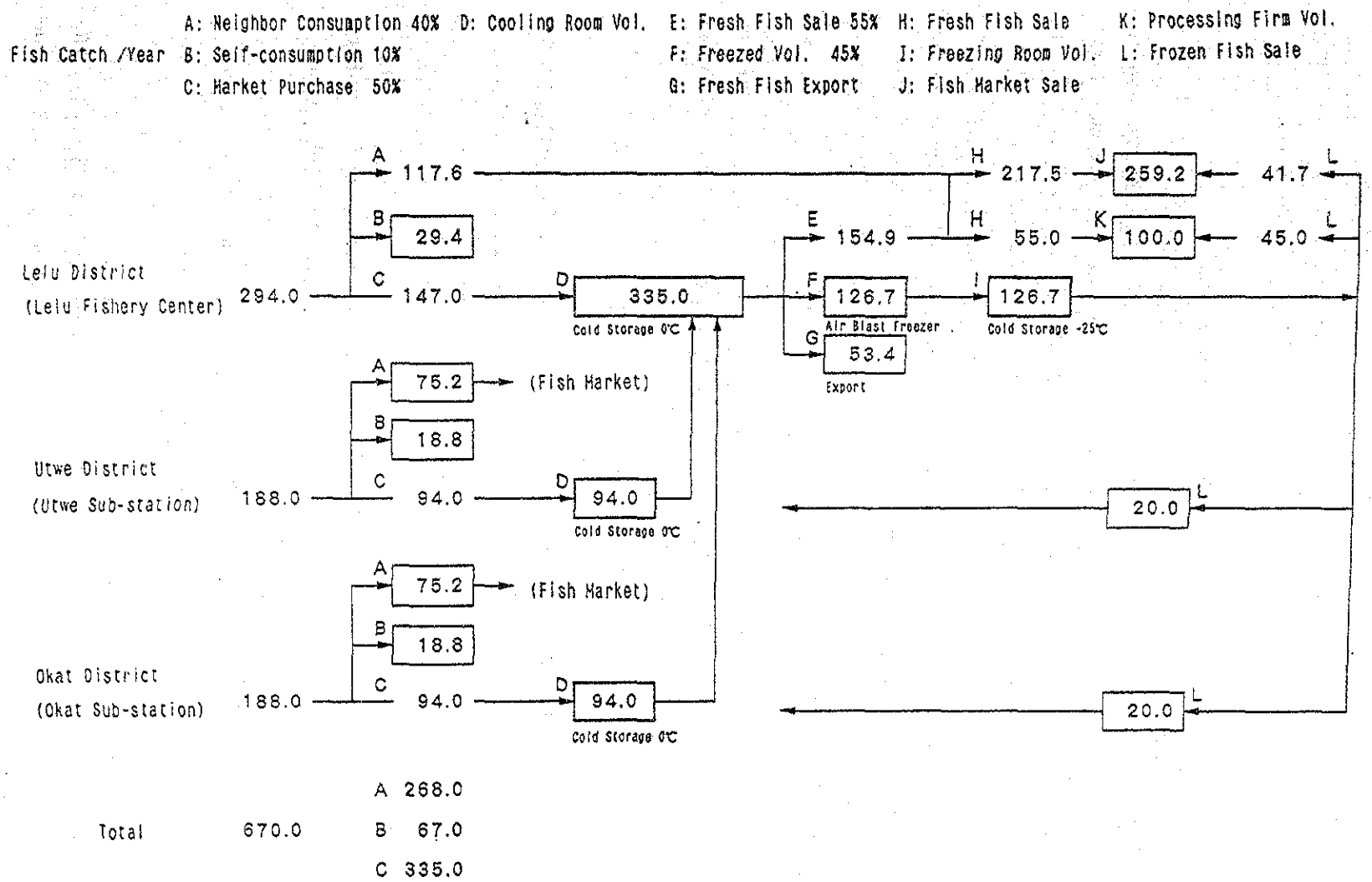


Table 4.1 Commercial Distribution Channel/Volume of Fish Product (unit t)

4.4.3 Distribution Center in Lelu Area

(1) Ice making facility

A daily demand for ice is calculated as follows.

1) Test fishing boat

Assuming that a fish catch of a two day trip is 528 kg and a volume of ice to be loaded is in the ratio of 1:1 to the fish catch, the demand for ice of the test fishing boat is

528 kg x 1 (ratio) x 1 (boat) = 528 kg

As the boat is provided with an ice storage of $5.2m^3$, there is no problem in loading that much ice.

2) Catamaran boat

Assuming that a daily catch is 35 kg on an average and a volume of ice to be loaded is in the ratio of 1:0.6 to the fish catch, a demand for ice of 70 boats is:

35 kg x 0.6 x 70 (boats) = 1,470 kg

As an ice box of 0.45 m^3 is provided to each boat, there is no problem in loading that much ice.

3) FRP boat

Assuming that a daily catch is 30 kg on an average and a volume of ice to be loaded is in the ratio of 1:0.6 to the fish catch, a demand for ice of 30 boats is:

30 kg x 0.6 x 30 (boats) = 540 kg

4) Fish market

Assuming that an average daily sale volume is 1.037 kg (259,200 kg/ 250 days) and a volume of ice is in the ratio of 1:0.2 to the fish, a demand for ice is:

1.037 kg x 0.2 = 207 kg

5) Fish processing plant

Assuming that a daily processing capacity of raw fish is 500 kg/8 hrs and a volume of ice is in the ratio of 1:0.2 to a volume of raw fish, a demand for ice is:

500 kg x 0.2 = 100 kg

6) Additional icing for transport

Assuming that a daily volume of fresh fish to be transported is 1.675 kg (335,000 kg/ 200 day) on an average from an annual distribution volume of two stations shown in Table 4.1. and a volume of ice is in the ratio of 1:0.2 to a distribution volume, a demand for ice of two stations is:

1.675 kg x 0.2 = 335 kg

7) Total volume of ice required

A total volume of ice required is addition of 1) through 6) and calculated as 3.180 kg a day.

At present, a flaked ice making machine with a capacity of 1.5 t per day is in operation in the Kosrae State under control of the Marine Resources Division. The production capacity of this ice making machine has fallen to around 80% of its rated capacity, 1.2 t per day due to use of sea water.

Therefore, the required additional ice making capacity is calculated by subtracting the existing ice making capacity from the volume of demand as below

3,196 kg - 1,200 kg = 1,996 kg

In consideration of the size and purposes of the machine, a flaked ice making machine is adopted.

(2) Ice storage (Storage temperature: -5^{o} C)

A floor area necessary for an ice storage to meet a daily ice making capacity of 2.0 t is calculated, by assuming an effective storing area ratio of 80 %, a bulk specific gravity of 0.4, a stacking height of 1.5m and a volume of ice to be stocked as 1.3 (peak factor) average daily demand,

$$2.0 \text{ t} / 0.8 / 0.4 / 1.5 \text{ m} \times 1.3 = 5.4 \text{ m}^2$$

A prefabricated type using polyurethane sandwich (laminated) panel is adopted. Based on the panel specifications, the following sizes are selected.

$$2.7 \text{ m in width} \times 2.7 \text{ m in depth} = 7.3 \text{ m}^2$$

A unit type refrigerator will be installed with a panel thickness, 100mm, an inside height of storage, 2.4m and a storage temperature at -5° C.

(3) Cold storage (Storage temperature 0° C)

Fresh fish are temporarily stored for distribution within the island and also for export. From Table 4.1, a volume of fresh fish to be distributed is 335 t per year. Assuming an average annual operating days as 200 days, an average volume of storage is calculated as follows.

$$335 \text{ t/year} / 200 \text{ days} = 1.675 \text{ t/day}$$

Assuming that an efficiency of storage is 80%, a bulk specific gravity of fish 0.4, a stowage ratio 2.5 and a stacking height 1.0m, a required inside floor area is calculated as below:

$$1.675 \text{ t} / 0.8 / 0.4 \times 2.5 / 1.0 \text{ m} = 13.0 \text{ m}^2$$

A prefabricated type storage using polyurethane sandwich (laminated) panel is adopted. The following sizes will be selected according to the specifications with a panel thickness 100 mm and an inside height of storage 3.0 m.

$$3.6 \text{ m in width} \times 4.5 \text{ m in depth} = 16.2 \text{ m}^2,$$

A refrigerator will be installed to the cold storage to keep a storage temperature at 0^{o} C.

(4) Air blast freezer

Fish to be frozen are mainly fish for distribution within the island. When a supply of fresh fish exceeds demand in the case of a big catch, surplus fish should be frozen. The volume of fish to be frozen is calculated as a difference between a supply and a demand. Based on the figures shown in Table 4.1, the volume of frozen fish is calculated as follows;

$$281.6 \times 0.45 = 126.7 \text{ t/year}$$

If operating days of the air blast freezer are assumed to be 100 days per year, a daily volume of fish to be frozen will be:

$$126.7 \text{ t} / 100 \text{ days} = 1.267 \text{ t}$$

As the existing freezing capacity is 480 kg/6hr or 1,440kg/day, a required additional freezing capacity is:

$$1{,}267 \text{ kg} - 1{,}440 \text{ kg} = -173 \text{ kg/day}$$

The existing freezer is of a sufficient capacity and will be relocated into a new building for an efficient integrated operation under the state finance and will be provided with necessary spare parts for repair works in this project.

(5) Freezing room (Storage temperature -20^{o} C)

Since a period of poor catch is estimated to be around 7 days according to interview surveys to fishermen, a necessary volume of stock is assumed to be 7 days' consumption which is calculated as follows.

$$1.267 \text{ t} \times 7 \text{ days} = 8.87 \text{ t}$$

Assuming that an effective volume rate inside a storage is 80 %, a bulk specific gravity of fish 0.4 and a stacking height 1.5 m, a required internal floor area for storage can be calculated as follows.

$$8.87\ t\ /\ 0.8\ /\ 0.4\ /\ 1.5\ m = 18.5\ m^2$$

As a 22.3 m^2 cold storage which was provided by the government of Japan to the State Government in 1982 is in operation, the required additional floor area for a cold storage is:

$$18.5\ m^2 - 22.3\ m^2 = -\ 3.8\ m^2$$

The existing freezing room is of sufficient capacity and will be relocated to the new building in the same way as that of the air blast freezer.

(6) Building

1) Design policies

A basic design of a building will be conducted by considering the request from the Government of the FSM, functions of project facilities, natural conditions, construction conditions and the results of the site survey. A special attention will be paid to the followings:

i) To design buildings of an easy and low cost maintenance work.

ii) To design buildings of low construction costs, short construction period and maximum use of local materials and labor.

iii) A layout plan will take into consideration streamlining of activities of workers, movement of fishes and ice, etc.

2) Building design

i) Floor plan

The Lelu distribution center is required to have following three major functions:

. Ice making and storage.
. Quick freezing and cold storages.
. Administration and operation.

Relations of above three functions are illustrated in Fig. 4.15.

A cargo handing room is surrounded by an ice making/storage, an air blast freezer and cold storages. This arrangement allow for an efficient and smooth handling of fish and ice in the building. This space also will be used for fish/ice loading and unloading by trucks. For this reason, it should be designed strong enough to carry the truck load with a non-slippery floor with a drainage system and an attic ventilation system.

To provide customer and working staffs with a comfortable working environment, administration office is designed as follows:

Administration Office: The staffs consist of one general manager, one sales manager, one mechanic manager totaling 4 persons.

Required furnitures are a counter, desks, chairs, filing cabinets, a word processor, a copy machine and a bulletin board.

To accommodate the staffs and furnitures mentioned above, the required floor area is calculated as 32.5 m^2 6.5 x 5 m^2 with density of 0.12 persons/m^2.

Based on the Japanese design criteria, the above floor area

is checked as follows;

- Required floor area

Section Chief	8.5 x 1 = 8.5
Clerk	7.0 x 3 = 21.0
	29.5 m^2

(0.13 persons/m^2)

- Acceptable density

The planned administration office with the floor area of 32.5 m^2 and density of 0.13 persons/m^2 meets the Japanese criteria and is judged adequate for an office space.

Workers' Room: Four workers use this room and the room is furnished with furnitures such as tables, chairs, a sink with a kitchen counter and lockers. To accommodate the workers and the furnitures mentioned above, a total floor area of 17.5 m^2 is required.

According to the Japanese design criteria, a floor area required for general office workers is 4.5 to 7.5 m^2 per person or 18.0-30.0 m^2 for four persons. This room is used for taking rest and simple desk works by workers in the Lelu distribution center and the above floor area is enough for this purpose.

Storage: A storage is used for spare parts, fishing gears, fishing and boat's accessories, stationary, etc.

A total planned floor area is 27.5 m^2 consisting of the followings;

Spare parts	5.0 m^2
Fishing gear/Boat's accessories	7.5 m^2
Stationery	2.0 m^2
Passage	13.0 m^2
	27.5 m^2

Rest rooms: Two toilets for gentleman and lady and one shower room are provided for office staffs and fishermen.

3) Structural design

Most buildings in the Kosrae States are a wooden structure or a concrete block structure. A reinforced concrete structure is adopted for some of hotels and major Government buildings. The Government buildings, harbor warehouses and large private warehouses are of a steel structure. The special features of local structures are combination of a wooden truss roof and reinforced concrete block walls used in school buildings and some private houses.

Concrete blocks are locally produced but there is no supplier of ready mixed concrete and therefore large reinforced concrete buildings are very few. Since this building needs to have a wide span and a high eave height, a steel structure is selected. A steel structure is of a reasonable construction cost and is selected because of a high accuracy of building works. It also is of lighter weight and a construction period can be planned shorter.

The State Government basically follows the U.S. Building Code. However in this project, as all the construction works will be done by a Japanese contractor with Japanese building materials, the State Government has agreed to follow the Japanese Building Code in this particular project.

The structural design conditions are set as follows:

Materials:

Concrete: 180 - 210 Kg/cm^2

Reinforced steel bar: SD 30 (JIS) yielding point 3,000 Kg/cm^2

Structural Steel: SS 41 (JIS) yielding point 2,400 Kg/cm^2

Design Load:

Seismic Load:

$Q_i = C_i \cdot W_i$ $\quad C_i = Z \cdot R_i \cdot A_i \cdot C_o$

C_i : Story shear coefficient

Q_i : Seismic design load of each story

W_i : Building weight of each story

Z : Zone coefficient $Z = 0.7$

R_t : Deformability and damping factor of structure

A_i : Ratio of story shear coefficient to base shear coefficient.

C_o : Standard shear coefficient $C_o = 0.2$

Wind Load:

$P = c \cdot q$

$q = 60\ \mathrm{sqrt}(h)$

c : Wind factor coefficient

q : Velocity pressure

h : Height from ground

p : Wind pressure

3) Design of building components:

The following conditions are taken into consideration in designing each building part.

i) A corrosion effect is high due to a briny air, because of proximity to sea-shore.

ii) Local climate is of high temperature, heavy rainfall and high humidity throughout the year.

iii) Major building materials are to be imported.

- Roof: Most of the building roofs in the Kosrae States are of a type of gable roof or a hipped roof with a limited number of a gambrel roof. Most of reinforced constructions have flat roofs. For small houses, roof materials are coconuts leaves or

colgated steel sheets while most of large houses are roofed with colgated steel sheets. This building will be designed with steel sheets for its roofs since they are commonly used in the state and are easy to be maintained.

To design the roofs, ventilation, insulation and corrosion control should be taken into consideration.

- Exterior Wall: Most of wall materials in the Kosrae State are plywood, colgated steel sheets and concrete blocks. Only concrete blocks are made locally and the rest of construction materials are imported. In this project, concrete blocks shall be used for exterior walls in preference of its durability and local availability. Concrete blocks shall be used with water tight paint finish to prevent damage from salty sea water permeation.

- Interior Finish: A standard finish is with a mortar steel trowel for a concrete floor slab. A hardener finish will be applied to a floor to prevent abrasion. In an administrative office a vinyl floor tile shall be used. In rest rooms and a shower room, ceramic floor tiles are used.

  A standard interior wall finish is a cement-plaster with paint while walls in the rest rooms and shower room are with a ceramic wall tile finish.

- Ceiling: In an administrative office, a workers' room, rest rooms, a shower room, corridors and a storage will be of a plywood ceiling with oil paint finish.

- Structural Summary:

Building Area:	$300.0m^2$
Total Building Floor Area:	$300.0m^2$
Eave Height:	$4.0m^2$
Maximum Height:	$5.8m^2$
Exterior Finish:	Walls: Sprayed tile finish.
	Roof: Colgated colored stainless sheet
	Door and Windows: Aluminum Sash

Interior Finish:

	Floor	Wall	Ceiling
Administrative Off.	VCT	CP.EP	OP
Workers' Room	VCT	CP.EP	OP
Rest rooms	CFT	CWT	OP
Shower Room	CFT	CWT	OP
Corridor	VCT	CP.EP	OP
Storage	Concrete Steel Trowel	CP.EP	OP
Cargo Handling	Concrete Steel Trowel	CP.EP	OP
Machinery Room	Concrete Steel Trowel	CP.EP	

Abbreviations:

VCT:	Vinyl Composition Tile
CFT:	Ceramic Floor Tile
CP.EP:	Cement Plaster w/Emulsion Paint Finish
CWT:	Ceramic Wall Tile
OP:	Oil Paint Finish.

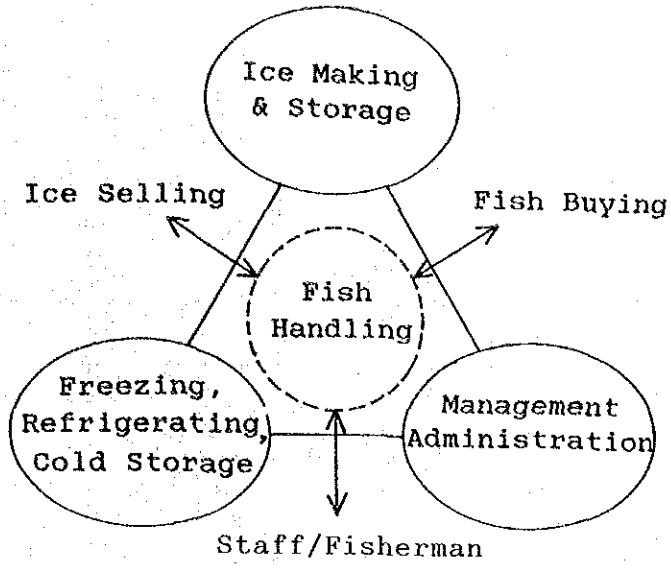


Fig.4.15 Building Function

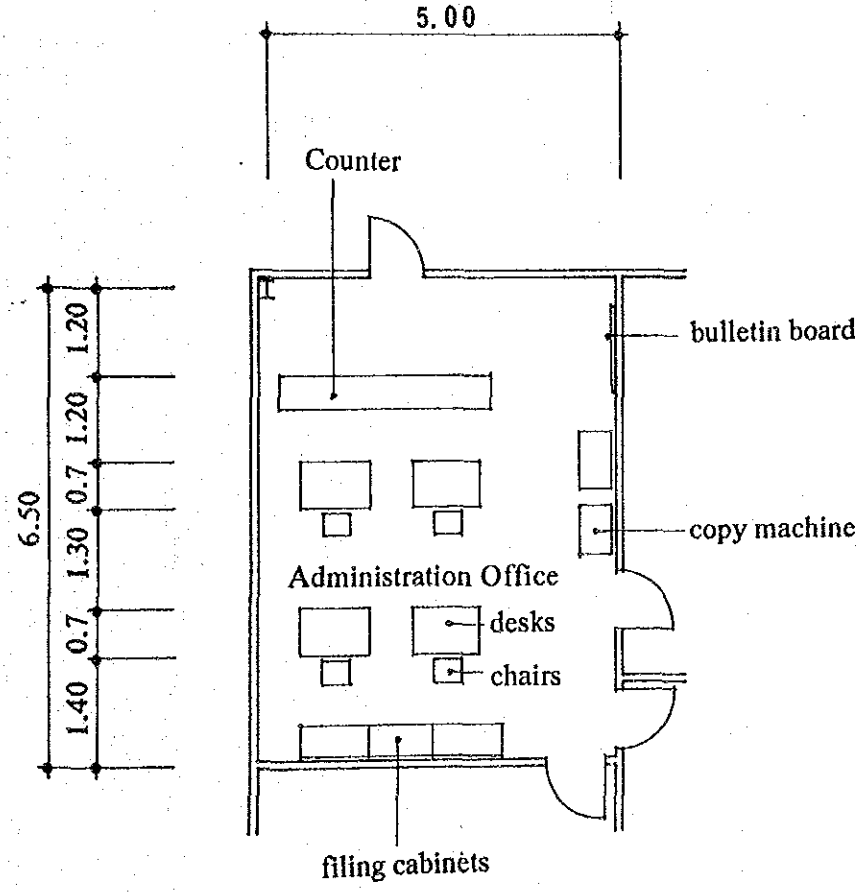


Fig.4.16 Layout of Administration Office

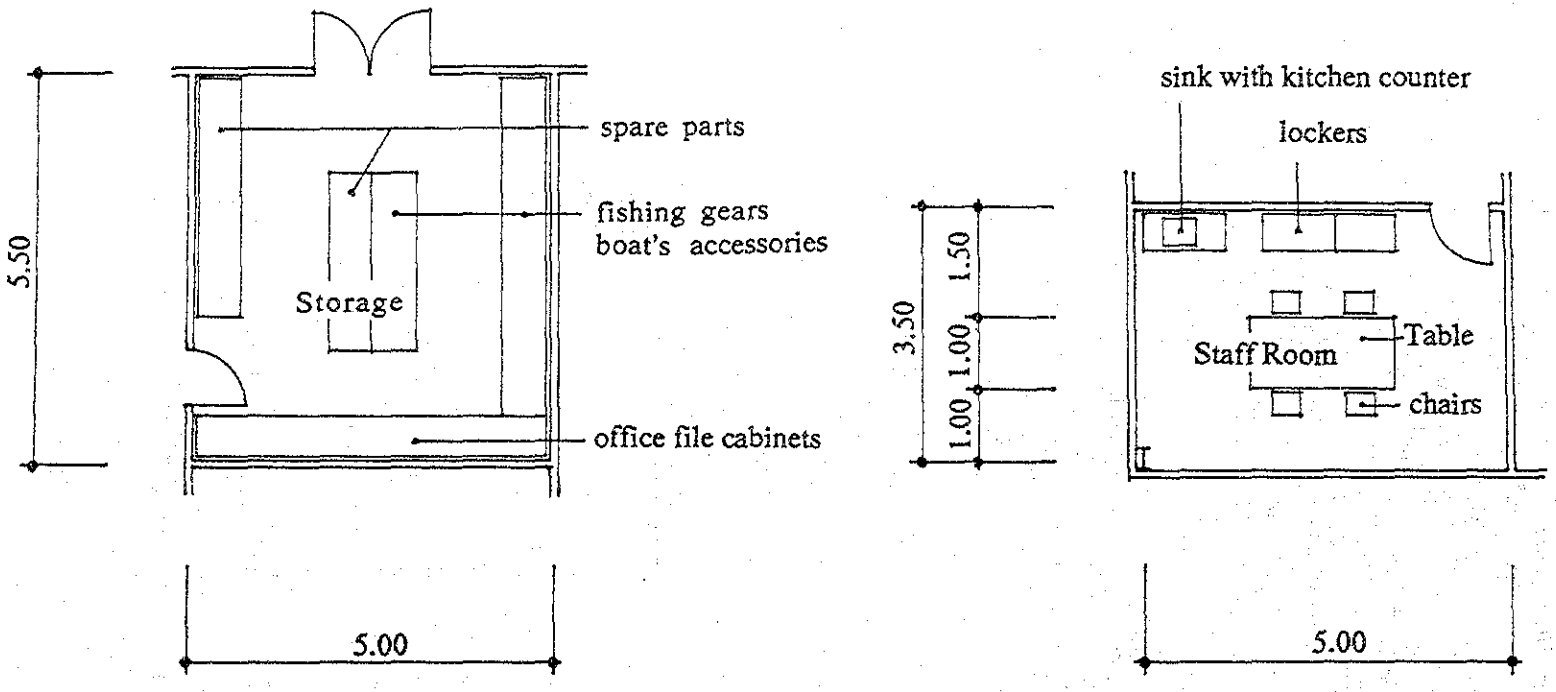
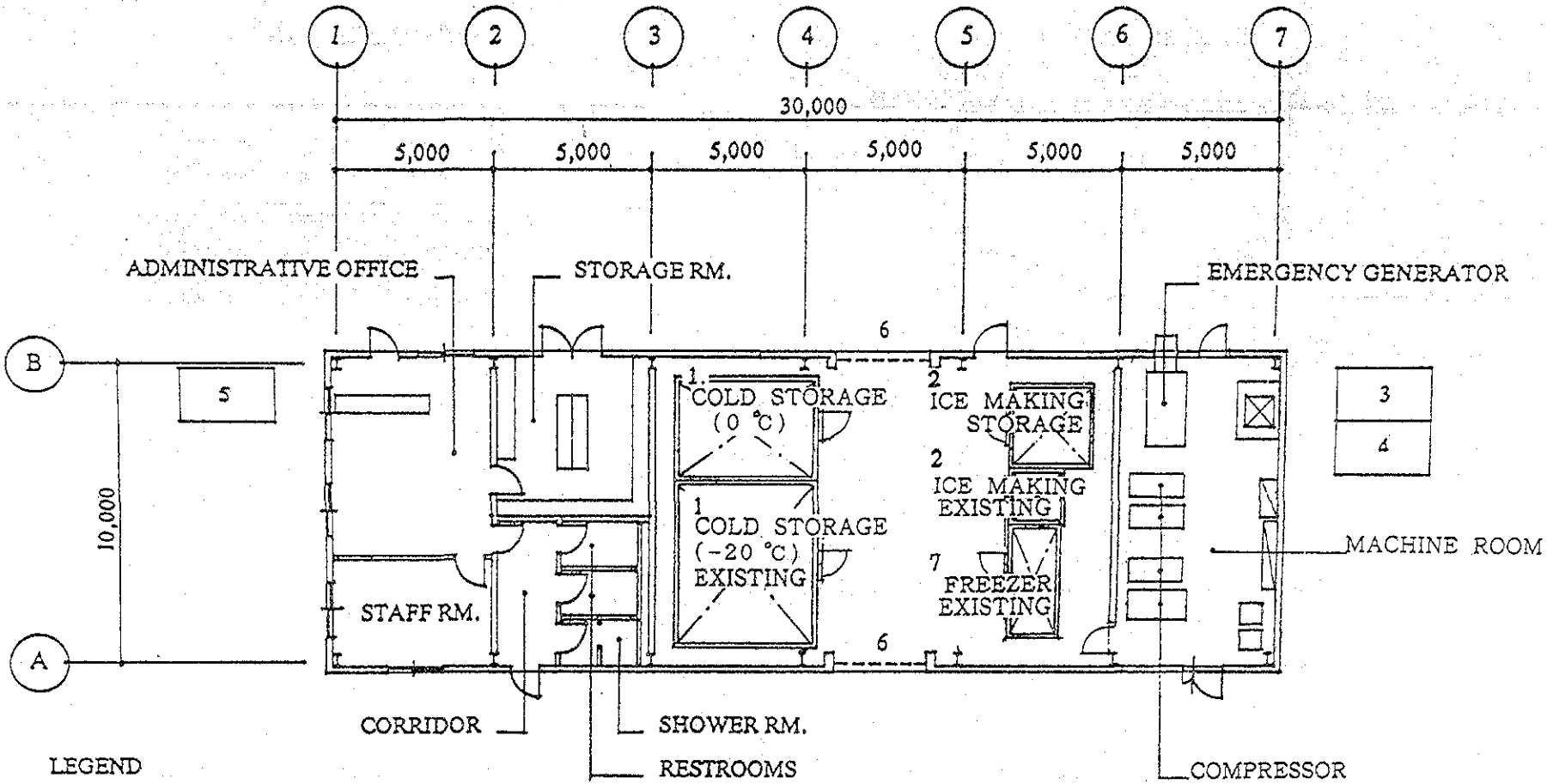


Fig.4.17 Workers' Room and Storage

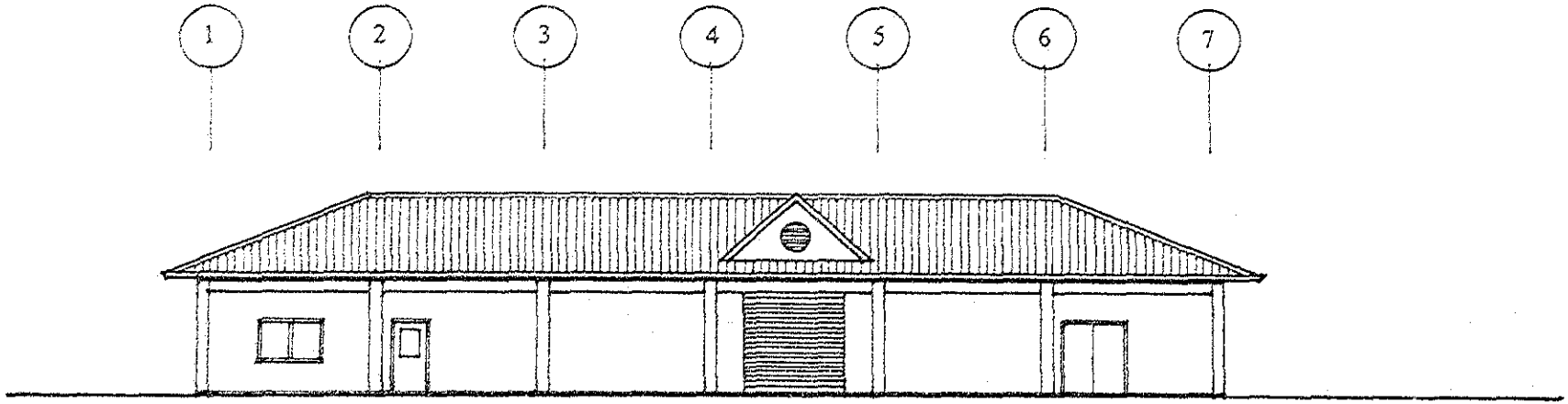


LEGEND

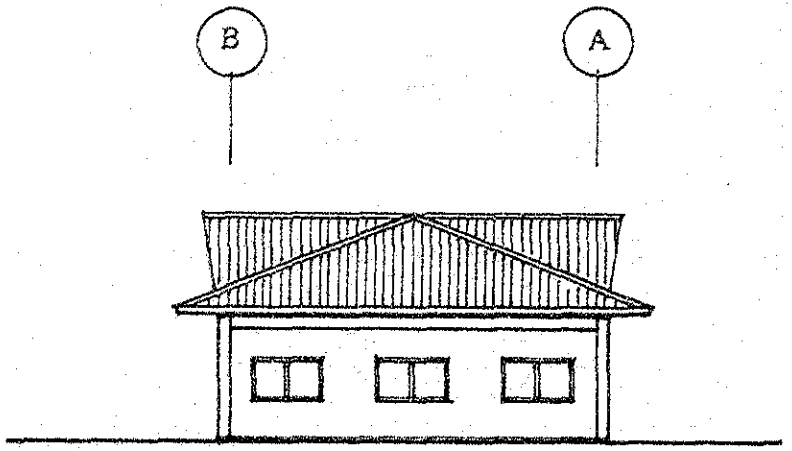
1 COLD STORAGE
2 ICE MAKING STORAGE
3 POTABLE WATER TANK
4 WATER TANK FOR REFRIGERATION
5 RAINFALL WATER TANK
6 ROLL-UP DOOR
7 FREEZER

FLOOR PLAN SCALE 1:200

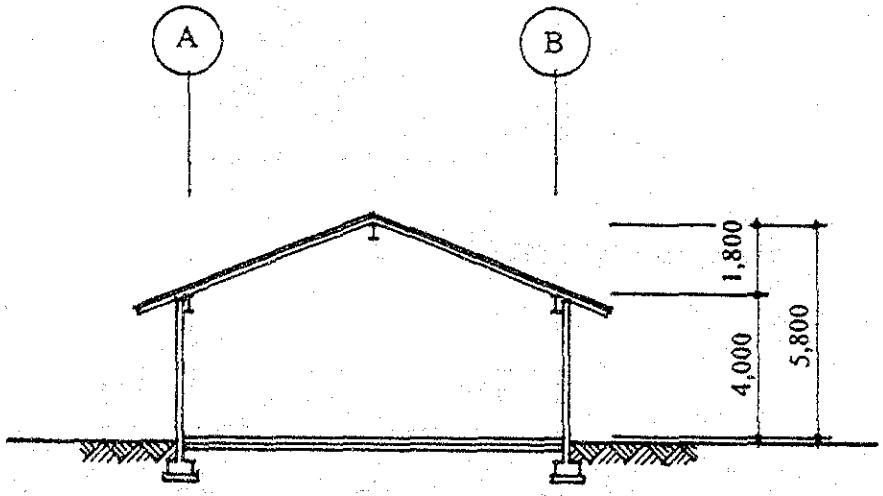
Fig.4.18 Machinery & Office, Lelu



FRONT ELEVATION

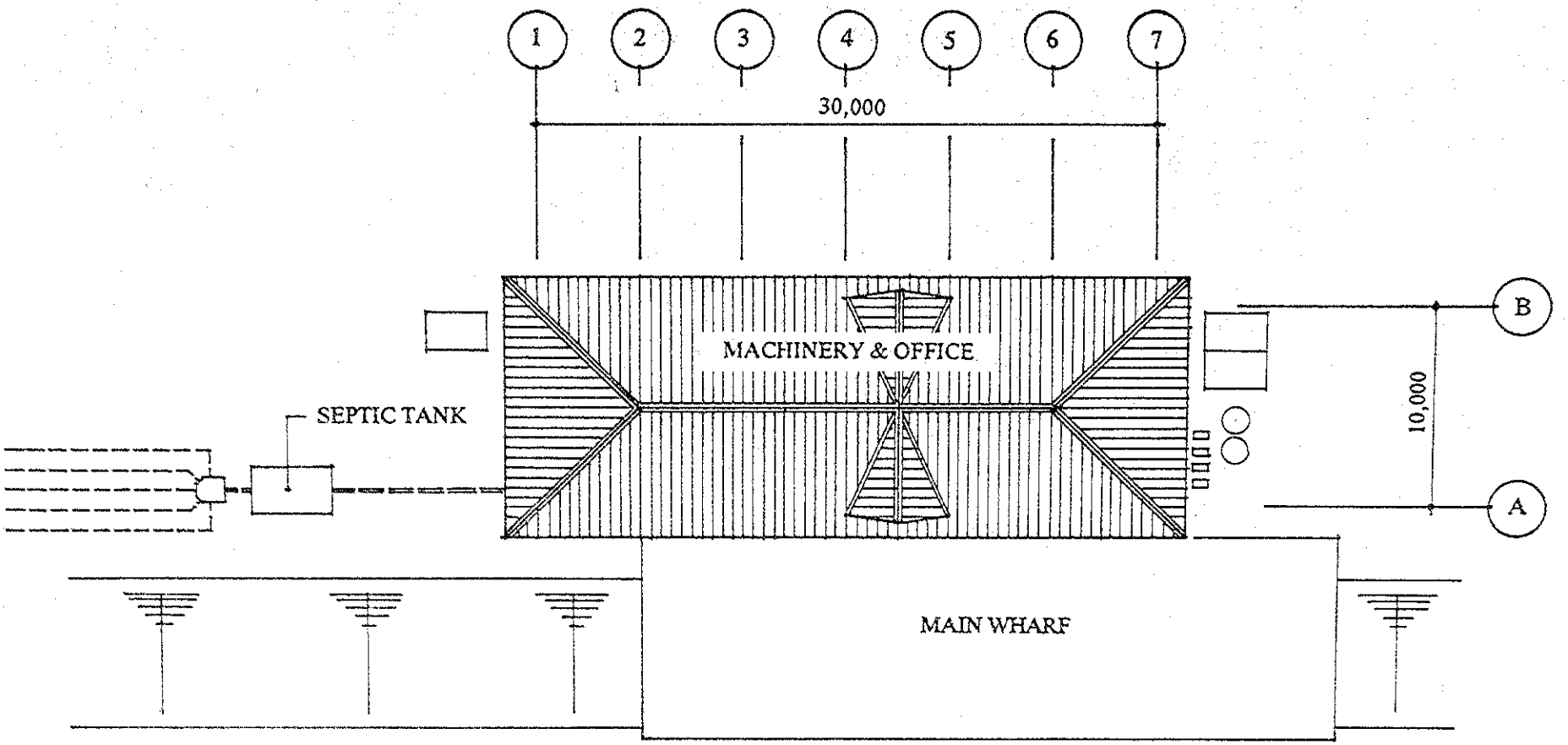


SIDE ELEVATION



CROSS SECTION

Fig.4.19 Machinery & Office, Lelu SCALE 1:200



SITE LAYOUT PLAN SCALE 1:300

Fig.4.20 Machinery & Office, Lelu

4.4.4 Utwe Distribution Station

(1) Ice/cold storage (Storage temperature: 0^{o} C)

1) Ice storage

Fish catch excluding mangrove crab is 188.0 tons a year as shown in Table 4.1. Assuming that ice is required in the ratio of 1:0.6 to fish catch and annual operating days are 200 days, a daily volume of ice required in Utwe is calculated as follows.

188.0 t x 0.6 / 200 days = 0.564 t/day = 564 kg/day

Additional ice for purchasing and transporting fish is 188 kg/day as planned for the ice making machine.

As the Utwe station will not be provided with an ice making machine, ice is transported and supplied from the Lelu distribution center, the combined total demand of which will be 752 kg/day.

A floor area to be used for storing ice can be calculated as follows assuming that a storage efficiency is 80 %, a bulk specific gravity of ice 0.4 and a stacking height 1.0 m.

0.752 t / 0.8 / 0.4 / 1.0 m = 2.35 m^2

2) Space for temporary storage of fresh fish

Based on an annual distribution volume of 94 t indicated in Table 4.1 and 200 annual working days, an average daily incoming volume of fish can be calculated as follows.

94 t / 200 days = 0.47 t/day = 470 kg/day

A floor area for storing fresh fish can be calculated by assuming a storage efficiency as 80 %, a bulk specific gravity of fish as 0.4, and a stacking height as 1.0 m.

0.47 t / 0.8 / 0.4 / 1.0 m = 1.47 m^2

3) A required floor area of a cold storage is summation of 1) + 2) above, and as a plastic basket will be used for stacking, a storage efficiency is assumed as 0.66.

$$(2.35\ m^2 + 1.47\ m^2) / 0.66 = 5.8\ m^2$$

A prefabricated type with a polyurethane sandwich (laminated) panel will be adopted, and the following is selected according to the specification with a panel thickness 100 mm and an internal height of storage 2.6 m

2.7 m in width (frontage) x 2.7 m in depth = 7.3 m^2

(2) Building

A. Layout plan

A building consists of a refrigeration and administration spaces. A working space will be provided with a wide canopy, so that staffs can work even in a heavy rainy day. A storage room and a rest room will be also provided. Furnitures to be provided include desks, chairs, filing cabinets and a small sale counter. Based on the above, the proposed floor plan is as follows:

Floor area:	6.9 m^2
Density:	0.14 person per m^2

According to the Japanese design criteria, a chief manager requires 7.0 m^2 of floor area and the proposed following floor plan, is appropriate for an office space.

B. Structure

The building will be of a rigid frame steel structure.

C. Design of building component

A roof and walls shall be of a colgated steel sheet. Exterior walls along an office room shall be of a reinforced concrete block structure. A floor shall be a concrete steel trowel finish.

Structural Summary:

Building Area:	39.0 m^2
Total Building Floor Area:	39.0 m^2
Eave Height	3.5 m.
Maximum Height:	4.1 m.

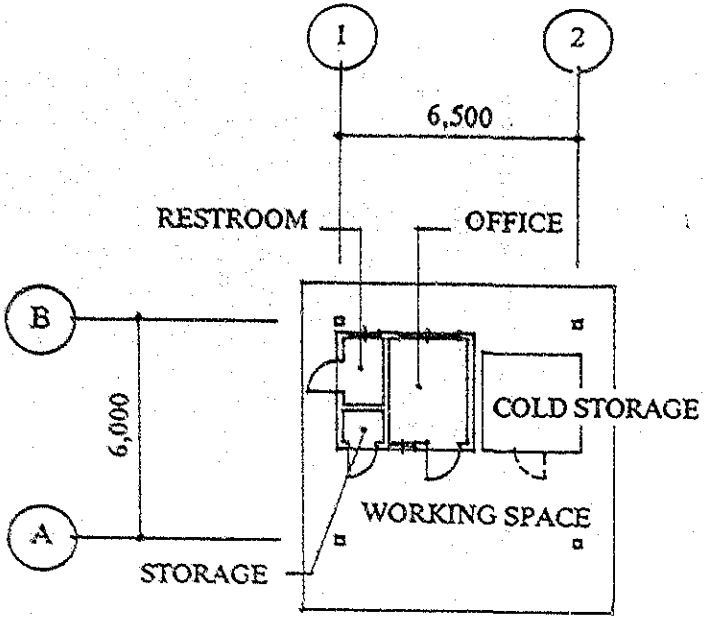
Exterior Finish:	Walls:	Sprayed tile finish.
	Roof:	Colgated colored stainless sheet.
	Door and Windows:	Aluminum Sash.

Interior Finish:

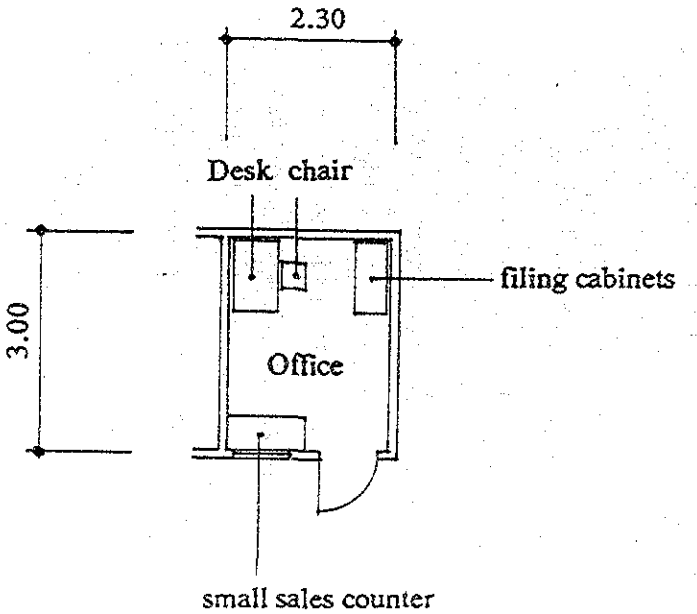
	Floor	Wall	Ceiling
Office	VCT	CP,EP	OP
Rest rooms	CFT	CWT	OP
Storage Room	Concrete Steel Trowel	CP.EP	OP

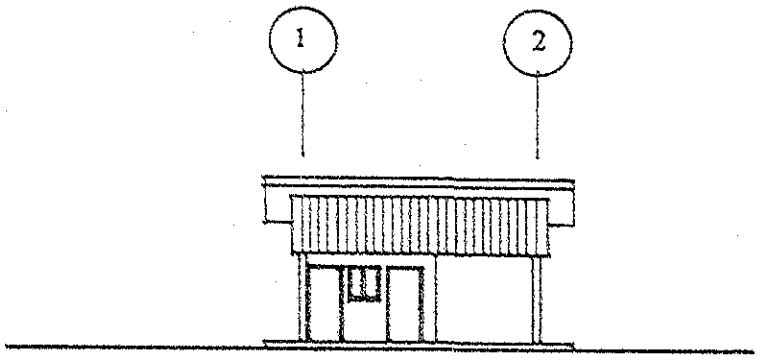
4.4.5 Okat Distribution Station

The same facilities as in the Utwe Distribution Station are provided in the Okat Distribution Station.

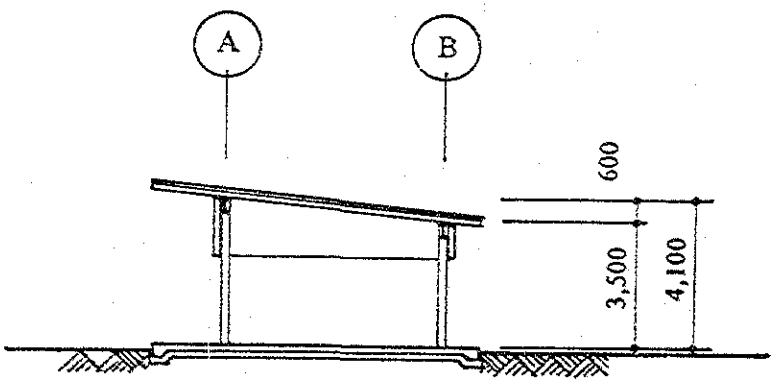


FLOOR PLAN





FRONT ELEVATION



CROSS SECTION

Fig.4.21 Cold Storage & Office, Utwe & Okat

SCALE 1:200

4.4.6 Utilities Plan

(1) Water supply facilities

1) City water

Water supply pipe to each project site will be laid from the existing city water supply pipe. As city water is not treated and not potable, it will be connected to water taps of an ice making machine, a cooling tower and sanitary ware and for general washing purposes at each station. There is no problem in volume and pressure of water. Piping work up to the project sites for supplying necessary volume of water will be executed by the State Government. All the works for installing water tanks and piping within the project sites are included in this project.

2) Potable water (rain water)

Potable water is collected from a roof of a building and stored in a rain water tank. Water is fed to a boiler, a machinery room, etc. and all the works for installing a rain water receiving tank and water feed piping are included in this project.

(2) Drainage facilities

1) Sanitary sewage

Sanitary sewage will be treated in a septic tank, then discharged into ground through an infiltration basin and disposed within the site.

2) Miscellaneous waste water and storm sewage

These water are discharged into the sea through outside ditches.

(3) Sanitary ware

Sanitary ware to be used in this project are the ones made in Japan or their equivalents.

(4) Ventilation facilities

To remove radiant heat from a roof surface, louvers will be provided on an upper part of a gable and air is ventilated through a loft. A natural ventilation will be first employed, but a mechanical ventilation is also used in a machine room and a toilet to remove offensive odor.

(5) Air-conditioning facilities

A window type cooler will be installed in an administration office for cooling and ventilating.

(6) Electrical wiring work

1) Scope of wiring work

In order to supply necessary electric power, an installation of power line up to the project sites will be executed by the State Government, and all the wiring works within the project sites will be included in this project.

2) Distribution system and receiving and distributing facilities

* A distribution system of electric power is planned as follows:

Power circuits: AC 220V, 3 phase, 3 wire, 60 Hz
Lighting and outlet circuits: AC 120V, single phase, 2 wire, 60 Hz

* A incoming panel is to receive power from both a commercial source and an emergency generator. Each source is provided with a main switch with interlocking device.

* A power board is provided on a power circuit and a panel board on a lighting circuit, from which wiring will be done.

3) Emergency diesel generator

As a countermeasure against power failure, a 125 KVA diesel

generator will be installed in the Lelu distribution station. No generator is provided in the Utwe and Okat distribution stations.

4) Lighting facilities

Waterproof incandescent lamps are used inside a ice storage, a cooling room, an air blast freezer and a freezing room, and fluorescent lamps will be mainly used in the other places. Intensity of illumination at various places are as follows.

Office room : 400 Lux
Other rooms : 100 Lux
Inside a storage, toilet and shower room : 50 Lux
Outdoor lighting : approx. 10 Lux

5) A special consideration is necessary to protect all the electrical facilities from high temperature, high humidity, brine damage and corrosion.

(7) Refrigeration system

Design conditions are as follows. A refrigerator is used for an ice making machine, an ice storage, cold storages.

1) Refrigerant : Freon R-22

2) Atmospheric temperature : 31° C

3) Cooling temperature : 0 - -5° C

4) Control method : Automated operation

(8) Telephone facilities

An empty conduit piping work for leading a telephone wire into offices will be included under this project, while a telephone cable laying work to the sites shall be executed by the State Government.

4.4.7 Equipment and Materials Plan

(1) Refrigerating truck

A refrigerator is mounted on a truck so as to control a storage temperature between +5° C and -10° C depending on cargos. Since a transportation to each area is restricted by time, and especially fresh fish for export must be delivered to an airport on time for shipment, two trucks are necessary and are assigned to the Lelu distribution center.

Vehicle	:	Small sized refrigerated truck
Type	:	Mounted with a diesel engine, box type
Loading capacity	:	2,000 kg
No. of vehicles	:	two

(2) Hand cart for cold storage

Hand carts for handling various items to be stored in a cold storage are provided in the Lelu distribution center.

Type	:	4 wheel hand cart for low temperature
Vehicle dimensions	:	1,200 mm in length x 650 mm in width x 1,100 mm in sleeve height
Loading capacity	:	300 kg
No. of carts	:	2

(3) Hand cart for fresh fish and ice

Hands cart for handling fresh fish and ice are provided in each station.

Type	:	2 wheel hand cart
Vehicle dimensions	:	1,200 mm in length x 385 mm in width x 780 mm in floor height
Wheel used	:	200 mm solid rubber wheel
Loading capacity	:	150 kg
No. of cars	:	2 carts for each station, total 6 carts for three stations

(4) Plastic container

Plastic fish boxes are provided for handling fish and ice.

Type	:	Plastic basket with handles		
Capacity	:	70 liters		
Quantity	:	Lelu Station	:	71 ea.
		Utwe Station	:	28 ea.
		Okat Station	:	28 ea.
		Total		127

Dimensions (internal dimensions): 662 mm x 422 mm x 322 mm
Capacity : 70 liters
Material : Polypropylene (basket shaped)

1) For the Utwe and Okat Stations

Baskets are used for transporting ice:

Ice: 754 kg/day/station

Ice which can be loaded in a basket:
70 liters x 0.4 kg/l = 28 kg/ea.

A number of baskets necessary for transport:
754 kg / 28 kg/ea. = 26.9 ea.

With allowance of 5 %, a number of required baskets is calculated as below:

26.9 ea. x 1.05 = 28.2 ea. per station

2) For the Lelu Station

Baskets are to be used in stacking and storing fresh fish in a cold storage:

Average daily volume of fish stored: 1,900 kg
Fish which can be loaded in a basket:
70 liters x 0.4 kg/l = 28 kg/ea.
No. of baskets necessary for storing:
1,900 k / 28 kg/ea. = 67.8 ea.

With the same allowance, a number of required buskets is calculated as below:

67.8 ea. x 1.05 = 71.2 ea. = 71 ea.

(5) Fresh fish tank

FRP tanks for retaining freshness of fresh fish for export by dipping them in iced water are provided in the Lelu Station.

Type	:	FRP tank with 4 casters and drain cock
Capacity	:	1,000 liters
Quantity	:	4 units

(6) Weighing scale

Weighing scales for purchasing and selling fish are provided at each station.

Platform scale

Type	:	Platform scale with caster
Maximum weighing measure:		100 kg
Quantity	:	One each for each station, total 3

(7) Fish smoking machine

A production capacity of half-dried bonito of the existing fish processing plant is 100 kg/cycle in terms of raw fish. Considering that pre-treatment work in producing smoked fish is almost the same as that of half-dried bonito, a production capacity of the smoking machine is determined as the same value of 100 kg/cycle.

Type : Box type
Capacity : 100 kg/cycle
Quantity : 1 set

(8) Small truck

A small truck is provided to the Lelu station for transportation and the other miscellaneous purposes.

Type : W cab truck
Seating capacity : 5 persons
Loading capacity : 1,000 kg
No. of truck : 1

4.5 Fishing Boats and Gears

(1) Tuna long line

A small-sized light-weight line hauler is installed by removing the existing capstan located at the starboard of the bow in order to use a training boat for training of long line tuna fishing as well. A side-roller is installed to follow changes in a hauling direction of a main line. A long line casting operation is carried out from a stern deck. 10 radio buoys to be used in casting a long line are also provided.

1) Line hauler

Line hauler is an equipment indispensable for tuna long line fishing boats and is used for heaving a main line. Generally two units, one main unit and one stand by unit are equipped in specialized tuna long line fishing boats. The stand-by line hauler is used in the case of a trouble of the main line hauler, breakage of a main line, and the other troubles. In small-sized fishing boats a driving power is provided by a main engine and in large-sized fishing boats a line hauler is powered by a motor which drives a line hauler and a windlass. The line hauler is installed on a deck at the bow side for facilitating maneuver of a boat and a fishing operation. A line hauling speed is in an order of 68 m per minute for a small size, about 144 m per minute for

medium size and about 184 m per minute for a large size.

There are various types of line haulers for coastal fishing use, and small-sized equipment is powered either by hydraulic mechanism or by battery. The smallest model is selected having 70kg hoisting capacity, 60 m/min hoisting speed, consuming 14 L/min of oil and uses 45 kg/cm^2 hydraulic pressure. It is necessary to shorten the line hauling time by installing side rollers with the line hauler, and it becomes possible to haul 70 - 80 baskets with 5 - 9 hooks per basket in about 4 hours.

2) Fishing gear

A long line fishing gear for tuna is designed for catching mainly yellow fin tuna, but it can be used to fish big eye tuna as well. The long line is attached with 5 hooks per basket, in the same way as in the long line already purchased by the State Government, and two sets of long line fishing gears consisting of 60 baskets and 300 hooks are included in the project.

3) Auxiliary fishing gear (Radio buoy)

Auxiliary fishing gears of radio buoys are indispensable and must have sufficient buoyancy and high stability. The body of the radio buoys are made of plastic and its circuitry will be fully transistorized for long durability. The radio buoys with a radio direction finder are included for tuna long line fishing and possible to use them also in deep sea bottom long line fishing.

(2) Spare parts for outboard engine

Parts and components with frequent troubles are included as spare parts by referring to a repair record the existing workshop.

(3) Ice Box for catamaran boats

Ice boxes should be installed on all the catamaran boats to keep

freshness of fish.

Ice box:	FRP ice box with 50 mm thickness, urethane foam heat insulator, provided with heat-proof lid.
Outer dimension:	1,600 mm length, 700 mm width, 600 mm height
Quantity:	45 units

Ice boxes and spare parts for outboard engines will be sold to fishermen at reasonable prices and the revenues will be reserved in a revolving fund. The fund will be used for promotion of the fisheries industry in the state.

(4) Fish aggregating devices

10 sets of fish aggregating devices were provided in the previous Japanese grant aid project, but four sets were lost due to current and waves. Their effectiveness was fully confirmed and 10 sets are included in the project. Fish aggregating devices are effective mainly for migratory fishes. It has advantages of easy construction, low cost and increase in fishing efficiency. The major causes of their losses are mentioned in the followings.

1) Loss due to a breakage of a mooring line caused by ocean currents, tidal currents, waves, etc.

2) Abnormal sinking and loss of a raft due to strong tidal current.

3) Breakage of steel components of mooring line due to deterioration, corrosion and other relevant factors.

4) Loss due to insufficient weight and strength of mooring line, etc.

5) Breakage and loss by human

Proper countermeasures must be taken by analyzing the aforementioned causes in order to prevent loss of the installed fish aggregating devices. Careful study must be carried out in connection with such aspects as a location of installation site, water depth, a method for discovering the installed fish aggregating devices, a method for catching fishes gathered , etc., in order to attain efficient results. The State Government is carrying out studies to construct and install an improved type of fish aggregating devices designed by the FAO and the SPC.

The 10 fish aggregating devices included this project are of spherical steel buoys similar to those being used in Hawaii and other places in conformity with the request of the state. A fish gathering effect and a durability have been confirmed through many installation cases in Hawaii.

1) Radar reflector

A radar reflector shall be locatable from 3 miles or more.

2) Flashing light

A flashing light is attached on top of the buoy with range of 1.3 - 2.5 km for night fishing.

5) Deep sea long line

A deep sea long line used for catching snappers in Japan is included in the project.

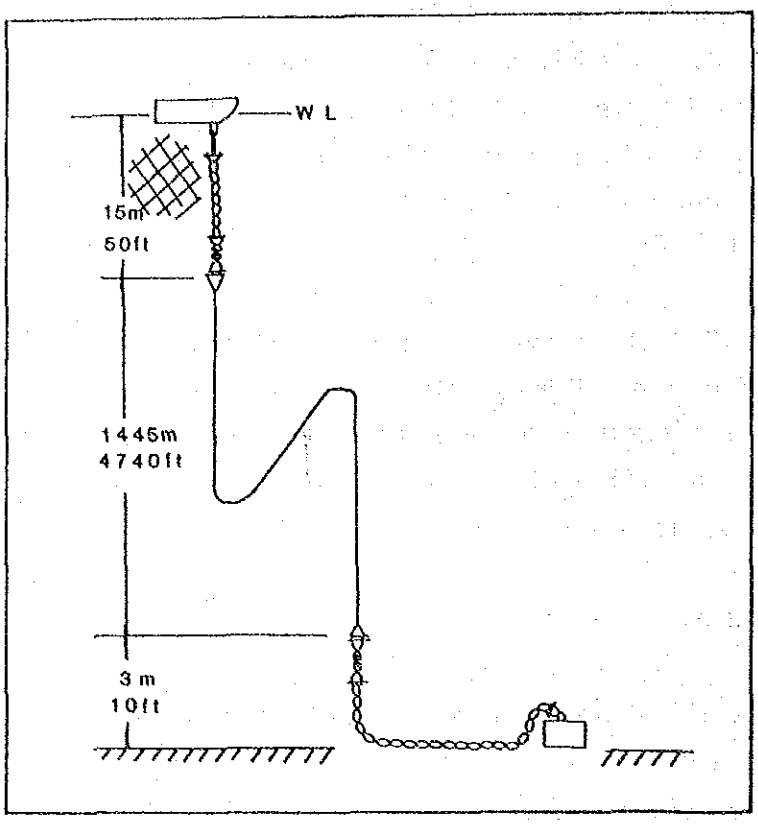


Fig.4.21 Sketch of Fish Aggregating Devices

CHAPTER 5

IMPLEMENTATION PLAN

CHAPTER 5 IMPLEMENTATION PLAN

5.1 Organizations of Project Implementation

The organizations responsible for implementing the project are as follows.

i) Bidding and Contract

Department of External Affairs, Federated States of Micronesia

ii) Control of Construction Work

Marine Resources Division, Department of Conservation and Development

Kosrae State Government

iii) Operation and Management of the Facilities

Marine Resources Division, Department of Conservation and Development

Kosrae State Government

Bidding and contract procedures are undertaken by the central government in Pohnpei and construction works will be controlled by the state government with assistance of the consultants and also possibly the public work department and the construction and engineering office. Operation and management after the completion of the project facilities will be undertaken by the Kosrae Fishing Cooperative Association under control of the Marine Resources Division.

All the engineering services will be undertaken by the Japanese consultants after a contract with the state government following the exchange of note between the two governments. The consultants will prepare all the required bidding documents such as drawings, technical specifications, cost estimates, conditions of contract,etc. A contractor for this project will be selected upon agreement of the FSM through

prequalification and bidding. Construction works will be carried out according to a contract between the FSM and the contractor.

5.2 Scope of Construction Works

Scopes of the project to be borne by the Governments FSM and Japan are as follows.

1) The works to be borne by Japan

i) Lelu Site

- Mooring facilities for catamaran boats
- Slipway for catamaran boats
- Wharf for large size boats
- Fuel tanks
- Ice making machine and cooling room
- Refrigerating trucks
- Smoking machine
- Line hauler and long lining fishing gear
- Outboard engine spare parts
- Small size trick

ii) Utwe Site

- Mooring facilities for catamaran boats
- Ice/cold storage
- Office
- Gasoline tank

iii) Okat site

- Mooring facilities for catamaran boats
- Ice/cold storage
- Office
- Gasoline tank

iv) Others

- 45 ice boxes for catamaran boats
- 10 fish aggregating devices

2) The works to be borne by the FSM

i) Construction of utilities such as electricity, water supply, drainage, etc. to the project sites

ii) Relocation of the existing ice making machine, air blast freezer and freezing room.

iii) Provision of data and information required for design and construction works.

iv) Permission of priority navigation of work vessels in the water in and around the project sites.

v) Guarantee for smooth custom clearance and transportation of construction materials and equipment to the sites.

vi) Tax exemption of construction materials and equipment

vii) Tax exemption for Japanese construction staffs for the project.

viii) Arrangement for entry and stay permits of Japanese construction staffs.

ix) Adequate operation and control of all the project facilities planned in the project.

5.3 Construction Plan

5.3.1 Conditions of Construction Works in Kosrae

(1) General

Major construction works presently done in Kosrae covers public

infrastructure such as a road, a harbor, an airport, water supply, sewerage, etc. Large scale construction works are mostly undertaken by foreign firms. The new international harbor and airport were recently built in Okat under a joint venture of a Korean company Kongyon, a New Zealand company Black Construction and an American company International Bridge and Construction. The latter two companies have presently branch offices in Kosrae. Local companies are mostly small in scale and about 10 companies are working in the Lelu district.

Most of construction materials except for fine and coarse aggregate for a concrete work are not available locally . Operators for construction equipment are locally available except for very special ones.

A permission of the health department of the environmental agency is required for environmental control to the construction works of the project.

(2) Construction cost

Costs of construction materials and labors are summarized as follow.

1) Labor cost

Unskilled labor	1.5-1.8$/hr
Skilled labor	2.0-3.25$/hr

2) Construction cost

Excavation	Cubic Yard (C.Y.)	12.5$
Asphalt paving	2" x 20' x 1'	100.00
Dredging (soft soil, except mobilization)	C.Y.	6.50
Iron bar work	t	450.00
Placing concrete	C.Y.	5.00
Concrete worker	hr	2.00

Working hours in two weeks are 80 hrs and no work is allowed on

Sunday. Overtime work is allowed on week days with a wage of 50% increase.

(3) Construction material

Construction materials presently produced in Kosrae are fine and coarse aggregates for a concrete work, various sizes of stone and and the other materials are imported. Sale of stone materials from a crushing plant is controlled by the State Government and crushed stone for a concrete work costs 21.5 $/C.Y. at a production site.

The followings are unit costs of major construction materials collected during the site survey.

Material	Unit	Cost (US$)
Cement	40 kg bag	5.6
Sand	C.Y. at quarry	4.50
Crushed stone	C.Y. at quarry	21.5
Re-bar (5/8" -3/8" x 20')	pc	2.95 - 7.50
Plywood (2/1" x 4' x 8')	pc	22.5
Gasoline	Gall.	1.35
Diesel Oil	Gall.	1.5

(4) Transportation to the sites and others

Transportation means to Kosrae are made available by sea and air. The following liner is operated to the newly developed harbor in Okat.

Japan - Kosrae bimonthly Kyowa Shipping Co.

An air service is run biweekly.

Guam - Kosrae - Hawaii Air Micronesia

A road network is provided to all four districts but are not paved except for about 3 mile section from the airport.

A power plant is located in Tofol and has 3 units of 400 kw diesel generators and 2 units of 300 kw diesel generators supplying

electricity to all four districts in Kosrae.

5.3.2 Construction Method

The major project components are construction of basic fishery infrastructure in three sites, construction of distribution facilities and introduction of fishing gears. The civil and architectural works are outlined in the following.

1) Civil work

i) Work Items

The followings are included in a civil work of the project.

a) Mooring facilities for catamaran boats

- dredging work in a mooring basin
- revetment work on a slope around a mooring basin
- floating pontoon and access bridge
- slipway for catamaran boats
- fuel tank
- road pavement

b) wharf

- rubble mound
- pile driving
- concrete deck
- apron pavement
- fender, bollard, etc.
- dredging work in a turning basin

ii) Construction material and equipment

The major construction materials used in the project are stone, FRP pontoon, steel and concrete. Construction materials except for fine and coarse aggregates are to be imported and the import plan of these materials and

mobilization of various construction equipment are very important for a successful project implementation.

iii) Construction Yard

A wide land area is required for storing construction materials and equipment, processing re-bars, a site office, etc. A construction yard can be secured in all three sites and should be located through consideration of a smooth construction work and the other activities near the sites.

iv) Control of quality and work progress

Civil works are frequently affected by natural conditions such as rainfall, wave, etc. A critical condition in Kosrae is heavy rain which will affect a working efficiency and quality control of concrete. Also, high temperature should be taken into consideration in a concreting work.

2) Architectural work

Most of construction materials for an architectural work are mobilized from overseas. Unskilled labors and some of skilled labors can be locally hired while skilled labors for a steel work, machinery, etc. should be hired from overseas.

5.3.3 Construction Supervising Program

To comply with policies set forth by the Japanese Government on a grant aid, the consultant shall organize an integrated project execution team for the detailed design and construction supervising works and try to smoothly implement all the works based on a tenor of the basic design. During the supervising stage, the consultant shall dispatch a resident supervisor with an appropriate technical competence to the construction site to provide guidance on the project works and maintain liaison and also dispatch specialized engineers for a short period as necessary in keeping a pace with progress of construction works for inspection, witnessing and offering guidance on a construction method of the works.

(1) Major policies of construction supervision

1) To aim at completion of all the facilities based on a construction

schedule without delay by maintaining a close contact with and reporting to the concerned authorities and personnel in charge in both countries.

2) To offer timely and adequate guidances and advice to those concerned with an execution of the works so as to construct all the facilities in conformity with design documents.

3) To encourage a use of a local construction method using local materials as much as possible.

4) To realize technology transfer with respect to construction methods and techniques and thus maximize benefits of a grant aid project.

5) To provide appropriate advice and guidances on maintenance and management of facilities after completion and delivery for their smooth operation.

(2) Details of construction supervision

1) Assistance on construction contract procedures

To select a contractor, determine a type of construction contract, examine detailed schedules of construction cost, and witness awarding of a construction contract.

2) Inspection and verification of working drawings, etc.

To check working drawings, construction materials and samples, etc.

3) Instruction on construction works

To examine work plans and a work schedule, instruct contractor and report a progress of the work to the executing agency.

4) Assistance in preparing a payment approval procedure

To assist examination of contents of bills for construction cost

payable during and after a completion of construction works and processing them.

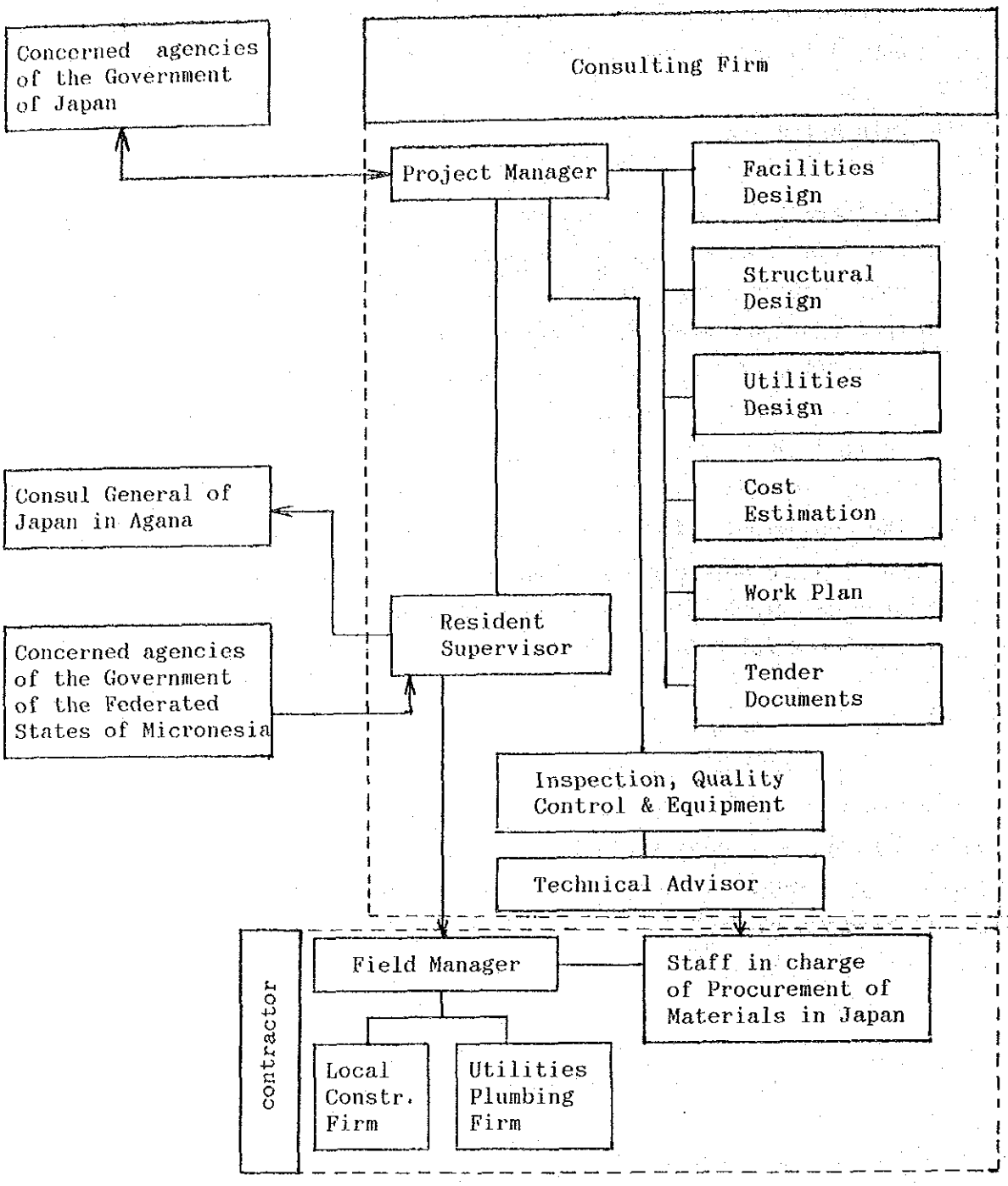
5) Witnessing inspections

To inspect the works in progress during construction as necessary and offer guidances to a contractor. The consultants shall, upon confirmation of a completion of construction and fulfillment of the terms and conditions of the contract, witness delivery of the facilities of the contract and with the government's confirmation of the acceptance thereof, the consultants will have completed their duties.

The consultants shall also report to the concerned authorities of the Government of Japan progress of construction works, payment procedures, and necessary matters concerning a delivery of completed facilities.

5.4 Construction Schedule

Construction works for the project will require five months for detailed design and a contract after the exchange of note, two months for preparation and mobilization and eleven months for construction work at the sites totaling 18 months.



Organization for Construction Supervision

Table 5.1 Construction Schedule

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Detailed Design & Procedures	Exchange of Notes Consulting Contract	.....																	
	Detailed Design		.....	.....	.....	.....													
	Prequalification & Tender					.....													
	Construction Contract																		
Construction Item	Construction Period																		
	Material Oder & Mobilization Preparation						.....	.....	.....										.....
	• LELU Site																		
	Wharf																		
	Floating Pontoon																		
	Slipway																		
	Building																		
	Fuel Tank																		
	• UTWE Site																		
	Floating Pontoon																		
	Building																		
	Fuel Tank																		
	• OKAT Site																		
	Floating Pontoon																		
	Building																		
	Fuel Tank																		

CHAPTER 6

OPERATION AND ADMINISTRATION PLAN

CHAPTER 6 OPERATION AND ADMINISTRATION PLAN

6.1 Operation and Administration Organizations

Operation and management after completion of the project facilities will be undertaken by the Kosrae Fishing Cooperative Association under the control of the Marine Resources Division as in the same way as that of the existing fishery facilities in Lelu.

The association was organized pursuant to the policy of the State Government by 156 individuals deeply involved in fisheries.
Actual performance record of the association shows that it has rented and operated the ice making, freezing and cold storage facilities provided by the Japanese Government to the Kosrae State in 1983, and promoted fishery development and fishery product distribution. Because of this, it is the only organization in the island having experience in operating distribution facilities.

The association, having received training in manufacturing and processing technologies and having experience in operating distribution facilities, is expected to assume responsibility for the production and operation of the fish processing plant constructed by the Kosrae State which is scheduled to start operation in May, 1989. At present, the distribution facilities being operated by the association have five employees. The association plans to hire more than 10 additional employees with a start-up of the processing plant in order to strengthen its organizational structure.

Thus, it can be judged that the said association is well qualified to assume actual responsibility for operation, maintenance and management of the distribution facilities under this project upon their completion with a support of the State Government.

6.2 Operation Staffing Plan

(1) Staffs necessary for management and operation of distribution facilities at three locations are arranged as follows.

Operating Chief	1
Operating staff	4
Clerical staff	1
Engineering Chief	1
Staff for Utwe Station	1
Staff for Okat Station	1
Total	9

Staffs will consist of 9 persons as above and their duties are as follows.

Operating Chief : Person responsible for numerical control of refrigeration, freezing and storage, and also for sale of ice, collection of charges and export business.

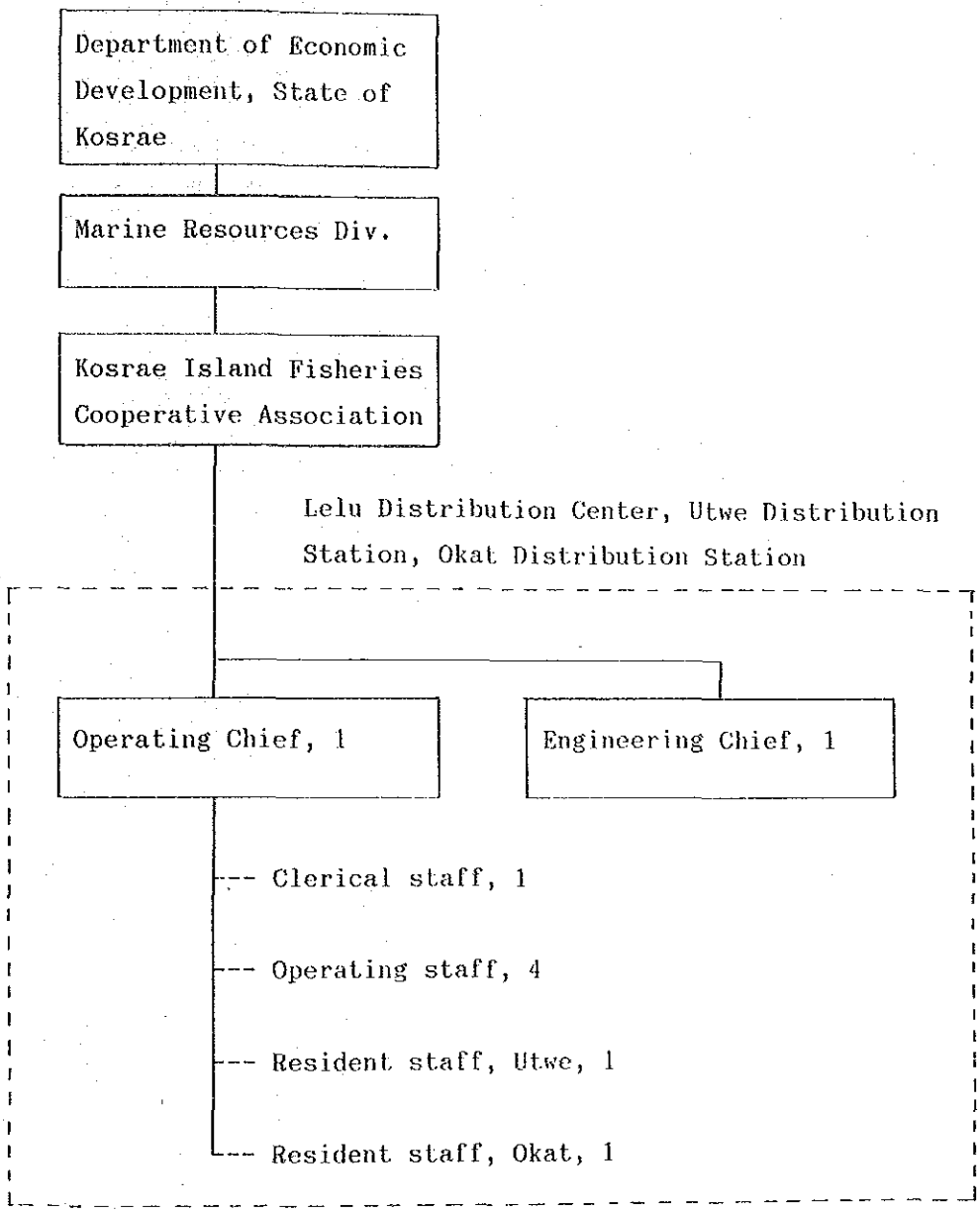
Operating staff : Sale of ice, entry into and issuance from storage and custody, freezing work, driving of refrigerated truck, collection and delivery work.

Clerical staff : Clerical assistance and sales duties.

Engineering Chief: Person responsible for overall facilities. He must be an engineer or a person experienced in maintenance and operation of air blast freezer and generator, ice making, etc.

Staff for Utwe & Okat Stations : Sale of ice, purchase of fish, entry into and issuance from cold storage.

(2) The following shows a system of maintenance and management of the facilities.



Equipment and machinery selected for the distribution facilities under this project are those for which technology for maintenance and operation can be easily acquired. It is essential that these equipment be inspected periodically and their parts replaced and overhauled as necessary. Engineers with adequate experience shall be assigned to these duties. Necessary education and training will be given to personnel prior to delivery of the facilities.

6.3 Operation and Management Plan

6.3.1 Basic Fishery Facilities

Maintenance works for the basic fishery facilities include periodical painting, minor repair and replacement of parts. The maintenance cost is estimated at about 2,600 US$ a year and should be borne by the Marine Resources Division while the present work force can undertake the maintenance works without reinforcement.

6.3.2 Distribution Facilities

A financial soundness of this project is examined by expected revenues and expenditures.

1) Expected revenues

Expected revenues are shown as below:

sale of ice	0.10 $/kg	35,840	US$
sale of fresh fish	5 % of sale	10,843	
sale of frozen fish	10 %	17,738	
export of fresh fish	10 %	28,836	
export of mangrove crab	10 %	936	
Total		94,193	US$

2) Expected expenditure

electricity	13,186	US$
salary	29,100	
overhead	35,810	
Total	78,096	US$

3) Estimated annual balance

Revenues	$94,193
Expenditures	76,006
Balance	18,187

A balance after paying for operating expenses generates a profit. However, it is necessary for the State Government to take budgetary measures to support and undertake education and training from the standpoint of promoting fisheries and distribution project. Detailed calculation is presented in Appendix.

CHAPTER 7

EVALUATION OF THE PROJECT

CHAPTER 7 EVALUATION OF THE PROJECT

The State Government of Kosrae is planning economic development focusing on fisheries, agriculture and forestry and industry sectors to cope with a planned large reduction of the US aid after expiration of the United Nations Trusteeship. Of the above economic sectors, fisheries is considered most promising and contribute to economic development of the state. Promotion of fisheries industry in the state aims at, as stated in the First National Development Plan, increase of employment opportunity and competitive export industry. To achieve the economic development plans mentioned above, the Government of FSM has received Japanese grant aids for two fishery projects in the Kosrae State in 1981 and 1985. The Kosrae State has achieved a drastic improvement in a fisheries industry by introduction of distribution facilities and catamaran boats. As will be detailed in a subsequent section, about 80 % of protein demand from fish is now met by a local production which greatly contributes saving of foreign exchange of the state.

This project consists of basic fishery and distribution facilities in three sites covering an entire area of the state and aims at further improvement of self-sufficiency of fishery products and promotion of export of high value fish. The project will greatly contribute to reinforcement of the state economy and public benefit and therefore it is judged to be appropriate to implement this project under a Japanese grant aid.

7.1 Basic Fishery Facilities

Three project sites proposed in the project are located in calm inner parts of a reef flat sheltered from offshore waves and therefore mooring and cargo handling operations at floating pontoons and a wharf will not be affected by waves. Also, tidal currents do not affect operation of fishing boats at any of three project sites.

The basic fishery facilities planned in the project are mooring facilities for catamaran boats in three sites and a wharf in Lelu site and benefits to be brought by these facilities are as follows.

(1) Improvement of safety

Most of the catamaran boats are, due to absence of adequate mooring facilities, anchored near a coast and this situation imposes fishermen a dangerous and inefficient operation of mooring and handing fish. Further, abrasion of a bottom of boat with coarse sea bed at low tide, pilferage of fishing gears, etc. are reported. All these problems will be eliminated by provision of the basic fishery facilities and safely of boat operation will be greatly improved.

(2) Improvement of efficiency

The basic fishery facilities will greatly contribute to reduction of time required for mooring, handling fish, loading ice and fuel and thereby improve an efficiency of fishing boats. Some of the catamaran boats are unable to sail out for fishing due to grounding on sea bed at low tide and this will be also eliminated. The test fishing boat "Mutunte" presently anchored offshore will be efficiently used with the provision of the wharf.

7.2 Distribution Facilities

Lack of adequate distribution facilities and commercial system are hindering an increase in fish consumption in the Kosrae State. Objectives of this project are to provide basic fishery and distribution facilities in order to further enhance a fisheries industry into an export industry, to promote professionalization of fishermen and to develop distribution market system of fishery products.

Establishment of fishery facilities is in line with policies of the Government of FSM which aims at independent domestic economy, and this project will assume an important role in improving basic fishery infrastructure. Success of this project, however, will depend on how the Government will organize a operation and management system with adequate establishment of governmental policies.

Expected benefits:

1) Increase in fish consumption by improving quality of fishery products and stably supplying fish during a poor fishing season.

2) Increase in export of fresh fish and decrease in import of canned fish and frozen meat.

3) Efficient fishing operation and increase in catch by increasing well trained full-time fishermen.

4) Organization of fishermen and strengthening of training and guidance activities.

5) Promotion and activation of local industries.

7.3 Fishing Boats and Gears

(1) Catamaran boat

Coastal fishing with the catamaran boats will make substantial contribution in promoting fisheries in the Kosrae State through further improvement of fishing techniques. Fishing efficiency of trolling operation will be further improved by supplying ice boxes, fish aggregating devices and spare parts of outboard engine. Moreover, it will be possible to to raise an income level of fishermen by introducing deep sea hand line fishing for catching fishes which though are available only in small quantities can be sold at high prices.

(2) Dual-purpose fishing boat for pole and line skipjack fishing and long line tuna fishing

Much expectation can not be put on development of bottom fish in the Kosrae State because of its sea bed topography of narrow reef and steep slope. It is recommendable to concentrate efforts on the development of pelagic fish, however, fishery resources are rich for surface-layer and middle-layer migratory fishes. Accordingly, efforts should be made on promoting and developing fisheries by continuing pole-and-line skipjack fishing carried out so far in addition to planned training and experimental operation of long line tuna fishing.

7.4 Forecast of Fish Catch

The following describes relationship between the population of the State of Kosrae and necessary volume of fish catch.

(1) Population

The population has grown at the rate of 3.2% per year between 1980 and 1986, and is anticipated to reach the following population by 1991 when this project is scheduled to start operating.

Year	1973	1980	1986	Est.1991
Population (persons)	3,989	5,552	6,607	7,819

(Based on the data of the Department of Statistics, Government of Kosrae)

(2) Demand of protein

According to the FAO recommendation, the necessary animal protein intake (true protein) in the Southern Pacific region is calculated to be 105 kg per capita per year, based on which the annual animal protein requirement in the State of Kosrae is shown as follows.

Year	1973	1980	1986	1991
Requirement (tons)	418	579	693	821

(3) Required supply of fish

Assuming that 60 % of necessary true protein would be intaken from fish and eatable portion of fish is 70%, the necessary fish catch is calculated as follows.

Year	1973	1980	1986	1991
Necessary catch (tons)	358	496	594	704

(4) Fish catch forecast

As the State of Kosrae has no reliable fish catch statistics, fish catch is forecasted as follows.

i) 1986

No. of FRP boats: 34

Average catch: 30 kg/day/boat (estimate)

No. of days sailing out fishing: 140 days/year

(according to the survey data of 1986)

34 x 0.03 x 140 = 142 tons

Shortage of fish: 142 t - 594 t = -452 t

According to the data of the Department of Ocean Resources, the State of Kosrae, total catch during the period between October 1986 and September 1987 was 145 tons, which was close to the estimate.

ii) 1987

After the provision of 70 catamaran boats.

34 FRP boats + 70 catamaran boats = 104 boats

Average catch: 30kg and 35kg per day per boat respectively (based on hearing survey of fishermen).

No. of days sailing out fishing: 140 days (based on hearing survey of fishermen).

Catch by the test fishing boat: 5.4 tons/year
(34 x 0.03 + 70 x 0.035) x 140 + 5.4 = 491.2 tons
Shortage of fish: 491.2 t - 651 t = - 123.8 t

iii) Estimate for 1991

70 catamaran boats + 30 FRP boats = 100 boats
Average fish catch: 30 kg and 35 kg per day per boat respectively (based on hearing survey of fishermen).

No. of days sailing out fishing: 200 days (planned)
Test fishing boat 23.1 t/year, mangrove crab 2.4 tons/year

(30 x 0.03 + 70 x 0.035) x 200 + 23.1 + 2.4 = 695.5 t
Shortage of fish: 695.5 - 704 = -8.5 t

When the catch by coastal canoe fishing (which is not included in the above calculation) is included, the supply volume of fish is anticipated to be close to the necessary volume even after subtracting the export volume.

If the conversion into full-time fishermen makes advances and systematization of fisheries and fish distribution is launched on a right track, attainment of necessary catch seems adequately possible by improving fishing technology, improving fishing efficiency and installing fish aggregating devices. Furthermore, incomes from the catch of pelagic fish suitable for export and which commands a high price, and collecting and exporting of mangrove crabs by organized efforts will enable fisheries to develop into a new industry.

(5) Export of fresh fish

The actual annual fresh fish export during 1988 was 1,278 kg, and export species mainly consisted of mangrove crab, the export sales of which was $12,173. (From the data of the Department of Economic Development).

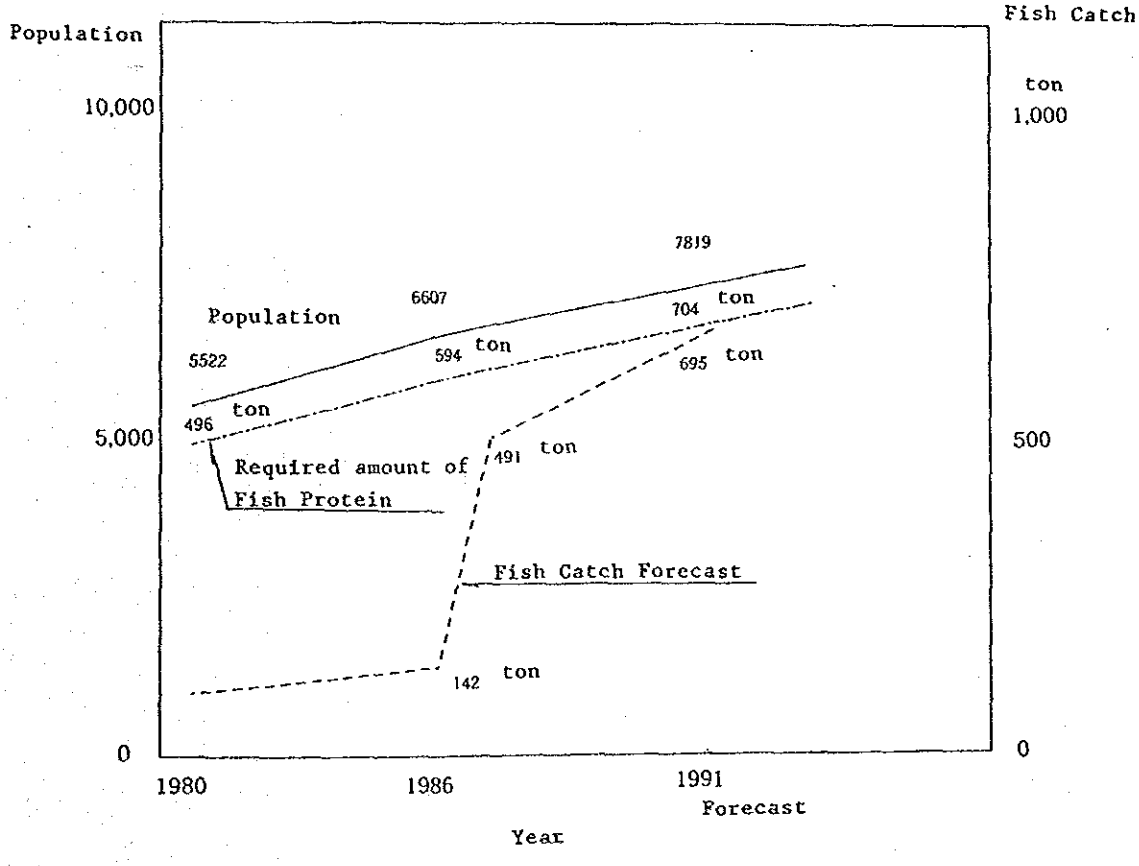
a) Average export price of fish: $9.60/kg (including expenses such as air freight)

($11.5/kg for mangrove crab and $7/kg for pelagic fish on average)

b) Average price of bonito and tuna sold in the island is $1.7/kg. Mangrove crab and pelagic fish are the species aimed for export as they are more advantageous in terms of price compared to other fish.

In order to develop the present fisheries into an export industry, however, it would be necessary to improve fishing technology and assure a certain supply volume by increasing the number of full-time fishermen and organizing them.

Although the State of Kosrae is reported to have abundant fishing grounds, they have not been investigated thoroughly enough, and the market survey is also inadequate. Accordingly, it is necessary to investigate and confirm the market supply and demand, forecast fish prices and prospect of fishing scale and determine how to respond to them, and in order to satisfy these requirements, a gradual development rather than a rapid change is preferable.



CHAPTER 8

CONCLUSION AND RECOMMENDATION

CHAPTER 8 CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion

The government of the FSM has been making a great effort on promotion of a fisheries industry toward an economic independence following the basic national policy set out in the First National Development plan. The past two Japanese grant aids, especially 70 catamaran boats are judged to greatly contribute to promotion of a fisheries industry in the Kosrae State.

As basic fishery facilities, a 34 m long wharf, mooring facilities for 30 catamaran boats, fuel tanks and a slipway are judged to be necessary in Lelu and mooring facilities for 20 catamaran boats and a fuel tank are proposed in Utwe and Okat. While as distribution facilities, an ice making machine, an ice storage and a cold storage in Lelu, and a combined ice and cold storage in Utwe and Okat are judged to be necessary. The existing air blast freezer and freezing room in Lelu are of sufficient capacity even for future demand and a relocation of these facilities by the Kosrae State is judged to be necessary for efficient operation of the facilities proposed in the project.

The project includes basic fishery facilities such as mooring facilities and a slipway for catamaran boats, a wharf and fuel tanks. These facilities are expected to improve safety and efficiency of fishing boasts and thereby increase fish catch. While distribution facilities included in the project are imperative for stable supply of fish and preservation of high freshness of fish and will contribute to establishment of commercial distribution system of fresh fish all over the island.

Further, introduction of long lining and bottom fishing gears will develop an commercial export channel of fish species competitive in foreign markets. Promotion of an export industry and substitute of imported processed fish will contribute to the state toward an economic independence. Earning of foreign exchange is the most important factor for the state and should be further promoted after completion of the project. Establishment of self-sufficiency and export of fishery products is a key factor for an economic independence.

This particular project is expected to greatly contribute to economy of the state and is judged appropriate to be implemented under the Japanese grant aid.

8.2 Recommendations

To maximize benefits accrued from this project, the followings are recommended to be conducted by the Marine Resources Division.

(1) Operation and Management System

To achieve a principal target of an economic independence of the state with this project, it is imperative to secure required staffs and budget to operate the facilities. Especially, an experienced fishery expert is essential to open up foreign markets and to establish a commercial distribution channel of fishery products.

(2) Survey of Fishery Resource

A detailed survey on fishing grounds around the Kosrae Island has not been conducted and is recommended to be urgently carried out. Introduction of new fishing techniques suited to the Kosrae water is also important. The survey will give important information with which an appropriate development plan can be worked out by taking into consideration demand of fish, prices of fish, fishing seasons, etc. The development plan should be coordinated with the other development plans and take steady steps in harmony with the state economy.

(3) Operation of Distribution Facilities

Substantial purposes of the distribution facilities are establishment of stable fish supply and promotion of fishery products export. To achieve these purposes, the Marine Resources Division should take an important role in professionalization of fishermen, reinforcement of the fishing association and establishment of an adequate price structure of fish by taking into consideration freshness of fish and financial soundness of individual fishermen.

APPENDIX

MINUTES OF DISCUSSIONS
ON
THE PROJECT OF INFRASTRUCTURE IMPROVEMENT FOR FISHERY DEVELOPMENT
IN
THE FEDERATED STATES OF MICRONESIA

In response to the request of the Government of the Federated States of Micronesia, the Government of Japan decided to conduct a basic design study on the project (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA"). JICA sent to the Federated States of Micronesia the study team headed by Dr. Tsutomu Tsuchiya, Overseas Fishery Cooperation Foundation, from February 22 to March 25 1989.

The team conducted a field survey and had a series of discussions on the Project with the officials concerned of the Government of the Federated States of Micronesia.

As a result of the study and discussions, both parties have 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.

March 2nd, 1989

Tsutomu Tsuchiya

Team Leader,
Japan International
Cooperation Agency (JICA)

Masao Nakayama

Chief, International Affairs
Department of External Affairs
Federated States of Micronesia

ATTACHMENT

1. Title of the Project
The Project of Infrastructure Improvement for Fishery Development

2. Objectives of the Project
The objective of the Project is to promote fisheries in the Federated States of Micronesia and to contribute to the development of the economy of the country.

3. Executing Agency
The executing agencies for the Projects will be the Department of Resources and Development of the Government of the Federated States of Micronesia.

After the completion of the works, the State of Kosrae will maintain and manage the facilities.

4. Request of the Government of the Federated states of Micronesia
The team will convey to the Government of Japan the request of the Government of the Federated States of Micronesia that the former takes necessary measures to cooperate in implementing the project and provide fishery infrastructure facilities listed in Annex I in order of priority within the limits of Japanese grant aid.

5. Project sites
The project sites are Lelu as a central station and Utwe and Okat as supporting stations.

6. Necessary Measures to be taken by the Government of the Federated States of Micronesia
The Government of the Federated States of Micronesia will take necessary measures listed in Annex II on the condition that the Grant Aid of the Government of Japan is extended to the Project.

7. Relocation of the existing facilities
The Japanese team will convey the request of the Government of the Federated States of Micronesia to the Government of Japan to include the relocation of the existing ice making machine, the quick freezer and the cold storage into the building planned in this project.

8. System of the Japan's Grant Aid Program
The Government of the Federated States of Micronesia side has understood the system of the Japan's Grant Aid, explained by the team, which includes a principle of the use of a Japanese consultant and a

Japanese firm for the implementation of the Project.

ANNEX I

Items requested by the Government of the Federated States of Micronesia are as follows in order of priority :

(1) In Lelu Site:

Loading, unloading and mooring facilities for the existing FRP catamaran boats,

An ice making machine, an ice storage and cold storages,

A building for an administration office and facilities listed above,

Fuel tanks for diesel and gasoline,

Fish preservation facilities for the existing FRP catamaran boats and

Refrigerating trucks.

In Utwe Site:

A revetment for a fishery complex land area,

A dredging work in an approach channel and a turning basin,

Loading, unloading and mooring facilities for the existing FRP catamaran boats,

An ice storage and a cold storage,

A building for an administration office and facilities listed above,

A fuel tank for gasoline.

In Okat Site:

A revetment for a fishery complex land area,

Loading, unloading and mooring facilities for the existing FRP catamaran boats,

An ice storage and a cold storage,

A building for an administration office and facilities listed above,

A fuel tank for gasoline and

Fish aggregating devices.

(2) A wharf with paved apron,

(3) A set of fishing equipment and gear for tuna long line test fishing mountable on the existing bonito test fishing boat,

(4) Additional fish processing machines,

(5) A slipway for the existing FRP catamaran boats,

(6) Small size trucks,

(7) A quick freezer,

(8) Dredging work in an approach channel and a turning basin for the existing fishery complex in Lelu and

(9) A tuna long line training vessel.

ANNEX II

Following arrangements will be required to be taken by the Government of the Federated States of Micronesia and the State of Kosrae

1) to provide access roads to the site of construction, the construction yard and for transportation of fish;

2) to provide facilities for distribution of electricity, water supply and drainage and other incidental facilities to the project sites;

3) to provide available data and information necessary for the design and construction of the Project;

4) to ensure that all vessels and vehicles for construction be given free and easy access to the construction site;

5) to ensure prompt unloading and customs clearance at the port of disembarkation in the Federated States of Micronesia and prompt internal transportation of imported materials and equipment to the construction yard/site;

6) to exempt any equipment, materials and supplies brought into and/or purchased in the Federated States of Micronesia in connection with the performance of the works from any taxes, duties, fees, etc. which are imposed in the Federated States of Micronesia;

7) to exempt Japanese personnel working on the project in the Federated States of Micronesia from customs duties, internal taxes and other fiscal levies which are imposed in the Federated States of Micronesia;

8) 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 and stay therein for the performance of their work;

9) to maintain and use properly and effectively those facilities constructed under this grant aid, and

10) to bear all the expenses, other than those to be borne by the Japan's Grant Aid, necessary in connection with the implementation of the project.

MINUTES OF DISCUSSIONS
ON
THE PROJECT OF INFRASTRUCTURE IMPROVEMENT FOR FISHERY DEVELOPMENT
IN
THE FEDERATED STATES OF MICRONESIA

In response to the request of the Government of the Federated States of Micronesia for grant aid for the Project of Infrastructure Improvement for Fishery Development (hereinafter 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 the basic design study team headed by Dr. TSUTOMU TSUCHIYA, Overseas Fishery Cooperation Foundation, from February 22nd to March 25th 1989.

As a result of the study JICA prepared a draft report and dispatched a team headed by Dr. TSUTOMU TSUCHIYA, to explain and discuss it from May 28th through to June 6th, 1989.

Both parties had a series of discussions on the draft 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.

June 3rd, 1989

Dr. TSUTOMU TSUCHIYA
Team Leader
Japan International
Cooperation Agency (JICA)

MR. ASTERIO R. TAKESY
Deputy Secretary
Department of External Affairs
Federated States of Micronesia

Attach:

ATTACHMENT

1. The Federated States of Micronesia side agreed in principle on the basic design proposed in the Draft Final Report (with minor alterations, which will be incorporated in the Final Report).

2. The Government of the Federated States of Micronesia will take necessary measures inclusive of preparation of budget for development and operating cost upon the execution of the Grant Aid to the Project by the Government of Japan.

3. The Final Report (10 copies in English) will be submitted to the Federated States of Micronesia side by the end of August 1989.

4. The Government of the Federated States of Micronesia will take necessary measures for proper and effective operation and maintenance of the facilities and equipment provided by "the Project".

5. The Federated States of Micronesia side understood Japan's grant aid system and confirmed that the necessary measures will be taken by the Federated States of Micronesia side as shown in the Annex II of the Minutes of Discussions on the Project signed on March 2nd, 1989, on condition that the grant aid by the Government of Japan would be extended to the Project.

6. The Japanese study team will convey the opinion of the Government of the Federated States of Micronesia to the Government of Japan that 25-horse power main engines are the minimum necessary for controlling the catamaran boats supplied by the Government of Japan in rough seas conditions, and to

reduce the fuel oil consumption they should be replaced by diesel outboard engines when the existing gasoline engines are worn out.

7. The Japanese study team will convey to the Government of Japan the request of the Government of the Federated States of Micronesia that the parts necessary for repairing and reconditioning the existing ice making machine, quick freezer and cold storage unit will be provided by the Government Japan.

8. Communication regarding the finalization of the Report will be between the established channels of communication of the Government of Japan and the Government at the Federated States of Micronesia.

Organization of the Study Team and Itinerary of Field Study

The field study was carried out for thirty two (32) days from 22nd February to March 25th, 1989. Organization of the Study Team and itinerary of Field Study are shown as below.

(1) Organization of the Study team

The following staffs are assigned to the study ;

Name	Assignment	Position
< Official Member >		
Dr. Tsutomu Tsuchiya	Team Leader	Overseas Fishery Corporation Foundation
Mr. Kenji Ishiwata	Project Coordinator	Kanagawa International Fisheries Training Center, JICA
< Consultant Member >		
Mr. Hisanori Kato	Fishing Port Planning	Nippon Tetrapod Co., Ltd.
Mr. Hideo Yoshioka	Port Civil Engineering	ditto
Mr. Kiyoshi Nakamoto	Architecture	ditto
Mr. Hisashi Hiratsuka	Cold Storage Facility	ditto
Mr. Sadao Watase	Fishing Boat and Gear	ditto
Mr. Hiroaki Gahara	Natural Condition Survey	ditto
Mr. Kiyotaka Sasao	Cost Estimation	ditto

(2) Itinerary of Field Study

DAY	DATE	DESCRIPTION	
		< Official Member> Dr. T. Tsuchiya Mr. K. Ishiwata	< Consultant Member > Messrs. Kato, Yoshioka, Nakamoto, Hiratsuka, Watase, Gahara, Sasao
1	Feb. 22 (Wed)	Tokyo-Guam, Co-960	same as Official Member
2	23 (Thu)	Guam-Kosrae, Co-956 Courtesy call to Japanese Consulate in Agana, Guam	ditto
3	24 (Fri)	Courtesy call to and discussion with Kosrae State on Inception Report LELU Site Inspection	same as Official Member Preparation of Field Survey
4	25 (Sat)	UTWE and OKAT Site Inspection	ditto
5	26 (Sun)	Team Meeting	ditto
6	27 (Mon)	Discussion with State Government	ditto
7	28 (Tue)	Discussion with State Government	same as Official Member Starting Tide Observation
8	Mar. 1 (Wed)	Discussion with State, Kosrae-Ponape, Co-957 (Messers. Tsuchiya, Ishiwata, Kato)	Storage, Test Boat, Survey (LELU)

DAY	DATE	DESCRIPTION	
		<Official Member>	<Consultant Member>
9	2 (Thu)	Courtesy call to and discussion with Departments of External Affairs and Resources & Development	Discussion with MRD & PWD Survey(LELU) MR.Kato Ponape - (Co-956) Kosrae
10	3 (Fri)	Inspection of Fish Facility Courtesy Call to Government	Team Discussion
11	4 (Sat)	Inspection of Fish Market and National Fish Corp.	Data Reduction
12	5 (Sun)	Ponape-Guam, Co-957 (Messrs. Tsuchiya, Ishiwata)	Data Reduction
13	6 (Mon)	Report to Japanese Consulate in Agana Guam-Tokyo, Co-965 (Messrs. Tsuchiya, Ishiwata)	MRD, Interview to Fisherman Survey(LELU)
14	7 (Tue)	Quarry Site Inspection Fishing Corp. Interview	Survey(LELU)
15	8 (Wed)	Fish Market, Fisherman Interview	Wind Data Survey(OKAT)
16	9 (Thu)	Bonito Boat Inspection Fisherman Interview	Survey(UTWE)

DAY	DATE	DESCRIPTION	
		<Consultant Member>	
		(Messrs. Yoshioka, Watase, Nakamoto, Sasao)	(Messrs. Kato, Hiratsuka, Gahara)
17	10 (Fri)	Discussion with State Kosrae-Ponape, Co-957	Discussion with State Survey(LELU)
18	11 (Sat)	Fish Market, Fishery Harbor Inspection at Ponape	Quarry Site, Road, Data Reduction
19	12 (Sun)	Ponape-Guam, Co-957	Data Reduction
20	13 (Mon)	Guam-Tokyo, NH-012	Catamaran Boat Inspection Power Plant Inspection Survey (LELU)
		<Consultant Member>	
		(Messrs. Kato,Hiratsuka)	(Mr.Gahara)
21	14 (Tue)	Discussion with Lieutenant Governor Fishery Gear Inspection	Survey (LELU)
22	15 (Wed)	Discussion with Lieutenant Governor Kosrae-Ponape,Co-957	Survey(OKAT)

DAY	DATE	DESCRIPTION	
		<CONSULTANT MEMBER>	
		(Messrs. Kato, Hiratsuka)	(Mr. Gahara)
23	16 (Thu)	Ponape Fishery Harbor, Fishery Facilities, Ministry of Foreign Affairs Marine Resources Division	Survey(OKAT)
24	17 (Fri)	Ponape-Guam, Co-957	Survey(UTWE)
25	18 (Sat)	Machines in Guam Guam-Tokyo, Co-965	Current Measurement
		<Consultant Member> (Mr. gahara)	
26	19 (Sun)	Data Reduction	
27	20 (Mon)	Current Measurement Preparation of Boring	
28	21 (Tue)	Survey(LELU) Preparation of Boring	
29	22 (Wed)	Preparation of Boring	
30	23 (Thu)	Boring	
31	24 (Fri)	ditto Discussion with MRD Kosrae-Guam, Co-957	
32	25 (Sat)	Courtesy call to Japanese Consulate in Guam Guam-Tokyo, Co-965	

List of Interviewees

FSM Government

Name	Organization	Position
Mr. Masao Nakayama	Department of External Affairs	Chief
Mr. Tadao P. Sigrah	Department of External Affairs	Deputy Chief for Asian Affairs
Mr. David W. Panuelo	Department of External Affairs	Foreign Service Officer
Mr. Mike Gawel	Department of Resource and Development	Chief of Marine Resource Division
Mr. Peter Sitan	Micronesian Maritime Authority	Executive Director
Mr. Christer S. Friberg	National Fisheries Corporation	Commercial Fisherirs Advisor
Mr. Terry Taube	Hawaiian Fish Distributers Inc.	Plant Manager

Kosrae State Government

Name	Organization	Position
The Hon. Yoshio P. George		Governor
The Hon. Moses T. Mackwelung		Lt. Governor
Mr. Gerson A. jackson	Department of Conservation & Development	Director
Mr. Lewis S. Brooks	Division of Production and Marketing	Cfief
Mr. Tony Sur Sison	Office of Planning	Project Analyst
Mr. Likiak Wesley	Department of Planning & Statistics	Acting Chief
Mr. Hostino Livae	Department of Public Warks	Acting Director
Mr. Bruce Howell	Office of Planning & Budget	Civil Engineer
Mr. Jack Sigrah	Division of Marine Resources	Acting Chief
Mr. Tony Abraham	"	Diesel Eng./Mech.
Mr. Semeon Senne	"	Otbrd. Mtr. Mech.
Mr. Standon George	"	Refrig. Mtr. Mech.
Mrs. Josemary Nedlic	"	Clerk Typist
Mr. Michael E. Molina	"	Fish Specialist
Mr. Takashi Nakamura	Department of Conservation & Development	FAO expert
Mr. Madison Nena	Division of Tourism	Chief
Mr. Alokoa Tally	KIFCA	Vice Chairman
Mr. Ringsley Cornelius	KIFCA	Manager
Mr. Roy Ngirchechol	Sealot Fish Market	Manager
Mr. Perfecto O. "PJ" Jose,Jr.	Black Construction Corp.	Vice-President

Meteorological Data, Etc.

Mean monthly and annual air temperatures at Lelu

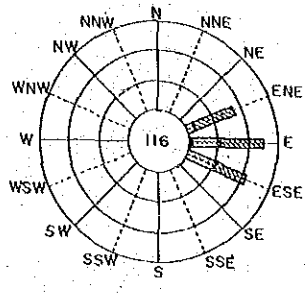
[Published by National Oceanic and Atmospheric Administration in degrees Fahrenheit; converted to degrees Celsius]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Mean	Annual Max.	Annual Min.
1956	27.6	27.9	28.3	27.9	27.9	27.2	27.7	27.4	27.6	27.3	--	27.2	--	33	--
1957	27.4	--	--	27.0	27.3	27.6	27.3	27.3	27.2	27.4	27.3	27.2	--	--	21
1958	27.2	27.1	26.7	27.4	26.8	27.1	27.4	27.4	27.4	27.4	27.2	27.3	27.2	32	21
1959	27.2	26.7	26.8	26.9	26.8	27.1	27.0	27.1	27.0	27.0	27.1	26.5	26.9	33	23
1960	26.8	26.9	26.8	26.6	26.5	26.7	26.8	26.9	26.7	26.9	26.7	26.7	26.8	32	23
1961	--	--	--	--	26.8	26.8	27.0	26.9	27.0	26.9	26.8	--	26.7	--	--
1962	26.3	26.6	26.4	26.6	26.6	26.7	26.4	26.6	26.4	--	26.3	26.5	--	31	21
1963	26.6	26.4	26.5	26.5	26.7	26.6	26.6	26.5	26.7	26.6	26.7	26.4	26.6	31	21
1964	26.7	26.5	26.6	26.7	26.7	26.7	26.7	26.6	26.4	26.7	26.6	26.7	26.6	31	23
1965	--	--	26.8	26.5	26.7	26.8	26.7	--	--	28.0	27.9	27.2	27.2	--	22
1966	28.5	29.1	28.2	28.1	28.6	28.8	28.2	28.5	28.4	28.6	28.6	28.1	28.5	34	21
1967	27.8	27.6	27.7	26.9	27.7	27.7	27.9	27.7	28.1	27.9	28.4	28.9	27.8	34	22
1968	28.7	28.1	28.0	28.0	28.2	27.6	28.1	28.4	28.4	28.8	28.4	28.6	28.3	36	21
1969	28.1	27.8	27.9	27.8	28.2	27.7	27.3	27.7	27.7	27.9	28.1	27.1	27.8	34	18
1970	27.5	27.4	27.9	27.5	27.4	27.1	--	27.9	27.8	28.3	28.4	30.1	--	33	--
1971	30.1	--	--	29.9	27.9	27.8	27.9	27.7	26.7	25.7	25.6	26.9	--	--	11
1972	--	27.6	26.9	27.2	--	28.0	27.7	27.8	26.9	--	--	26.0	--	--	--
1973	26.2	26.1	26.7	26.8	27.3	27.3	26.9	27.1	--	26.8	27.5	--	--	--	17
1974	26.9	27.8	27.1	27.4	27.6	27.7	27.4	27.2	27.4	27.4	27.7	27.5	--	34	18
1975	27.6	28.0	--	--	--	26.1	26.4	27.1	--	27.3	27.5	27.2	27.4	33	16
1976	28.2	--	27.3	27.8	--	27.4	--	27.5	27.6	28.2	28.0	27.9	--	--	21
1977	28.4	28.1	27.4	27.3	26.8	--	--	28.2	--	28.2	27.7	--	--	--	16
1978	27.4	27.6	27.6	26.9	27.6	27.6	--	--	--	--	--	27.6	--	--	--
Mean	27.6	27.4	27.3	27.3	27.3	27.3	27.2	27.4	27.3	27.5	27.4	27.4	27.4		
Number of years.	20	18	19	21	20	22	19	21	18	20	20	20	--		

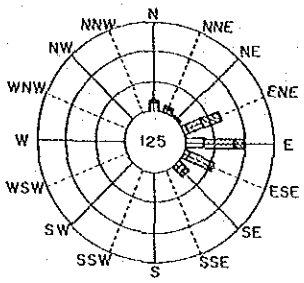
Monthly mean, minimum and maximum rainfall, in inches, at Lelu

[1903-12, 1954-78]

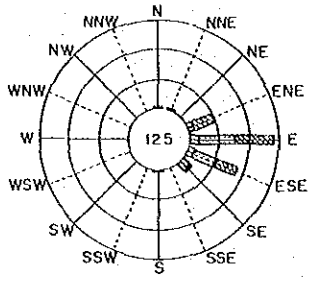
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Number of years.	27	29	30	26	26	27	28	32	29	26	29	29	
Mean	14.39	16.35	18.67	21.66	18.80	17.86	16.03	15.00	14.39	12.73	14.83	19.88	200.59
Percent	7.2	8.1	9.3	10.8	9.4	8.9	8.0	7.5	7.2	6.3	7.4	9.9	100
Minimum	3.51	3.97	3.93	10.59	7.71	8.08	8.62	5.08	5.22	6.26	7.10	5.28	3.51
Year	1973	1970	1970	1978	1970	1973	1960	1969	1969	1969	1975	1904	1973
Maximum	37.51	38.67	34.38	53.19	43.95	37.75	38.04	34.37	33.65	20.46	26.38	40.88	53.19
Year	1962	1959	1959	1960	1958	1958	1957	1963	1957	1958	1957	1959	1960



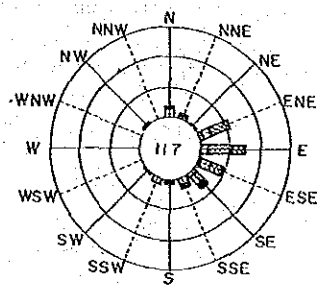
March 1988



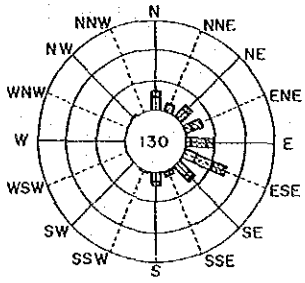
April 1988



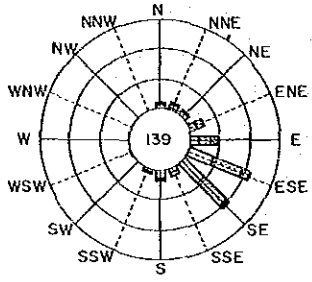
May 1988



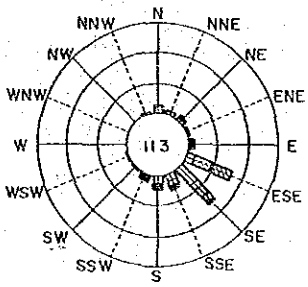
June 1988



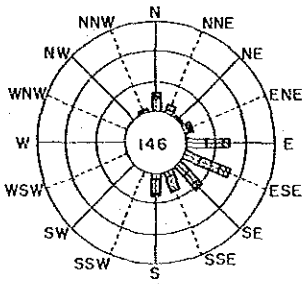
July 1988



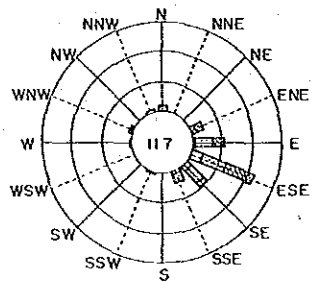
August 1988



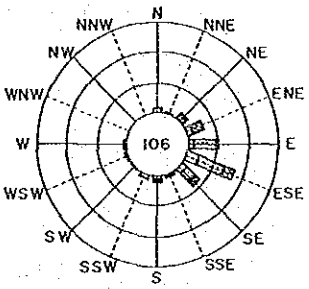
September 1988



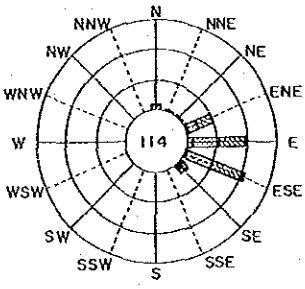
October 1988



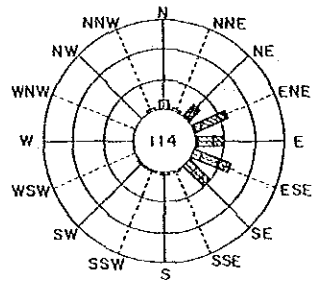
November 1988



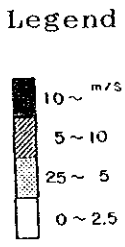
December 1988



January 1989



February 1989



Distribution of Wind Speed and Direction at Kosrae Airport
(March 1988 - February 1989)

Record of Fish Catch

Since the state of Kosrae does not have any reliable statistical data on the volume of catch, the volume of catch was estimated on the basis of the record of catch for seven months of Mr. Andrew Isaac, a full-time fisherman.

Smallest catch	:	5.0 kgs./day
Largest catch	:	210.9 kgs./day
Average catch	:	37.6 kgs./day
Total catch	:	3,279 kgs./seven months
Operating rate	:	41.4%

From the above, the basis for estimation were set as follows.

Average catch of catamaran fishing	:	35 kgs./day
Duration of poor fishing season	:	7 days

Actual performance record of Mr. Isaac is attached on the next page.

Actual Fishing Performance of Mr. Andrew Isaac (1988)

(Units in Lbs.)

May	Jun	Jul	Aug	Sep	Oct	Apr	Total
1 Su	1 M	1 F 52	1 M 376	1 Th 40	1 Sa	1 F	
2 M	2 Th	2 Sa 32	2 Tu	2 F	2 Su	2 Sa 25	1. Mean catch: 37.6 kgs./day
3 Tu 85	3 F	3 Su	3 W	3 Sa 15	3 M 83	3 Su	2. Largest catch: 210.9 kgs./day
4 W 36	4 Sa	4 M	4 Th	4 Su	4 Tu	4 M	
5 Th 20	5 Su	5 Tu 136	5 F 124	5 M	5 W	5 Tu	3. Average of more than mean catch: 71.7 kgs./day
6 F	6 M 197	6 W 127	6 Sa	6 Tu	6 Th	6 W 35	
7 Sa	7 Tu	7 Th 22	7 Su	7 W	7 F 20	7 Th	4. Smallest catch: 4.5 kgs./day
8 Su	8 W 80	8 F 71	8 M	8 Th	8 Sa	8 F 30	
9 M	9 Th 224	9 Sa 91	9 Tu 37	9 F	9 Su	9 Sa	
10 Tu	10 F	10 Su	10 W	10 Sa	10 M 48	10 Su	
11 W 35	11 Sa	11 M	11 Th	11 Su	11 Tu 44	11 M 20	
12 Th 30	12 Su	12 Tu 44	12 F	12 M	12 W	12 Tu	
13 F 10	13 M	13 W 12	13 Sa 23	13 Tu 141	13 Th 72	13 W 35	
14 Sa	14 Tu 99	14 Th 90	14 Su	14 W 124	14 F 87	14 Th	
15 Su	15 W	15 F	15 M	15 Th 25	15 Sa	15 F 5	
16 M	16 Th	16 Sa	16 Tu 104	16 F	16 Su	16 Sa 57	
17 Tu 88	17 F	17 Su	17 W 200	17 Sa	17 M	17 Su	
18 W 130	18 Sa	18 M	18 Th	18 Su	18 Tu	18 M 273	
19 Th 75	19 Su	19 Tu	19 F 20	19 M 80	19 W 178	19 Tu 139	
20 F	20 M	20 W 56	20 Sa 10	20 Tu	20 Th	20 W 485	
21 Sa	21 Tu 88	21 Th 30	21 Su	21 W 21	21 F 55	21 Th	
22 Su	22 W	22 F	22 M	22 Th 25	22 Sa 340	22 F	
23 M	23 Th 169	23 Sa	23 Tu 20	23 F	23 Su	23 Sa	
24 Tu	24 F	24 Su	24 W 20	24 Sa 121	24 M	24 Su	
25 W	25 Sa	25 M 35	25 Th 25	25 Su	25 Tu	25 M 18	
26 Th	26 Su	26 Tu 32	26 F	26 M 128	26 W 64	26 Tu 20	
27 F 35	27 M 73	27 W 40	27 Sa	27 Tu 109	27 Th	27 W	
28 Sa 143	28 Tu 82	28 Th 106	28 Su	28 W	28 F	28 Th 80	
29 Su	29 W	29 F 105	29 M	29 Th	29 Sa	29 F	
30 M 50	30 Th 36	30 Sa 149	30 Tu	30 F 134	30 Su	30 Sa 30	
31 Tu		31 Su	31 W 15		31 M		
12 days	9 days	18 days	12 days	12 days	10 days	14 days	87 days 7,231 Lbs/7 months
726	1,042	1,290	974	966	991	1,242	210 days @ 83 Lbs/day
@ 60	@ 115	@ 71	@ 81	@ 80	@ 99	@ 88	0.414 1,033 Lbs/day

5. Income 12,396 x 0.8$ = 9.916$/d 6. Annual total catch 7,231 ÷ 7 x 12 = 12,398 Lbs.

Revenue and Expenditure

(1) Estimated revenues

In order to increase distribution volume by containing price of fish and also to promote export business, revenues will be calculated on the basis of sales incomes only until the domestic distribution market develops to a certain extent.

1) Income from sale of ice

Assuming that the sales price of ice will be set at C5/kg, maximum daily production 3,200 kg, sales ratio of 0.7, 200 operating days a year and actual annual sales 80% of production capacity, sales revenues will be:

3,200 kg x 0.7 x 200 days x 0.8 x $0.10 = $35,840

2) Income from sale of fresh fish

Assuming that the annual distribution volume is 335 t as shown in Table 4.1, of which export volume is 53.4 t in total and fish processed by freezing 126.7 t the volume of fresh fish distributed as a balance will be:

335 t - (53.4 + 126.7) t = 154.9 t

Assuming that the purchase cost of fresh fish is $1.4/kg and sales commission 5% or C7/kg, the sales price will be $1.47 on average. Thus, the sales income will be:

154,900 kg x $0.07/kg. = $10,843

3) Income from sale of frozen fish

Assuming that the annual distribution volume is 126.7 t, purchase

cost $1.4/kg, processing and sales commission 10% or C14/kg, the sales price will be $1.54 on average. Income from sales will be:

126.700 kg x $0.14/kg. = $17.738

4) Income from export of fish

a) Assuming that the annual export volume of pelagic fish is 53.4 t , purchase cost of demersal fish $5.4/kg., sales commission 10% or C54/kg., export sales price will be $5.94/kg on average. Income from export sales will be:

53,400 kg x $0.54/kg. = $28,836

b) Assuming that the annual export volume of mangrove crab is 1.2 t, purchase cost $7.8/kg., export sales commission 10% or $0.78/kg, export sales price will be $8.58/kg on average. Income from export sales will be:

1,200 kg x $0.78/kg. = $936

5) Total revenues : 1) + 2) + 3) + 4) = $94,193

(2) Estimated expenditures

1) Schedule of electric charges

Installed capacity and power consumption within the facilities will be as follows:

Item / Usage data	Installed capacity		Load factor		Operating hours		Days per year		KWH
Ice making machine	11.5kW	x	0.75	x	24	x	200	=	41.400
Ice storage	0.1kW	x	0.7	x	18	x	250	=	315
Cold storage (refrigerated)	6.0kW	x	0.7	x	18	x	365	=	27.594
Pump	4.5kW	x	0.8	x	24	x	250	=	21,600
Lighting	6.0kW	x	0.9	x	8	x	250	=	10,800
Outlet	3.0kW	x	0.9	x	8	x	250	=	5,400
Outdoor lamps	6.0kW	x	0.9	x	12	x	365	=	23,652
Utwe/Okat	4.0kW	x	0.7	x	18	x	365	=	18,396
Existing ice making machine	8.0kW	x	0.75	x	24	x	200	=	28,800
Existing air blast freezer	12.5kW	x	0.75	x	16	x	100	=	15,000
Existing cold storage (frozen)	6.3kW	x	0.7	x	18	x	365	=	28,973
Total									221,930

Accordingly, annual power consumption will be 221,930 kWh and as the unit rate is 0.05 US$ per kWh, the electric charge will be as follows.

221,930 kWh x $0.05 = $11,096/year

2) Water charge

As water is not treated at present, no charge is collected.

3) Schedule of manpower expenses

Manpower expenses for the personnel examined in the personnel plan are as follows.

Job classification	Number		Monthly salary		Year		$
Chief	2	x	$350	x	12 months	=	8,400
Staff	4	x	$250	x	12 months	=	12,000
Staff (Utwe & Okat)	2	x	$250	x	12 months	=	6,000
Clerk	1	x	$225	x	12 months	=	2,700
Total							$29,100

4) Annual expenses

Electric charge	From Item 1)	$11,096
Manpower expenses	From Item 3)	29,100
Expendable supplies	$500 x 12 months	6,000
Fuel	3,000 gal. x $1.5/gal	4,500
Communication	$300 x 12 months	3,600
Packing cost	2 % of export price	2,000
Travel expense for marketing		4,500
Welfare & fringe benefit	5 % of manpower expenses	2,010
Repair cost	Annual amount	6,000
Miscellaneous	$600 x 12 months	7,200
Total		$76,006

Total annual expenses will be $75,287.

5) Estimated annual balance

Revenues	$94,193
Expenditures	76,006
Balance	18,187

The balance after paying for operating expenses generates a profit.