Republic of the Marshall Islands
Marine Resources Authority

BASIC DESIGN STUDY
ON
THE PROJECT FOR CONSTRUCTION OF FISH MARKET CENTER AT MAJURO ATOLL
IN
REPUBLIC OF THE MARSHALL ISLANDS

FEBRUARY 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

FISHERIES ENGINEERING CO., LTD.

Preface

In response to a request from the Government of the Republic of the Marshall Islands, the Government of Japan decided to conduct a basic design study on the Project for Construction of Fish Market Center at Majuro Atoll and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Marshall Islands a study team from July 23 to August 16, 2008.

The team held discussions with the officials concerned of the Government of the Republic of the Marshall Islands, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to the Marshall Islands in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government the Republic of the Marshall Islands for their close cooperation extended to the teams.

February 2009

Ariyuki Mastumoto
Vice-President
Japan International Cooperation Agency

February 2009

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Construction of Fish Market Center at Majuro Atoll, in the Republic of the Marshall Islands.

This study was conducted by Fisheries Engineering Co., Ltd., under a contract to JICA, during the period from July, 2008 to February, 2009. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of the Marshall Islands and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Kuniaki Takahashi
Project manager,
Basic design study team on
The Project for Construction of Fish Market Center at Majuro Atoll
Fisheries Engineering Co., Ltd.

SUMMARY

(1) **Country Profile**

The Republic of the Marshall Islands (hereinafter referred to as RMI) is a Pacific island country located between latitude 4°- 14° north , and longitude 160° - 173° east, consisting of 5 independent islands, 29 atolls, and a total of 1,225 islands. The population is 52,338 (2007), the majority of which is concentrated in the capital, Majuro and Ebeye. The total land area is 181 square kilometers, and there are no mountains or rivers. On the other hand, RMI has an exclusive economic zone (EEZ) of 2 million square kilometers. The climate is tropical, with an average temperature around 27°C, which is constant throughout the year.

The economy of RMI is heavily dependent on the United States of America, with public works expenditure based on the Compact of Free Association with the USA and the service industry for the US military base at Kwajalein responsible for a large share. However, funds from the USA based on the Compact of Free Association will come to an end in 2023, so in Vision 2018, the RMI 15 year long term national development plan from 2003, defining the road to economic self-reliance has been raised as the first priority. On the other hand, great portion of population of the Outer Islands, where the opportunities for earning cash are scarce as subsistent economies are dominant and the economic activities are almost limited to copra production, fisheries, and hand crafts production, has been migrated rapidly to the two urban centers of Majuro and Ebeye nearby a US military base. So the population structure of the Outer Islands and the urban centers has been changed drastically. Thus insufficient urban infrastructure and the decay of communities on the Outer Islands, the social and cultural basis of the RMI, have become serious problems. Investments in urban social infrastructure and the sustainable development of the Outer Islands are highlighted in the national development plan.

As a result of financial assistance from the USA, GDP per person in 2007 is US$2,515, and GNI per person is second after Fiji in the neighboring island countries. However, in the breakdown of GDP, Government and public corporations are responsible for 47%, the household sector which is mainly under a subsistence economy is responsible for 13%, and private companies are responsible for 32%, which indicates the economic structure of RMI has been less developed. Also, the breakdown of GDP by sector shows the primary industries at 10.8%, the secondary industries 19.5%, and the tertiary industries 69.7% (2001).

Although the population and the money flows to the urban areas, the Outer Islands stagnate in a subsistence economy based on copra production, subsistence fisheries and hand crafts manufacturing. Opportunities for earning cash are scarce, of which fishery production is the largest. The income generated by fisheries in 1999 is estimated at about 4 million dollars, or more than 53% of the value of subsistence production .

Also, RMI depends on imports for most of its food, with imported cans and meat as the main source of protein in 77% of households in urban areas. As a result of consuming high-calorie high-protein imported food, many urban residents are suffering from diabetes, obesity, or high blood pressure, so the Government is aiming to ensure the food security and improve the national dietary habits by a changeover from imported food to fish, which is virtually the only source of animal protein locally obtainable.

(2) Background, history, and basic concept of the requested project

A plan to provide opportunities for earning cash for local fishers is included in the national development plan, and in the fisheries development plan, fostering of the Outer Island fisheries is focused in coastal fisheries development.

In order to provide a source of income for the Outer Island fishers and to ensure the supply of fish for the urban areas, the RMI Government has established the fish bases in the Outer Islands, and collects the fish there and transports to the urban areas for sale. This Outer Islands fish collection project is being implemented by the Marshall Islands Marine Resources Authority (MIMRA), and fresh fish from the atolls of Arno, Aur, Maloelap, and Jaluit are sold in the Outer Island Fish Market Center (OIFMC) in Majuro.

It is estimated that consumption of fresh fish in Majuro Atoll in 2005 was about 1,700 tons, but 80% of Majuro consumers feel that the supply of fresh fish is insufficient. It is considered that there has already been excessive fishing in Majuro Atoll and increasing production within the atoll is difficult, so it is essential to increase the fresh fish supply from the Outer Islands in order to meet the demand in Majuro.

However, of the fish collection boats owned by MIMRA, only 2 are capable of the long sailing to the Outer Islands, and the operation rates for fish collection trips which must be undertaken in severe ocean conditions is low due to frequent breakdowns caused by wear and tear. Therefore numbers of trips to the Outer Islands is decreasing. In 2007 the supply of fresh fish from the Outer Islands remained at 23 tons, and the cash income to the fishers of the Outer Islands resulting from fish sales remained at $42,000. Also, the OIFMC sales facility is located in the industrial area of Delap, which is rather far from the commercial and residential areas. Not only is this an inconvenient location for the consumers, but also the building is small and the market facilities are poorly equipped and inconvenient for marketing fresh fish.

In order to improve this situation, the Government of RMI has formulated the “Project for Construction of Fish Market Center at Majuro Atoll”, of which objective is to increase the supply of fresh fish from the Outer Islands by means of improvement of the transport, landing, and handling of

fresh fish through construction of a landing dock and a fish market at Majuro and procurement of fish collection boats. In March 2006 the Government of RMI requested to the Japanese Government for grant aid to implement the project.

In response to this request, the Japanese Government decided to carry out a preliminary study, and from the 13th January to the 15th February 2008 the Japan International Cooperation Agency (JICA) dispatched the preliminary study team to RMI, to confirm the details of the request and the necessity of the technical supports (soft components).

(3) Summary of study results and contents of the project

Based on the results of the preliminary study, the Japanese Government decided to carry out a basic design study, so JICA dispatched a basic design study team to RMI from the 23nd July to the 16th August 2008, and dispatched a team for explanation of the draft basic design study report to RMI from the 15th December to the 20th December 2008.

As a result of the study it was confirmed that the existing fish market facilities in Delap are small and located rather far from the commercial and residential areas, that this is inconvenient for the Majuro consumers to purchase fresh fish, that the number of boats for transporting the fresh fish from the Outer Islands is insufficient and they are old, so the fresh fish collection operation is stagnating, and the inappropriate handling of the fresh fish from the Outer Islands debase the quality of fish. Therefore taking the fish collection transport situation and the consumer trends in Majuro, into account, it was judged appropriate to develop the fish market facility at Uriga to make convenient for the consumers, and to procure equipment including fish collection boats, as well as to implement technical supports (soft components) for quality improvement. A cutting board and a slicer were included in the initial request from the RMI side as market equipment, but they were excluded from the scope of the cooperation as items to be supplied by the RMI side. The basic policy is that the planned facilities and equipment in the scope of the cooperation should be appropriate to the performances of MIMRA fish collection operations.

In this study, based on field surveys and analyses carried out within Japan, the project background, content, natural conditions, maintenance and management system, construction conditions, etc., were studied, and details of the appropriate scope for grant-aid cooperation were determined as follows.

Item	Structure /Specification	Size
1) Civil engineering facilities		
Dock	Steel sheet pile structure	Length:90m（berth length:40m）
Land reclamation		Volume: about 7,400m^3
Apron paving	Concrete paving	Area: 600m^2
Ancillary facilities	Derrick crane, Bit, Fender, Curb	Derrick capacity: 500kg

Item	Structure /Specification	Size
2) Building Facilities		
Fish market center building	Reinforced concrete structure, Single-story	Floor area: 406.0m^2
Ice-making machine	Plate ice type	Capacity: 1ton/day
Ice Storage	Prefabricated insulation panel	Capacity: 2ton
Chilled storage	Prefabricated insulation panel	Capacity: 0.5ton
Water catchment tank	Reinforced concrete structure	Capacity: 20m^3
Toilet	Concrete block structure	Floor area: 25.8m^2
Elevated water tank	Reinforced concrete structure	Floor area: 16.0m^2, H= 10.8m
Garbage depository	Concrete block structure	Floor area: 6.0m^2
Solar power system	For daytime use	Max. power: 7.38kW
Security lighting		5 Nos
Exterior facilities	Parking lot, Paving driveway	Area: 950m^2
3) Equipment		
Fish collection boats	FRP 16m	2 Nos
Equipment for the market	Fish carrying boxes, carts, insulated tanks, fish storage boxes, insulated containers, a band saw, a high pressure water washer, scales, SSB radiotelephones, VHF radiotelephones	1 set
4) Soft components	Improvement of fish quality Improvement of fish handling Improvement of fish processing, marketing and hygiene Improvement of public relations	Technical Support by two Japanese consultants (About 43 days in Marshall)

(4) Project time period and project cost estimation

To implement the subject Plan on the basis of grant-aid from the Government of Japan, a time period of 6.5 months for the detailed design and 17.0 months for the construction and equipment procurement, or a total of 23.5 months is required. The project cost to be borne by the RMI Government for the electrical and water installation cost to the site and the bank commissions, is estimated to be about US$ 1.6 thousand.

The annual cost balance of the project including the maintenance and management cost is estimated to be a loss of US$107,867. However, this loss will be subsidized by MIMRA, as it has been to date. As the level of loss is such that MIMRA can afford it, it is judged that OIFMC is able to maintain and operate the facilities.

(5) Project evaluation and recommendations

As a result of the implementation of this project, the following effects are expected.

Problems	Measure taken in the Japanese assistance	Direct effects, extent of improvement	Indirect effects, extent of improvement
The supply of fresh fish from the remote atolls is unstable because the facilities of MIMRA, which is responsible for transport of fresh fish from the Outer Islands to Majuro, are small and the equipment including the fresh fish collection boats are of the wear and tear and insufficient. Also, in its distribution the quality of the fish is degraded. There is insufficient fresh fish supply to Majuro, and the fishing activities in the Outer Islands is stagnating.	・Construction of a fish market facility, and a dock ・ Procurement of equipment ・Implementation of soft components for improvements in handling fresh fish	(1) The number of trips of the fish collection boats will increase, so the volume of fresh fish shipped from Arno, Aur, Maloelap, and Jaluit Atolls to Majuro will increase from the 23 tons/year in 2007 to about 100 tons/year. (2) By increasing the volume of fresh fish purchased in the Outer Islands, the income of the fishers of Arno, Aur, Maloelap, and Jaluit will increase from the US$42,487/year in 2007 to approximately US$180,000/year. (3) By installing a solar power system, about 8,000kWh of commercial electricity consumption will be saved. (4) The following effects are expected by implementing the soft components. 1) Handling of the fresh fish after collection from the Outer Islands will be improved, and developed the greater understanding of freshness management by those engaged in fish handling in the Outer Islands. 2) Efficiency of the series of handling operations such as landing of fresh fish from the fish collection boat, transport, sorting, weighing, etc., will be increased. 3) The freshness of the fish sold will be improved, and the fish will be sold in a manner to be acceptable by general consumers of Majuro. 4) The operation of the fish collection boats will become widely known, to make users more convenient. 5) The percentage of fish left unsold will be reduced as a result of the improvement of freshness of the fish and convenience for the consumers of Majuro.	(1) Opportunities for earning cash in the Outer Islands will be increased, which will contribute to support the Outer Island communities, and reduce the migration of population to the urban areas. (2) Increasing the volume of fresh fish transportation will contribute to change the Majuro residents' dietary habits away from imported food to domestically produced sea food.

This project will contribute to development of the Outer islands through the fisheries, where the

majority of the households are in poverty, by increasing the volume of fresh fish supplied to Majuro, and contribute to reducing the chronic shortage of fresh fish in Majuro as well. The population benefiting from the project accrues to about 57% of the population of RMI, and this project is to create opportunities for earning cash in the Outer Islands and expected to ensure the food security in Majuro, it is, therefore, appropriate and justified that this project be implemented on the basis of grant-aid cooperation.

In order to more efficiently and effectively implement this project, it is recommended that careful consideration should be paid to the following points.

1) **Establishment of the fish collection boats operation system as early as possible and maintaining regular trips to the Outer Islands**

The fish collection operation will play an important role in vitalizing the fisheries in the Outer Islands and matching demand for fresh fish in Majuro with supply by the fish collection boats. Fishers in the Outer Islands strongly desire more frequent fish collection trips, and the consumers of Majuro are demanding an increase in the deliveries of fresh fish. To respond to this situation it is necessary that MIMRA establishes a sustainable operation plan, and maintain regular fish collection trips. Achieving a regular operation of the boats will also add convenience for passengers and users for cargo shipping, and is important for bringing consumers to the fish market.

2) **Maintenance of the facilities and equipment and ensuring the budget for operation**

MIMRA has kept remarkably running the fish collection operations over more than 20 years, but in the past few years activities have stagnated as a result of frequent breakdowns of the boats due to the wear and tear and the rapidly rising cost of fuels. The fish collection operations would be kept running at a loss even after the project had been implemented, but in order to continuously develop these operations in response to the strong wishes of the fishers in the Outer Islands, it is necessary to maintain appropriately the fish collection boats and facilities in good condition. In addition, it is important to add value to the products sold at the market in order to increase income as much as possible, and to ensure the budget to subsidize for the loss on operation activities.

3) **Recognizing the needs of consumers**

In order to sell fresh fish from the Outer Islands to the consumers of Majuro, who have a strong preference for fish caught in Majuro, it is necessary not only to ensure quality of fish and arrange the retail prices but also to present the fish in assortment forms that the consumers can accept. It is necessary to recognize the needs of consumers, and to provide products reflecting the consumers' wishes for promoting the sale of the Outer Island fresh fish.

4) **Effective resource management**

It is believed that the fishing pressure for reef fish in the Majuro Atoll has already reached its limit, and in the Arno Atoll also the stage where it is necessary to implement appropriate resource management

is approaching. Although it is considered that there is still some margin of the fishing resources in the Outer Islands, it is necessary to assess the resources allowable catch to develop the fish collection operations sustainably and to ensure the food security, and in the future to carry out effective resource management as necessary.

5) Prevention and Mitigation of Environmental and Social Impacts

In order to prevent and mitigate environmental and social impacts by the implementation of the project, it is necessary that MIMRA take the following measures;

- To hold meetings regularly with the owners of retail shops and the gas stations and to solve the problems in case that were found in the meetings
- To continue monitoring the water quality regularly at the water area in front of the planned site, one of the water quality monitoring points of the EPA.
- When a cyclone approaches, to pay attention to the weather conditions and to take refuge fish collection boats timely so that to avoid risks.

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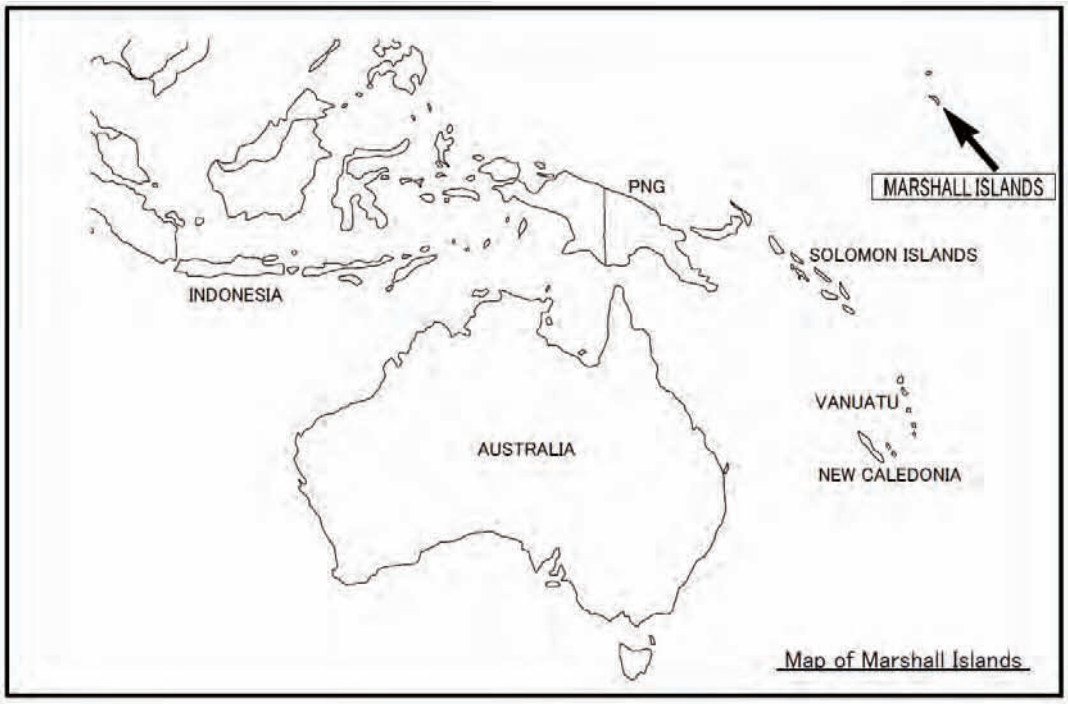
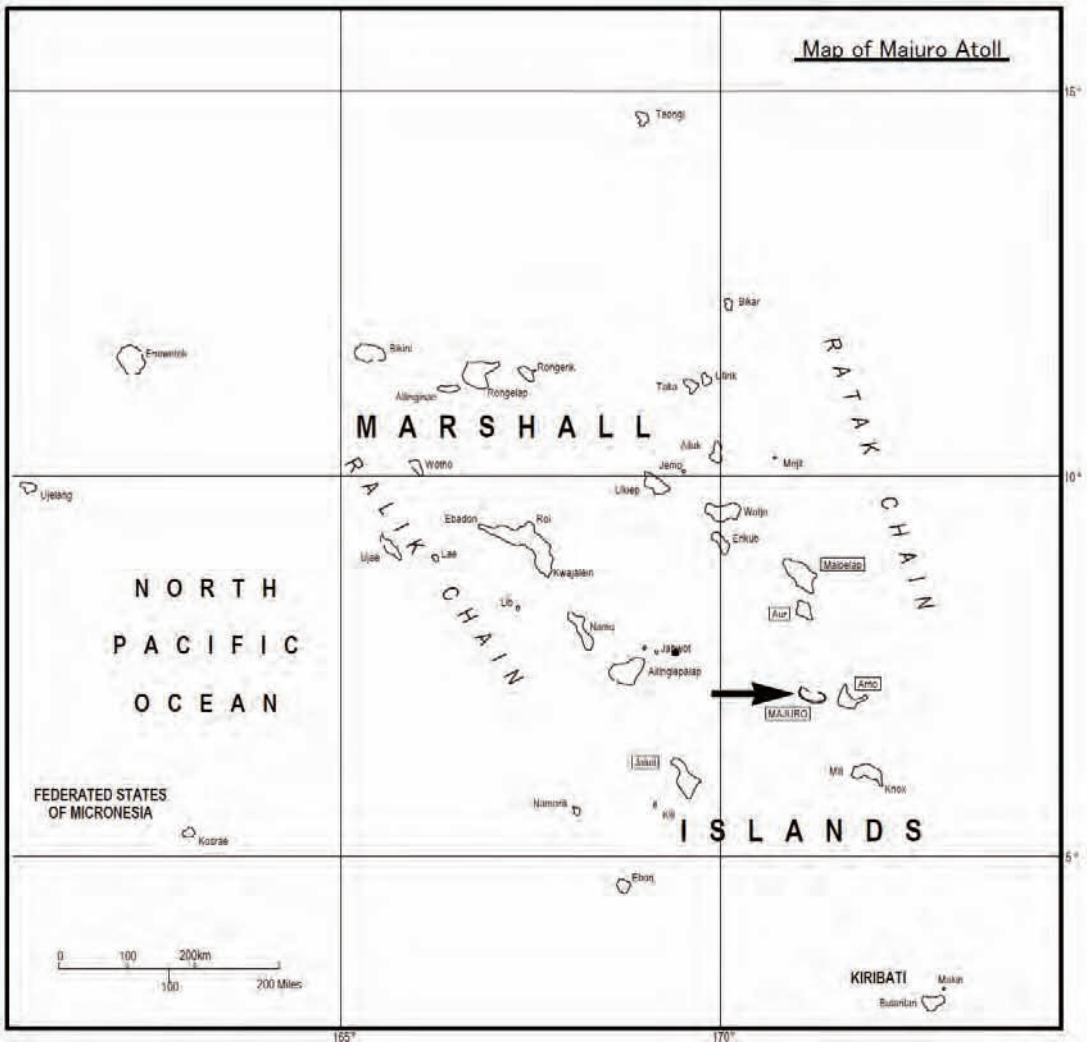
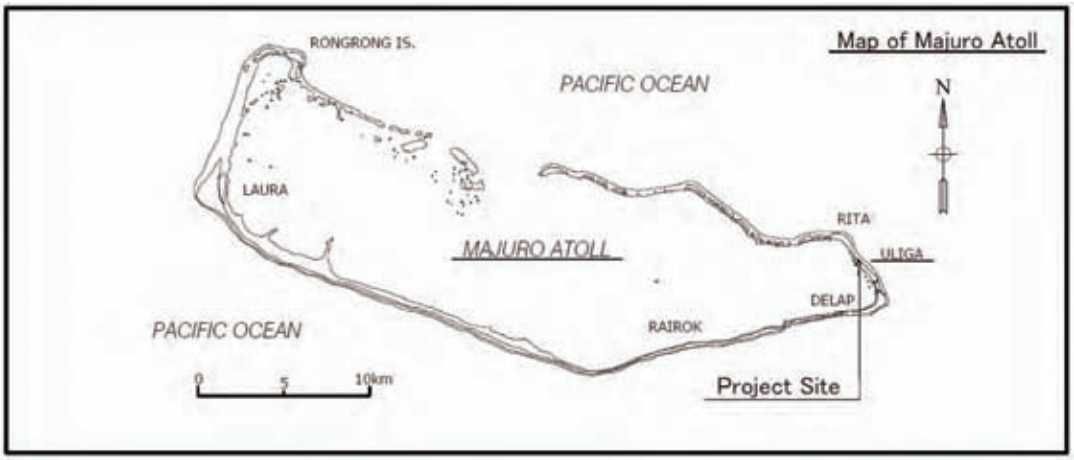
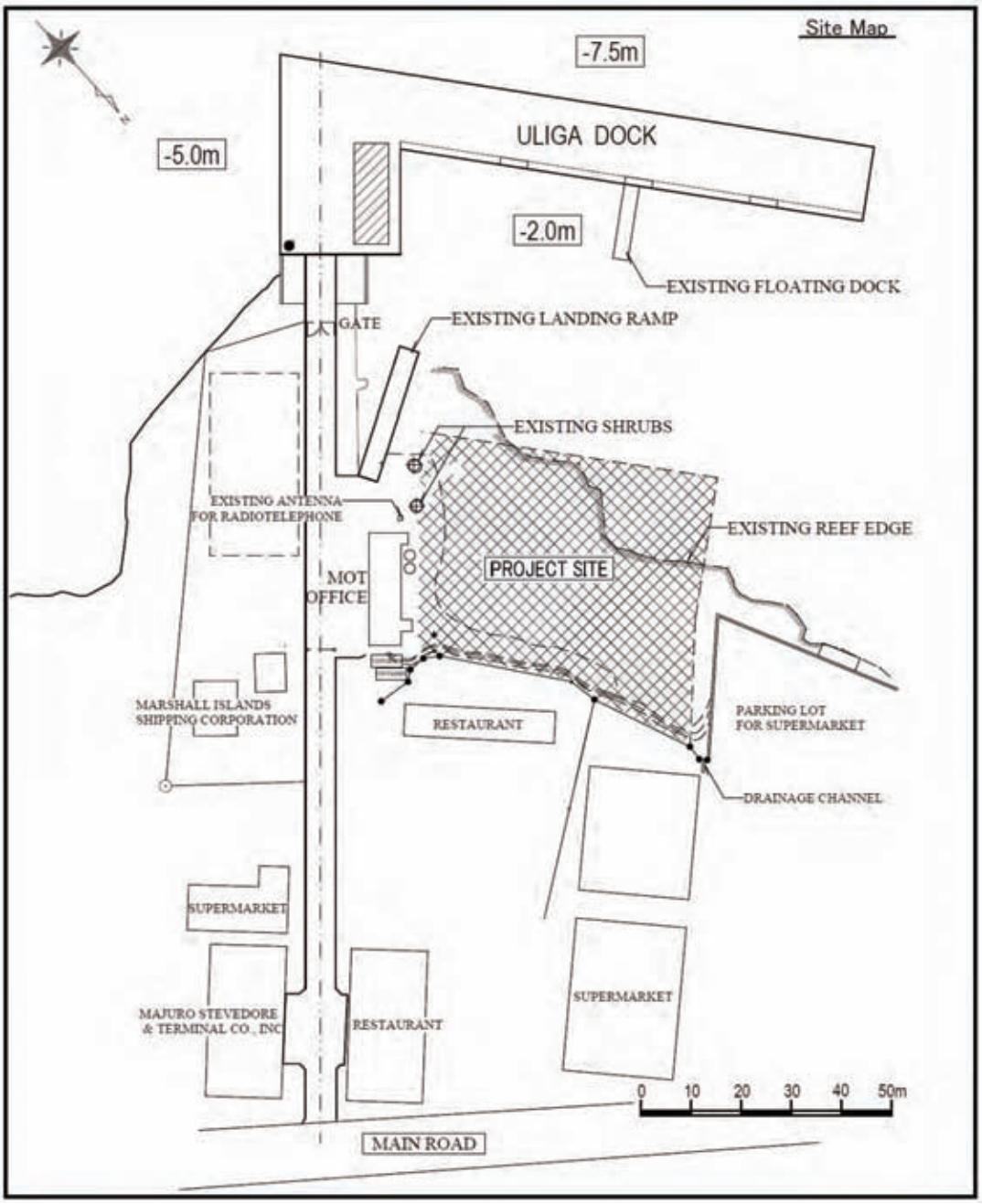




Location Map (1)





Location Map (2)


Perspective

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Abbreviations

AAFA	Arno Atoll Fisheries Association
COFDAS	Coastal Fisheries Development and Assistance Service
EIA	Environmental Impact Assessment
EPA	Marshall Islands Environmental Protection Authority
FAO	Food and Agriculture Organization
HPO	Historical Preservation Office
IEE	Initial Environmental Examination
JAFP	Jaluit Atoll Fisheries Project
KAFMC	Kwajalein Atoll Fish Marketing Center
Lbs	Pounds（1Lbs≒0.45kg）
MIMRA	Marshall Islands Marine Resources Authority
MIPA	Marshall Islands Port Authority
MIWSC	Marshall Islands Water and Sewerage Company
MOT	Ministry of Transportation and Communications
MPW	Ministry of Public Works
MRD	Ministry of Resources and Development
NOAA	National Oceanic & Atmospheric Administration
OFCF	Overseas Fishery Cooperation Foundation
OIFMC	Outer Island Fish Market Center
RMI	The Republic of the Marshall Islands

CHAPTER 1　BACKGROUND OF THE PROJECT

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1-1 Background of the Project

The Republic of the Marshall Islands comprises over 1,000 islands and atolls, and has the scarce land resources. Although it has blessed with the marine resources, markets are far from the country and each island is geographically isolated, so the fisheries industry has not been developed as expected. On the other hand, there are large employment opportunities in the urban areas of Majuro and Ebeye, resulting from financial aid under the Compact of Free Association with the USA and the service industry for the US Base in Kwajalein. Therefore the migration from the Outer Islands continues, resulting in a significant inequality between the Outer Islands and the urban areas. Funds from the Compact of Free Association with the USA are due to end in 2023, so the first priority of the national development plan is the achievement of economic self-reliance. To achieve economic self-reliance, it is an urgent issue to develop the Outer Islands economic sustainably to deter the migration to the urban areas as well as to prevent the decay of the communities in the Outer Islands.

The urban areas of Majuro and Ebeye are heavily dependant on imported foodstuffs. For the majority of urban households the main source of protein in their diet is imported canned foods, and including imported frozen meat, 77% of households rely on imported meat and fish as their main source of protein. The Government is aiming to reduce imports, and is aiming to ensure the food security by recommending a change from imported meat to sea food, which is virtually the only domestically produced source of dietary protein. As many urban residents suffer from diabetes, obesity, or high blood pressure, the Government is trying to improve the dietary life style by the change to local marine food.

In order to provide a source of cash income for the fishers of the Outer Islands and ensure the supply of local produced fish in Majuro and Ebeye, the Government of RMI has established and is implementing the Outer Island fisheries development plans. Japan has also contributed to the RMI development policy, by construction of the Outer Islands fish bases in Arno, Jaluit, Ailinglaplap, Likiep, and Namu, and the procurement of fish collection boats under the grant aid cooperation programs, and by dispatching fisheries experts to improve the fish products distribution system from the Outer Islands.

However, of the fish collection boats owned by MIMRA, only 2 are capable of the long sailing to the Outer Islands, and the operation rates for fish collection trips which must be undertaken in severe ocean conditions is low due to frequent breakdowns caused by wear and tear. Therefore numbers of trips to the Outer Islands is decreasing. In 2007 the supply of fresh fish from the Outer Islands remained at 23 tons, and the cash income to the fishers of the Outer Islands resulting from fish sales remained at $42,000. Also, the OIFMC sales facility is located in the industrial area of Delap, which is rather far from the commercial and residential areas. Not only is this an inconvenient location for the consumers, but also the building is small and the market facilities are poorly equipped and inconvenient for marketing fresh fish.

However, the aging fish collection boats that collect fish from the Outer Islands must sail long distances in severe ocean conditions, and their operation rates have been decreasing due to delay of replacement parts after breakdowns, or unavailability of them as production of the parts has stopped. Therefore the average volume of fresh fish supplied from the Outer Islands to Majuro has stagnated at around 35 tons per annum. The facility that receives the fresh fish from the Outer Islands is a refurbished facility of MIMRA, which is not only small and poorly equipped, but also it is located on the compound inconvenient for consumers, so it is difficult to increase marketing volume of fresh fish from the Outer Islands.

As a result of this situation, it is an urgent task to provide fish collection boats to collect fish from the Outer Islands and to construct the fish market facility at Majuro to distribute the fresh fish from the Outer Islands. The Government of RMI has formulated the "Project for Construction of Fish Market Center at Majuro Atoll", and has requested for Japanese grant aid cooperation to implement the project.

To confirm the background to the RMI Government request and to confirm the details of the market construction and fish collection boat procurement plan, the Japan International Cooperation Agency (JICA) dispatched the preliminary study team of the Project for Construction of Fish Market Center at Majuro Atoll to RMI from 13th January to 15th February 2008. The RMI side had requested some changes of the request to the preliminary study team. As a result of the discussions the request shown in Table 1-1 and their order of priority were confirmed.

Table 1-1 Components of the request confirmed in the minutes of discussions of preliminary study

Priority	Requested facilities, equipment		Remarks
First	Civil engineering facilities	Dock (110m)	with mooring function
		Land reclamation (10,000m^3)	
		Apron paving (2,900m^2)	
		Drainage facilities (130m)	
	Building facilities	Fish market center building (650m^2)	
		Ice making machine (1t/day)	
		Ice storage (5t)	
		Chilled storage (15t)	
		Water tank (15t)	
		Toilet (60m^2)	
		Waste water treatment facilities	
		Electrical power facilities (including solar power system)	
		Security lighting	5 Nos.

Priority	Requested facilities, equipment		Remarks
	Equipment	Fish collection boats (2 No.)	made from FRP, 16m
		Equipment (fish boxes, retailing tables, weighing scales, carts, SSB radiotelephone)	
	Others	Soft components: Consulting services for Management and Operation of Facilities and Equipments	
Second	Equipment	Equipment (Chopping block, Band saw, slicer, high pressure water washer)	
Deleted	Civil engineering facilities	Floating jetty for mooring and landing function	*1
		Repair of the existing dock	Already repaired by RMI
	Building facilities	Gate	Responsibility of RMI

*1: Deleted from the requests because a floating pier for landing and mooring is not suitable for the fish collection boats, and the water areas in the existing dock will be made narrower. Instead of it, a pier, originally requested as a seawall, shall be changed to a dock with a mooring and landing function.

As the results of the preliminary study, JICA dispatched the basic design study team from the 23th July to 16th August 2008. In the basic design study, the components of the request and order of priority shown in Table1-2 were confirmed in discussions with persons concerned. It was confirmed that a chopping board and a slicer be deleted from the requested items. It was confirmed that a band saw would remain as a requested item and was placed secondary priority, because large fish from the Outer Islands are to be frozen and cut for sale. Also, it was agreed that the scale and specification of each of the components are to be examined by the Japanese side based on the results of the field study.

Table1-2 Requested components identified in the Minutes of Discussions of the Basic Design Study

Priority	Requested facilities, equipment		Remarks
First	Civil engineering facilities	Dock (110m)	with mooring and landing function *1
		Land reclamation (10,000m^3)	
		Apron paving (2,900m^2)	
		Drainage facilities (130m)	
	Building facilities	Fish market center building (650m^2)	
		Ice making machine (1t/day)	
		Ice storage (5t)	
		Chilled storage (15t)	
		Water tank (15t)	
		Toilet (60m^2)	

Priority	Requested facilities, equipment		Remarks
		Waste water treatment facilities	
		Electrical power facilities (including solar power system)	
		Security lighting	5 No.
	Equipment	Fish collection boats	made from FRP, 16m
		Equipment (fish boxes, retailing tables, weighing scales, carts, SSB radiotelephone, high pressure water washer)	MIMRA has requested Japanese products for fish box
	Others	Soft components	
Second	Equipment	Equipment (Band saw)	
Deleted	Equipment	Equipment (Chopping block, slicer)	

*1: Specifically, a “derrick” has been requested.

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Regarding the soft components, the RMI side requests the following 2 issues.

- Technical support for improving efficiency of the series of handling operations after landing the fish from the fish collection boats, including in the market, and carrying out for marketing.
- Technical support for quality control for handling of the fresh fish.

1-2 Natural Conditions

1-2-1 Topography

The planned site (area scheduled for landfill) is a narrow site of about 70m width behind the existing Uliga Dock. The ground surface is gently sloping at DL. +0.6 to +1.5m, at low tide the ground surface is exposed, but at high tide it is below the sea.

There is an existing drainage trench for rainwater, etc., on the adjacent land to the north-east. Also the sea area to the front of the planned site has a sea bottom that is virtually flat at DL -2.0m.

1-2-2 Soil

In order to determine the geological conditions at the planned site, a drilling survey was carried out at 3 places near the normal line to the dock and seawall proposed construction locations. The geological conditions at the planned site are a surface layer of coral (20 to 30cm), below which the soil strata are mainly stones and fine to medium coral sand mixed with pebbles. No clay was found.

The profile of the soil strata inferred from the borehole results is shown in Fig. 1-1.

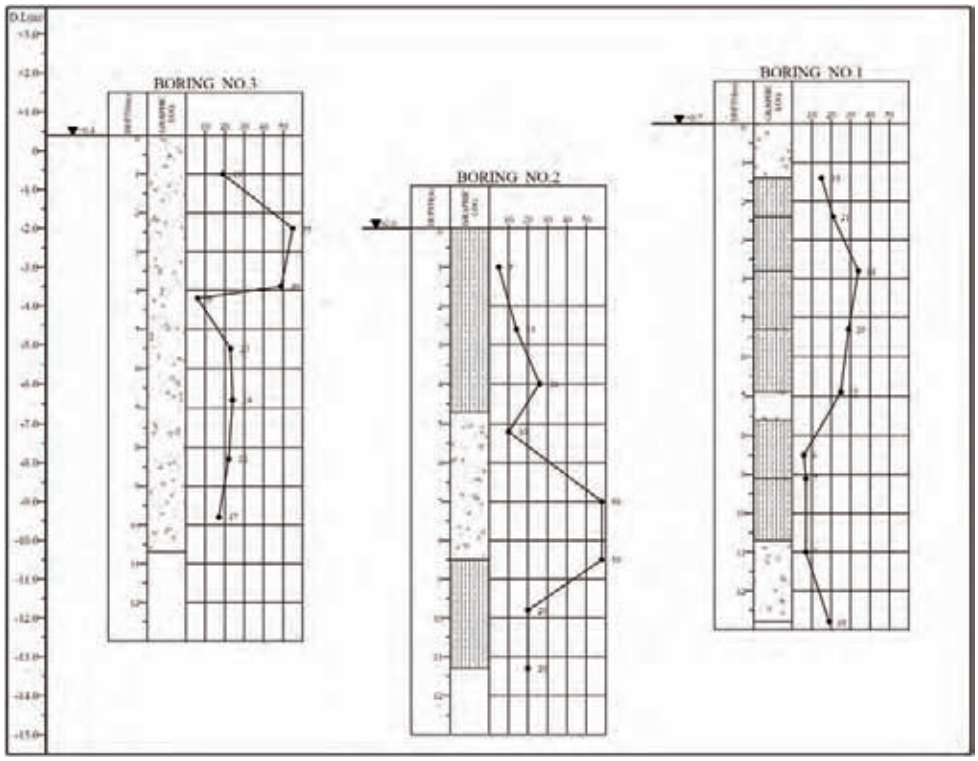


Fig. 1-1 Inferred soil strata profile

1-2-3 Water quality

The water area in front of the planned site is one of the water quality monitoring points of the EPA, where the enterococcus group is regularly measured. From the local water quality survey and past survey results provided by the EPA, it was confirmed that although the transparency of the water area in front of the planned site is high, and the salt content is lower compared with the open seas due to rainwater, when the habitation condition of marine life is taken into account the water quality is good.

However, it is clear that the water is being affected by waste water from daily activities, as the enterococcus results are positive, so the seawater is not suitable for uses where it will come into direct contact with food, or the fresh fish.

Table 1-3 Water quality survey results

Number of enterococcus group	Turbidity	pH	Electrical conductivity	Chloride content	Dissolved oxygen
5 MPN/100 ml	0.52 NTU	6.85	37.0 mS/cm	23.5 ppt	6.6 mg/L
2008/8/13	2008/8/14	2008/8/14	2008/8/14	2008/8/14	2008/8/14

Table 1-4 Measured results for the enterococcus group in the past (MPN/100 ml)

Sampling date	2008/1/9	2008/4/15	2008/5/28	2008/6/12	2008/7/16
No. of group (most probable number)	0	0	0	110	109

Data source: EPA

1-2-4 Marine ecosystem

Although the ecosystem around Uliga Dock received a devastating blow when the existing dock was constructed, and much trash is disposed of around the dock, the situation is healthy with more than 50% of the coral living. At least 500 colonies with 21 types of hard coral and 63 species of fish have been identified, of which *Lobophyllia corymbosa, Pavona cactus,* and *Plerogyra sinuosa* are rare species living at locations such as the planned site. Also, there have been cases where *Chaetodon bennetti* and *Cheilinus undulates,* etc., which are rare species in the Majuro Atoll, have been observed.

1-2-5 Hydrographic conditions

1) Tidal levels

The tidal levels used in the basic design are shown in Fig. 1-2.

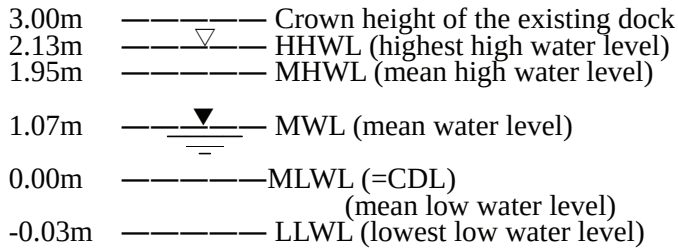


Fig. 1-2 Tidal levels in Majuro

Source: "Basic Design Study Report on the Project for Reactivation of Damaged Old Dock at Majuro" (1989, JICA)

2) Waves

In the sea area in front of the planned site, Uliga Dock plays the role of breakwater, so there is almost no effect from waves. Within the lagoon there have been no reports of the occurrence of large waves, and there have been no examples of damage to harbor facilities or protective works due to waves in the past.

The maximum wind speed in the past in the NW direction, which is the most severe wave conditions for the planned site, was 13m/s. The wave which occurred under this stormy weather condition is estimated at;

Wave height $H_{1/3}$ = 0.63 m

Period $T_{1/3}$ = 2.6 sec.

The wave height in front of the dock was set at about 0.5m.

3) Drift sand

The planned site is far from channels between sandbars that could transport sand from the ocean side. Also, the planned site is located on the east side of the lagoon of the atoll, whereas the waves occurring within the lagoon are virtually all caused by wind blowing from the east towards the west. Therefore it is considered that there is virtually no effect of drift sand at the

planned site.

The results of the field survey showed that there is no sandy beach that can be a source of supply of sand in the area around Uliga, and there has been virtually no deposition of sand seen in the water area within Uliga Dock (the water area in front of the planned site) which was built about 20 years ago. In hearings held locally also, it was stated that in the about 20 years since the construction of Uliga Dock, there has been no dredging carried out in the water areas within the dock.

From the above, it is concluded that there will be virtually no effect of drift sand (deposition of sand, recession of beaches) in the water areas in front of the planned site.

4) Coastal erosion

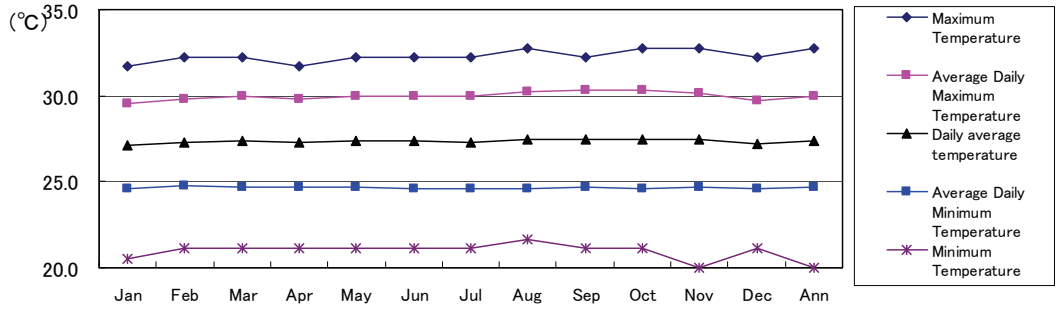
The planned site is in the shelter of Uliga Dock, there are almost no waves, and the results of tidal flow measurements show that there are almost no tidal flows. Hence it is judged that there will be no problem with coastal erosion.

On the other hand, some subsidence has been seen in a part of the tip of the existing ground (coral). Here the fine to medium coral sand below the coral bed has been exposed. It is considered that this has been caused by currents due to the ebb and flow of tides and waves caused by the movement of ships, etc., over a long time.

1-2-6 Climate

1) Temperature

The average temperature in Majuro is 27 degrees, and the temperature is virtually constant throughout the year.



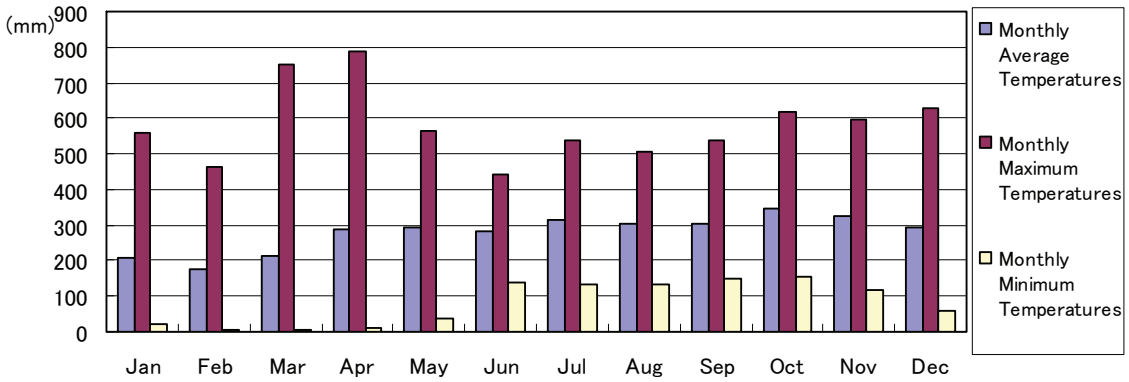
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Maximum	31.7	32.2	32.2	31.7	32.2	32.2	32.2	32.8	32.2	32.8	32.8	32.2	32.8
Average Daily Maximum	29.6	29.8	29.9	29.8	30.0	30.0	29.9	30.2	30.3	30.3	30.2	29.7	30.0
Daily average temperature	27.1	27.3	27.3	27.3	27.4	27.3	27.3	27.4	27.5	27.5	27.4	27.2	27.3
Average Daily Minimum	24.6	24.8	24.7	24.7	24.7	24.6	24.6	24.6	24.7	24.6	24.7	24.6	24.7
Minimum	20.6	21.1	21.1	21.1	21.1	21.1	21.1	21.7	21.1	21.1	20.0	21.1	20.0

Fig. 1-3 Temperature in Majuro

Source: "Comparative Clamatic Data for the United States through 2006" (NOAA)

2) Rainfall

The annual rainfall in Majuro is approximately 3,300mm. There is comparatively little rain between January and April, when in the past less than 10mm per month has been recorded.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly Average	205	174	214	287	293	282	315	304	304	349	325	292	3,344
Monthly Maximum Temperatures	558	466	750	790	565	441	538	507	536	616	598	630	
*1)	1961	1957	1991	1971	1956	1975	1987	1986	1964	1955	1978	1968	
Monthly Minimum	20	5	4	9	38	137	136	135	150	157	115	58	
*1)	1973	1992	1992	1992	1983	1984	1961	1959	1992	1990	1972	1957	

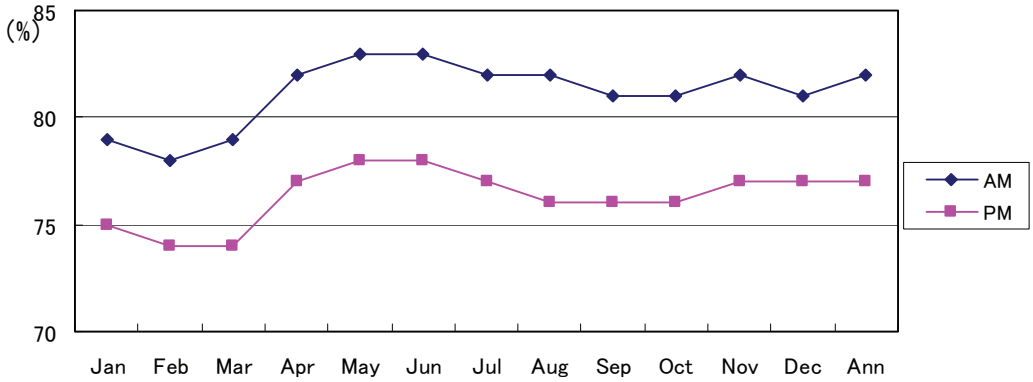
*1) Year of observed

Fig. 1-4 Rainfall in Majuro

Source: "Comparative Climatic Data for the United States through 2006" (NOAA)

3) Humidity

The relative humidity in Majuro is high, at about 75% or higher throughout the year. However, there is normally an east wind blowing, so the climate is pleasant if in the shade.



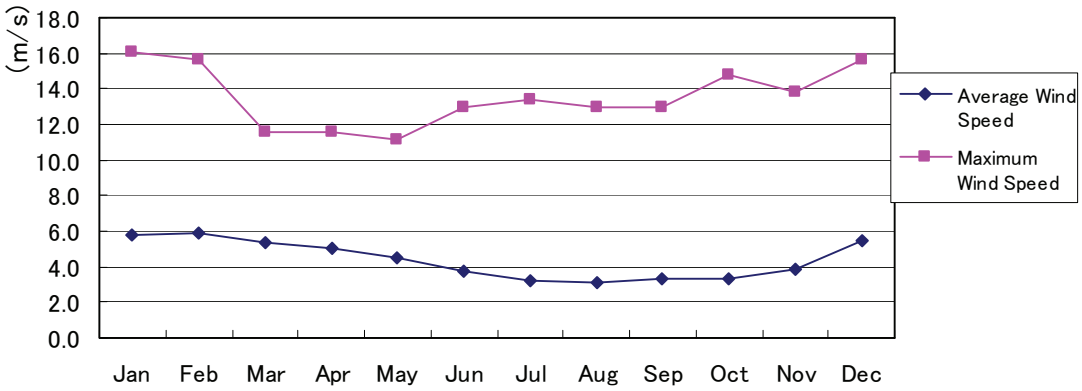
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
AM	79	78	79	82	83	83	82	82	81	81	82	81	82
PM	75	74	74	77	78	78	77	76	76	76	77	77	77

Fig. 1-5 Majuro's relative humidity (%)

Source: "Comparative Climatic Data for the United States through 2006"(NOAA)

4) Wind direction and wind speed

In Majuro the prevailing wind throughout the year is east or north-east. From December to April the wind is comparatively strong, but from April to November it is weak.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Average Wind Speed(m/s)	5.8	5.9	5.4	5.0	4.5	3.8	3.2	3.1	3.3	3.3	3.9	5.5	4.6
Wind Direction	ENE	ENE	ENE	ENE	ENE	ENE	ENE	ENE	E	E	E	ENE	ENE
Maximum Wind Speed(m/s)	16.1	15.6	11.6	11.6	11.2	13.0	13.4	13.0	13.0	14.8	13.9	15.6	
Wind Direction	ENE	ENE	ENE	ENE	ENE	E	SW	NW	SW	ENE	SW	E	

Fig. 1-6 Majuro wind direction and wind speed (m/s)

Source: "Comparative Climatic Data for the United States through 2006"(NOAA)

5) Natural disasters

RMI is located outside the path of typhoons, so there is very little typhoon damage. In the past 55 years there have been typhoon assaults 5 times, and the only case of occurrence of a death was the typhoon of 1958.

An example of typhoon damage at Majuro in recent years is typhoon Axel in 1992. At that time there was damage on the sea shore area on the south side facing the ocean, but there was virtually no damage on the lagoon side where the planned site is located.

There are no records of earthquakes, and likewise damage due to tsunamis has not been confirmed.

1-3 Environmental and social considerations

No major environmental or social impacts are expected as a result of implementation of this project, but the extent of the negative aspects postulated in the preliminary study and an outline of the corresponding measures are shown in Table 1.

Table 1-5 Measures to avoid or mitigate environmental or social effects

Item	Assumption during the preliminary study		Corresponding measure according to this plan
	Assessment	Extent of negative aspect	
Economic activity	B	Fresh fish is sold at 6 establishments including supermarkets, retail shops, and	According to a verbal survey of shops selling fresh fish, no shops are concerned over

Item	Assumption during the preliminary study		Corresponding measure according to this plan
	Assessment	Extent of negative aspect	
		gasoline stations near the proposed site. Therefore it is necessary to ensure that the existing sellers of fresh fish are not affected by the construction of the fish market center.	competition with the proposed market. After opening, MIMRA will hold periodic meetings with the retail shops, and if problems arise measures for improvement will be devised.
Traffic and livelihood facilities	B	It is considered that during construction and after opening, congestion of traffic and construction vehicles will occur to the existing Uriga pier.	During construction a traffic attendant will be deployed to ensure safety, and after opening the market facility congestion will be prevented by providing appropriate car parking lot.
Land ownership, water use rights, common rights	B	Of the land adjacent to the proposed facility, the RMI Government has confirmed a lease in writing for the land that adjoins the area to be reclaimed. However, the traditional land ownership system remains, so it is necessary to pay attention to this.	The basic agreement between the 4 land rights holders necessary for use of the planned site and MIMRA was concluded on 27th May 2008, and in the present study it was confirmed that the contents of the agreement is effective. The final lease contracts concerning the land use will be concluded after conclusion of the EN.
Health and welfare	B	It is considered that during construction there will be a worsening of the sanitary environment due to untreated sewage and trash from the workers engaged in construction.	A temporary toilet will be provided during construction, and thorough instructions will be given to the contractors.
Topography and geology	B	Depending on the source of the sand for the necessary reclamation, the amount of coral reef rock could be reduced.	There will be a plan for using imported soil and sand for reclamation, so the sand will not be obtained from along the coast.
Sea areas	B	As a result of the landfill, shallow areas by the water's edge will be lost, so the flow between the existing pier and the new pier could change.	The maximum wave height of the sea area in front of the proposed site is 0.5m, so there are almost no waves, and also the effect of drifting sand is almost zero. The tidal currents are weak, so it is judged that there will be no problems of coastal erosion.
Eco-system, flora & fauna habitat and cultivation environment	B	At present a sea area of about 2,500m^2 (50m × 50m) will be lost due to reclamation.	There is no coral in the part to be reclaimed, but small amount of coral colonies is existing in the part where sheet piles are to be driven, so before construction those will be transplanted by the RMI side.
Air pollution	B	During construction and after opening, the number of vehicles will increase, so air pollution could increase.	Contractors will be thoroughly instructed to forbid unnecessary idling during construction. After opening MIMRA will give similar instructions to the parked cars.
Water pollution	B	During construction, wastewater from the fresh concrete could flow into the sea. If an inappropriate wastewater treatment facility is installed, wastewater could flow into the lagoon after the market facility is opened.	During construction, the outflow of contaminants will be minimized by the use of a pollution control barrier To prevent direct discharge of wastewater into the lagoon from the market facility after it opens, wastewater will be fed into the public sewerage system after passing through primary treatment (grease trap, etc.).
Soil contamination	B	During construction, pollution from construction materials may flow into the water.	During construction, soil contaminants will not be used.
Waste	B	During construction, waste construction materials and trash from the operatives could flow into the sea. After the market facility opens, trash could be generated by the market.	The contractors will be instructed to take appropriate measures to deal with waste materials and trash during construction. After opening the market facility, garbage after gutting and processing will be sorted and collected by a waste company under contract.

Item	Assumption during the preliminary study		Corresponding measure according to this plan
	Assessment	Extent of negative aspect	
Noise, vibration	B	Noise and vibration could be generated by operation of construction vehicles and excavation of rock, etc.	The local residents will be informed in advance of the construction plan, and the contractors will be instructed not to carry out night time work that creates noise.
Ground subsidence	B	The nearby ground could be affected by the construction.	The soil at the site is sandy soil with N-values in the range 5 to 26, so the construction will have no effect on nearby ground.
Bad smells	B	Exhaust gases will be generated from construction vehicles and construction machinery during construction.	The number of construction vehicles will be minimized by establishing an appropriate construction plan.
Bottom sediment	B	During construction, muddy water could flow into the water's edge.	During construction, the outflow of contaminants will be minimized by the use of a pollution control barrier
Traffic accidents	B	Traffic accidents could occur during the construction due to the increase in construction vehicles. After opening the market facility, traffic accidents could occur due to the increase in traffic volume, and boat contact accidents could occur.	The number of construction vehicles will be minimized by establishing an appropriate construction plan. Also, during construction a traffic attendant will be deployed to ensure safety. After opening the market facility, MIMRA will instruct crew regarding safe navigation by boats.

(Note) Assessment classification B: Somewhat negative impact expected.

(1) Land use of the planned site

In a meeting held by MIMRA on the 27th May, 2008, it was confirmed that the concurrence of landowners on and near the planned site to the implementation of this plan was obtained, and the minutes of this meeting have been appended to the Minutes of Discussion (M/D) of the present study.

During this study, MIMRA arranged a meeting with the purpose of re-confirming the concurrence of those with landowners to this plan, and the land rights owners had confirmed that the document previously agreed to was still valid. Amendment of the final land lease contract between the land rights owners and the Government of RMI will be concluded after Exchange of Notes (EN), so that the site for the Project is secured.

(2) EIA

Based on RMI law, the environmental impact assessment will be implemented by MIMRA as the project implementation organization preparing an application based on the Basic Design and submitting it to the Environmental Protection Agency (EPA) as the responsible organization. In the present study the EPA expressed the opinion that as the plan does not include dredging, an EIA seems to be not necessary. However, whether or not an EIA is necessary will be examined by the EPA after MIMRA have presented the application. It is appropriate that the application be made after the project detailed contents have been agreed (components, scale, shape, specification).

(3) Dialog with stakeholders

In a meeting held by MIMRA on the 27th May, 2008, it was confirmed that the concurrence of

landowners on and near the planned site to the implementation of this plan was obtained, which was reconfirmed at the meeting on 8 August 2008 witnessed by the study team. It was confirmed that MIMRA will make public the details of this plan in the future, through associated meetings and surveys of the Outer Islands, etc., and will report the results of the hearings to the JICA Marshall Islands Office.

CHAPTER 2　CONTENTS OF THE PROJECT

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2-1 Basic Concept of the Project

2-1-1 Basic Concept of the Project

The economy of the Republic of the Marshall Islands (hereafter referred to as RMI) is heavily dependent on the United States, with public works expenditure based on the Compact of Free Association with the USA and the service industry for the US military base at Kwajalein responsible for a large share. However, funds from the USA based on the Compact of Free Association will come to an end in 2023, so in Vision 2018, the RMI 15 year long term national development plan from 2003, defining the road to economic self-reliance has been raised as the first priority. On the other hand, great portion of population of the Outer Islands, where the opportunities for earning cash are scarce as subsistent economies are dominant and the economic activities are almost limited to copra production, fisheries, and hand crafts production, has been migrated rapidly to the two urban centers of Majuro and Ebeye nearby a US military base. So the population structure of the Outer Islands and the urban centers has been changed drastically. Thus insufficient urban infrastructure and the decay of communities on the Outer Islands, the social and cultural basis of the RMI, have become serious problems. Investments in urban social infrastructure and the sustainable development of the Outer Islands are highlighted in the national development plan.

Since the opportunities for cash income are scarce in the Outer Islands, most households are engaged in subsistent production activities, in which fishing occupies a major position. Therefore, fostering fisheries is critical for the sustainable development of the Outer Islands, and a plan to provide opportunities for earning cash for local fishers is included in the national development plan. In the fisheries development plan, the promotion of the Outer Island fisheries is focused in coastal fisheries development.

Domestic food production in RMI is low, and the dependence on imports is high. In the national development plan, the RMI Government aims to reduce the imports of food for guaranteeing food security which is as important as economic self-reliance and recommends to change from imported canned meats to fish, which is virtually the only source of protein locally obtainable. Many of the urban residents suffer from diabetes, obesity, and high blood pressure as a result of consumption of high calorie, high protein imported foodstuffs, so it is considered that there is a high latent demand for fish. Therefore, the efforts towards the change to domestic sea food are also directed towards improvement in people’s dietary habits.

The Outer Island fisheries projects of the Marshall Islands Marine Resources Authority (MIMRA) are being implemented with the objectives of supplying fresh fish from the Outer Islands to the two major urban centers, Majuro and Ebeye, where there is an insufficient supply of fresh fish, and to

provide fishers of the Outer Islands with opportunities for cash income. Japan has provided grant aids programs for the development of the fisheries infrastructure and the procurement of fish collection boats for Majuro, Ebeye, and the surrounding atolls (Arno, Jaluit, Ailinglapalap, Likiep, and Namu), and contributed to the development of the Outer Island fish distribution system through the dispatch of experts, etc.

However, of the five MIMRA fish collection boats that had been engaging transport fresh fish from the Outer Islands, two are small boats not suitable for long navigation, well past their service life and too old to repair. Therefore fish collecting activities from the distant Outer Islands tend to be delayed. The annual supply of fresh fish from the Outer Islands to the Majuro Outer Island Fish Market Center (OIFMC) is about 35 tons, and the cash income from sale of fresh fish by the fishers of the Outer Islands is only about $42,000 annually. Also, the MIMRA's compound in which the market facilities of OIFMC is located is in an industrial area, not only a location that is inconvenient for consumers, but also the building is small, the market facilities are poorly equipped and inconvenient for marketing fresh fish.

The objective of this project is to increase the supply of fresh fish from the Outer Islands to Majuro, and to improve the landing and handling of fresh fish by procurement of fish collection boats and the construction of a fish market and fish unloading dock at Majuro. By increasing the cash income to the fishers of the Outer Islands through increasing the supply of fresh fish from the Outer Islands, the integrity of the communities on the Outer Islands can be secured. By increasing the supply of fresh fish in Majuro through improving the fish landing and handling, the change from imported foodstuffs to domestic sea food by the residents of Majuro will be promoted, which is expected to improve the people's dietary habits.

2-1-2 Examination of the Request

The requested components of the project and the results of the investigation of eligibility for the cooperation under the grant aid program by the Government of Japan are as shown in Table 2-1.

Table 2-1 Requested components and items subject to the cooperation as confirmed in the basic design survey minutes

Priority	Requested facilities, equipment		Results of the investigation of eligibility for the cooperation
First	Civil engineering facilities	Dock (110m) Provides mooring and landing function	Necessary for mooring of fish collection boats and landing work, so eligible for cooperation.
		Land reclamation (10,000m^3)	Indispensable to form the site, so eligible for cooperation.
		Apron paving (2,900m^2)	Indispensable for operation, so eligible for cooperation.
		Drainage facilities (130m)	Necessary to ensure the path for rain water, so included in the plan.
	Building facilities	Fish market center building (650m^2)	Indispensable as the market facility for fresh fish from the Outer Islands in Majuro, so eligible for cooperation.
		Ice making machine (1t/day)	Ice is indispensable to maintain the quality of the fresh fish, so eligible for cooperation.
		Ice storage (5t)	
		Chilled storage (15t)	Normal fresh fish is stored in iced water, but iced water storage is not applicable to bivalves, cephalopods, and crustaceans, so they are stored in chilled storages, so eligible for cooperation.
		Water tank (15t)	Indispensable for ensuring rain water supply, so eligible for cooperation.
		Toilet (60m^2)	A necessary facility, so eligible for cooperation.
		Waste water treatment facilities	Pipe connect with public sewerage, so primary treatment to be carried out to remove solid matter, etc.
		Electrical power facilities (including solar power system)	Necessary for supply of electrical power, energy efficiency, and safety, so eligible for cooperation.
		External lights (5 No.)	
	Equipment	Fish collection boats made from FRP, 16m (2 No.)	Indispensable to ensure fish collection and transport means, so eligible for cooperation.
		Equipment for the market (fish boxes, retailing tables, weighing scales, carts, SSB radiotelephone, high pressure water washer)	Indispensable equipment for operation of the fish market, including necessary equipment not described in the request, so eligible for cooperation.
	Others	Soft components: Consulting services for Management and Operation of Facilities and Equipments	Necessary to improve the quality of fresh fish from the Outer Islands, and necessary to improve the transport methods, handling, storage methods, etc., so eligible for cooperation.
Second	Equipment	Band saw	It is judged that selling large fish cut in filet will stimulate demand of consumers, so eligible for cooperation.
Deleted	Equipment	Chopping block, slicer	To be provided by MIMRA.

The present fish landing operations at Majuro are starting by pouring seawater into the fish hold to

remove the stacked ice, and scooping out the fish catch. The fish catch is sorted on the deck of the boat, and then placed into an insulated container. The insulated container that is filled with ice and fresh fish is lifted by a crane onto a truck, and transported to the market / processing plant. Then the container is unloaded with the crane again near the entrance, and then moved indoors manually. This transport method is very slow and landing of only 400kg fish takes about 1½ hours.

Reducing the handling times of the fish and speeding up the transportation operations of the fresh fish from the fish hold via the handling facilities to marketing is important for keeping the fish fresh. It is necessary to carry out the flow of landing operations efficiently and rapidly after off loading the fresh fish from the fish collection boat. The reasons that the present landing operations take time are because the sorting operation is carried out on the small deck of the boat and the fish containers are too heavy to handle manually. Therefore, the sorting operation should be carried out in a facility with sufficient operation space, and landing should be carried out using small containers and carts that can be handled manually. In this way, it is possible to reduce the time required for the flow of operations from moving the crane, preparations for use of the crane, lifting onto the bed, stowing away the crane, moving, preparation for using the crane again, off loading, etc.

The present MIMRA landing operations and the proposed landing operations at the planned market are shown in Fig. 2-1.

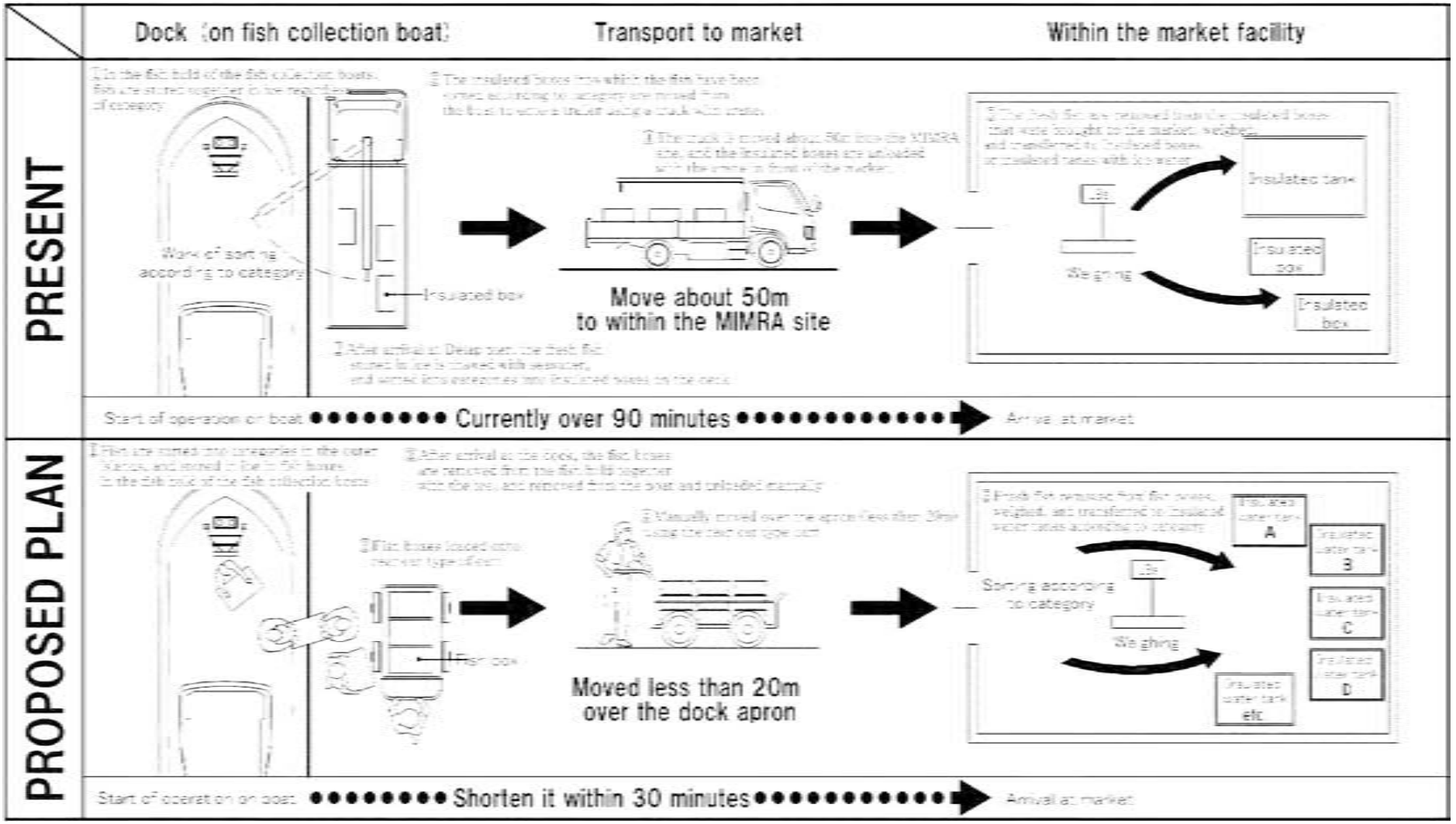


Fig. 2-1 Present and proposed unloading operations

(1) Civil engineering facilities

The planned site is located in the inter-tidal zone between DL. -3.5m to +2.0m, a natural terrain that appears out as far as the reef edge at about DL. +0.5m. Therefore it is necessary to reclaim the site. In addition providing a dock for the fish collection boats and paving an apron, etc., to facilitate the workability on the site are indispensable. Also, there is an existing drainage trench at the western end of the site, so it will also be necessary to provide the drainage facilities together with the reclamation. The crane truck operating at the present OIFMC for lifting heavy loads from the fish collection boats, is very old and it seems to be difficult to operate for a long run, so on the dock it is appropriate to provide a derrick boom that is capable of lifting heavy loads manually such as fuel oil drums for the Outer Islands.

(2) Building facilities

1) Fish market center building

In order to actuate the fishing activities in the Outer Islands, it is necessary to strengthen the marketing function at Majuro. However, at the existing market, fish handling does not work efficiently, and the situation of the building is not supportive to maintain proper hygienic conditions. Improving the handling space for the fresh fish and providing a market place in which both the retailers and consumers of Majuro are willing to use are essential conditions for expanding the volume of sales of fresh fish collected in the Outer Islands, and for this purpose it is necessary to provide the fish market center building.

2) Ice making machine, ice storage

To maintain the quality of the fish, it is essential to use ice in its distribution. However, the production capacity of the existing ice facilities at OIFMC is insufficient for the supply of ice for fish collection work at the Outer Islands in the high season, and it is not effective to transport ice every day from Delap to the planned market area at Uliga. Therefore it is appropriate to provide an ice making machine and an ice storage in the planned facilities.

Regarding the type of the ice, MIMRA has originally requested flake ice, though its engineers have experience of maintenance of a plate ice making machine, they have no experience of flake ice making machine. The maintenance cost of a flake ice making machine is higher than that of a plate ice making machine, and there are no other flake ice making machines operating in Majuro, so the supply of spare parts might be unstable. If plate ice for displaying fresh fish is made thinner, and crushed by ice crusher, it is not inferior to flake ice, so it is decided to select plate ice type. It is appropriate to provide a plate ice making machine, an ice crusher, and an ice storage as the ice making facilities.

Table 2-2 shows a comparison of the characteristics of the different types of ice making machine.

Table 2-2 Comparison of the characteristics of the different types of ice making machine

		Plate ice type	Flake ice type
1.	Size of ice (mm)	30W×40L×15T	10W×15L×1.2
2.	Ice making time	About 30 minutes / cycle	Continuous
3.	Melting time	Slow	Large surface area so easily melting
4.	Uses	・Contact with the fish is good, suitable for all types of fish ・Suitable for supply to fishing boats	・Not suitable for supply to small fishing boats. ・Suitable for fish processing. ・Easily melted, so not suitable for large and medium fish. ・Not suitable for ice water.
5.	Characteristics	・The thickness of the plate ice can be changed by adjusting the ice making time	・Size of ice cannot be changed
6.	Sale	・Weighing scales needed	・Weighing scales needed
7.	Environmental characteristics (refrigerant)	・NH_3 is special design ・Freon is ideal	・NH_3 is special design ・Freon is ideal
8.	Facility size	Small Compact layout	Small Compact layout
9.	Ice storage facility	・If the capacity is large the transport equipment is complex (rake equipment, etc.)	・If the capacity is large the transport equipment is complex (rake equipment, etc.)
10.	Ice storage time	・Short time (standard 2-4 days)	・Short time (standard 1-3 days)
11.	Maintenance	・Daily maintenance is normal ・If the water quality is poor the water sprinkling pipes must be inspected and cleaned	・Adjusting the spacing between cutter blades is difficult ・Periodic sharpening of cutter blades necessary
12.	Operatives	Automatic operation	Automatic operation
13.	Maintenance cost	1	1.2
14.	Ice making cost	1	1
15.	Others	・Same type as the existing facility, so MIMRA has experience.	-
	Overall evaluation	○	△

3) Chilled storage

Some of the species of the fish collected in the Outer Islands that are unpopular among consumers in Majuro may remain unsold. Also, the larger sizes of fish tend to be avoided by the consumers. Therefore, MIMRA plans to provide cuts and filets of the large fish for suiting the needs of the consumers and for improving the operation incomes of OIFMC by selling higher added value products. Processed fish cannot be kept in iced water, so a chilled storage is necessary for storage. Also, the catch collected from the Outer Islands includes octopus and giants crams, etc. These are sold as fresh produce, as well as used as raw materials for processed goods, but they cannot be processed in one day. Therefore, at OIFMC, having no chilled storage, they are stored for several days in cooler boxes filled with ice, which can deteriorate the quality. In order to prevent the deterioration and stabilize the supply of seafood products, there is a big necessity to provide a chilled storage for suitably storing the fish at the landing location.

For other fresh fish, it is appropriate to continue the method currently employed by OIFMC: storage in ice water using insulated tanks in air conditioned rooms. Freezing and storage of large fish that need to be cut and processed may be carried out by moving the existing freezer at the OIFMC facility, or may be newly provided by MIMRA, so installation space only is planned.

4) Water catchment tank

RMI depends on rainwater for city water and the supply of it is chronically insufficient. Therefore a rainwater tank to ensure water for cleaning operations within the market and for ice making is essential. Also, clean fresh water is precious, so it is necessary to use seawater, mains water, and rainwater in its proper application.

5) Toilet

There is no existing toilet at the site, so this is a necessary facility for both those working at the market and for visitors.

6) Waste water processing facilities

In the planned facility, not only it is planned to sell whole fresh fish, but it is also planned to provide cut and/or processed fish. Guts removed during treatment might be mixed in the waste water, so it is necessary to avoid discharging the waste water untreated into the public sewerage system. Therefore, a processing facility for primary treatment to remove the solid matter is essential.

7) Electrical power facilities (including solar power generation and security lighting)

Electrical power is essential for the planned facilities and equipment, and for security also security lighting is necessary. On the other hand, a state of energy emergency has been declared in the RMI as a result of the rapid rise in the cost of fuel oil, so it is necessary to introduce solar power system in order to reduce energy consumption and operating costs.

With the rise in the cost of fuel, the import of fuel oil became difficult in the beginning of July 2008, and the President declared a state of emergency, calling for restraint in the consumption of energy by the people, saying that generation of electricity could become difficult at the end of August. However, at the end of July the financial situation improved, and it became possible to temporarily avoid stopping electricity generation. In the RMI which relies on diesel engine generation, electrical charges are directly affected by the price of crude oil, revise the power rate every two months in Majuro, so there is a great need to reduce oil and energy consumption. Under these circumstances, there is a big need for solar electrical power system.

Although it is necessary to introduce a solar power system into the planned facilities, there are problems of maintenance and renewal cost and disposal problems with batteries. It is considered to use batteries is inappropriate. The reduction in operating cost as a result of introducing solar power system is larger than the maintenance cost, and it is considered to introduce a solar power system is

appropriate.

(3) Equipment

1) Fish collection boats

Of the boats owned by MIMRA, only F/V Lentanir and F/V Laintok can sail the long navigation to the distant Outer Islands. It is planned that one of the above boats will be switched to fish collection activities at Kwajalein, as the fish collection boat in Kwajalein could not be repaired and restored.

Also, the existing fish collection boats have been frequently broken down, and not able to set sail, to make the fresh fish collection system from the Outer Islands fragile. As a result there is insufficient fresh fish in Majuro. Apart from Arno, MIMRA's fish collection boats are virtually the only means of transporting the fish catch from the Outer Islands, so there is an urgent need to provide fish collection boats to strengthen the fresh fish collection system and provide opportunities for cash income in the Outer Islands.

2) Market equipment

Insulated tanks that are used for transporting the fresh fish from the fish collection boats, fish boxes, carts, fresh fish retailing counters stalls, weighing scales, etc., are essential equipment for the market. Also, a high pressure water washer can clean using a small quantity of water, so it can economize on water use while maintaining hygiene in the market. SSB and VHS radiotelephones are indispensable for contacting with the fish collection boats, so there is a big necessity for all these items. There are few consumers that will buy large fish among the fish from the Outer Islands, so large fish tend to be left over. Therefore there is a need for selling by cutting the frozen fish in order to stimulate the demand among consumers. For this reason it is appropriate to include a band saw in this plan.

(4) Soft components: Consulting services for Management and Operation of Facilities and Equipments

Some of consumers in Majuro tend to avoid fresh fish from the Outer Islands as they feel the taste of the Outer Islands fresh fish is not good as that of Majuro products. However, this is mainly because fish from the Outer Islands take about 3-4 days from catch reaching to consumers. In addition, the poor state of preservation on the fish collection boats and the inefficient landing operations at Majuro have caused a drop in quality, so their reputation has been low, which makes consumers avoid the fresh fish from the Outer Islands. In order to improve this situation and generate further demand in Majuro, it is essential to implement soft components, consulting services associated with freshness and quality to improve the transportation, handling, and storage of fresh fish from the Outer Islands.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Roles of Planned Facilities and Existing Facilities, and Division of Functions

At present, the only dedicated fish market in Majuro is the Delap fish market (OIFMC) operated by MIMRA. The Delap fish market is located in a corner of the harbor area, alongside RMF sea patrol facilities, and other buildings. In addition to being distant from the Uliga that serves as Majuro's core commercial and residential area with a large consumer population, its position on a back street away from the main road means that access cannot be considered very convenient. In addition, because the existing market shares facilities with a processing plant, the available floor space is barely 50m^2, which is not enough to adequately fill its function as a fish marketing site. On the other hand, the planned new market site can be said to be in a suitable location, at the center of a commercial zone of restaurants and hotels, and also relatively close to a residential area behind the main road.

The plan splits the market function away from the existing MIMRA facility in Delap to animate the fish market and to enable better use of the existing facility for fish processing and ship repair, etc. In the field survey, we confirmed that the division of functions between the new market site and the existing Delap site will be as detailed as in the preliminary survey, as shown below.

◆Planned Market (Uliga Site)	⇔ Division	◆ Existing MIMRA Facility (Delap Site)
・Marketing function for fish collected from the Outer Islands ・ Short-term storage function for soon-to-be-sold or left-over fish ・Supply of ice for fresh fish distribution ・Docking of fish collection boats		・Supply of ice to fish collection boats ・Fish collection boat maintenance and repair ・Fish processing ・Training for fishermen

Roles of the planned market site and existing Delap facility is shown in Fig. 2-2.

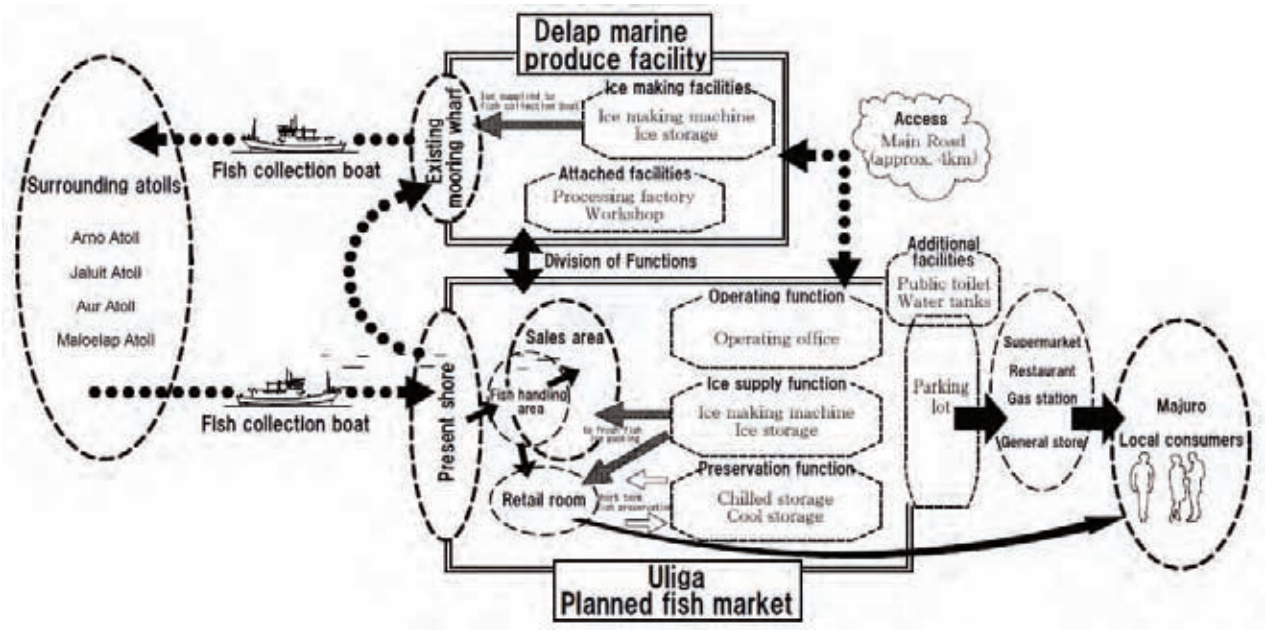


Fig. 2-2 Roles of planned market and existing facility

As the above shows, the planned fish market and the existing fisheries center do not have any overlap in responsibilities. The plan shows a clear division of functions, and all facilities, including those developed in the past in the Japanese Grant Aid for Fisheries, are expected to be put to suitable use.

With the clear positioning of the two facilities in this plan, we now need to prepare the components required for the planned market to ensure that the two facilities can smoothly assume their respective roles.

2-2-1-2 Design Policy for Dock

(i) Ensure the safety of boats using dock, and smooth fish landing functions.

(ii) Layout a plan for the planned dock that does not impede the incoming and out-going of other boats using the existing Uliga dock, and will not cause problems in the future with land use rights holders.

(iii) Based on the above requirements, study the existing sea bottom to develop an economic dock position that holds dredging, excavation, and other underwater work to a minimum, while ensuring the water depth and length necessary for the dock.

－Use a berth length long enough for two fish collection boats to tie up lengthwise.

－ While a berth depth of 1.0m + 0.5m beyond the maximum draft of the MIMRA boats is sufficient, use a berth depth of 2.0m in consideration of the water depth in front of the site and of the fact that the dock in the Delap is 2.0m.

(iv) Use a structural plan that takes into account protection against waves and the sediment of sand.

(v) Use a structural type that reduces adverse effects on the environment, and in the construction

phase take measures to protect coral communities adjacent to the construction site.

(vi) During the construction period, plan not to obstruct manoeuvre of the inter-islands ships and small crafts coming alongside and leaving the existing dock. At the same time, use a plan that clearly isolates the work area, to take due consideration for safety.

2-2-1-3 Design Policy for Market Facilities

(i) To maintain and develop the OIFMC retail function, make comprehensive use of the entire planned site.

(ii) Keep the main focus for the facility layout plan on rationalization of the flow lines of fish, people, and vehicles in the dock and the market.

(iii) Basically, plan the scale of the proposed facility to match the fish and visitor volumes of the current OIFMC. However, since the collected fish are purchased by MIMRA in the Outer Islands and transported, the facility needs to be able to handle the maximum volume. Set the maximum volume handled daily for the planned market amount to the equivalent of the intake of three fish collection boats from the Outer Islands arriving on the same day. Set the combined average daily delivery volume for the past five-year period from Jaluit, Maloelap, and Aur as the market's maximum intake volume, and set the number of consumers coming to the retail room as the number of small-lot (50 lbs≒22.5kg or less) customers at OIFMC.

(iv) While the site is a good location in the city center of Majuro, be aware that the area is restricted in future expansion, and incorporate into the plan considerations for both users and fish distribution. In particular, clearly partition the lines of flow for people, fish, and vehicles, and install buffer spaces in areas where they intersect to prevent congestion and interference. In addition, plan facilities in harmony with the surrounding environment and with existing facilities.

(v) For the fish storage, utilize insulated boxes with ice water, rather than a chilled storage, as the existing facility. Install a chilled storage only for the filets of large fish, bivalves, cephalopods, and crustaceans that are not appropriate for ice water storage.

(vi) To minimize electrical power use, make full use of natural light and use solar power system to reduce commercial power consumption during daylight hours.

(vii) To maintain constant cleanliness inside the market, apply a floor surface water-washable, with adequate drainage in the room.

(viii) Plan the maintenance and management after completion of the facilities remains simple, and management costs to a minimum.

(ix) Use adequate grades of facility equipment and materials in the situations at Majuro.

(x) Since the structure will be established adjacent to the coastal zone subject to constant salty sea breezes, take structural measures against salt damage. Pay particular attention to salt damage for the electrical and mechanical facilities.

(xi) Plan with tough materials and structures for the facility.

(xii) Since the plan is supported by Japanese grant aid cooperation, the construction period is

limited, and so we will endeavor to keep construction time as short as possible while ensuring structures, materials, and construction methods that take into account actual site conditions. We will also use local workforce, construction materials and machinery as much as possible during actual construction in an effort to contribute to stimulating the local construction industry economically.

2-2-1-4 Design Policy for Equipment

(i) Plan fish collection boats of the size suitable for sailing in the open sea, with equivalent capacity to that of the existing boats of MIMRA.

(ii) For keeping the fish fresh, plan the equipment which can be operated manually to maintain freshness of the fish on the boats, to shorten the time required for landing and handling of the fish and to streamline landing and handling operations.

2-2-2 Basic Plan

2-2-2-1 Setting Conditions for Scale of Requested Japanese Assistance

(1) Volume of Fish Handled

The amount of fish handled in this plan is determined by the three factors below.

1) Carrying capacity of fish collection boats
2) Fish catch on the Outer Islands
3) Level of demand in Majuro

1) Carrying Capacity of Fish Collection Boats

The volume of fish from the Outer Islands distributing in Majuro depends on how much can be carried by the fish collection boats. The volume in one trip carried by a fish collection boat also varies by island. Of the existing fish collection boats, two are not in operation and beyond repair, and one will be relocated to Ebye, which means there will be a fleet with four fish collection boats belonging to Majuro, two from this plan, one existing boat, and one existing outboard motorboat. The outboard motorboat will be used exclusively for Arno as it has been, and the remaining three boats combine will be used for collection from Maloelap, Aur and Jaluit.

In the Outer Islands, fish collection is done at night and dawn, and the crew can take only a catnap on deck or in the fish base during trip to the Outer Islands as there is no chance to have a rest. For this reason the week before and after the long navigations, boats usually stay moored to allow time for preparations, boat maintenance and rest and relaxation for the crew. However, for this reason, fish can be collected from the islands only once every three weeks. It would be possible to reduce the number of rest days when sailings to Maloelap and Aur, since they are both comparatively short trips than Jaluit. Furthermore, because preparation time before sailing out could also be shortened, it would be adequate to plan a week for rest and boat maintenance only after the trip to Jaluit. The proposed scheduling plan for boats once the new boats have been introduced is shown in Table 2-3.

Table 2-3 Boat deployment plan after new boats introduced

Fish collection boat	Week 1	Week 2	Week 3	Week 4
Boat A	Jaluit Atoll	Crew rest	Maloelap Atoll	Aur Atoll
Boat B	Aur Atoll	Jaluit Atoll	Crew rest	Maloelap Atoll
Existing boat	Maloelap Atoll	Aur Atoll	Jaluit Atoll	Crew rest

The fleet will operate for 48 weeks a year, leaving 2 week's holiday for Christmas and others and the 2 weeks considered necessary for servicing for the scheduled inspections of the boats. In line with this, the total number of collections from each of the islands, Maloelap, Aur and Jaluit, will be (48 weeks ÷4 weeks)×3 times ＝ 36 times.

In addition, the plan to visit Arno and Ine is set at 70 times same as the plan for 2008.
The volume of fish collected by trip from each island will not be changed, and from the average taken to OIFMC over five years, annual fish collection volumes will be:

Maloelap:	36 trips x 556kg	＝20,016kg/year
Aur:	36 trips x 570kg	＝20,520kg/year
Jaluit:	36 trips x 1,078kg	＝38,808kg/year
Arno/Ine:	70 trips x 324kg	＝22,680kg/year

And an annual total will be 102,024kg. Table 2-4shows a detail of fish collection volume by islands.

Table 2-4 Consignment volume according to island (2003 to 2007)

Unit (kg)

Name of island	Arno	Ine	Maloelap	Aur	Jaluit	**OIFMC total**
Maximum volume	624	371	690	739	1,427	**1,542**
Minimum volume	7	23	386	401	689	**7**
Average volume	197	127	556	570	1,078	**357**

Source: MIMRA materials

2) Fish Catch on the Outer Islands

The average atoll area per head of Aur, Maloelap and Jaluit is 62 ha, which is 62 times that of Majuro, and a little less than 4 times that of Arno. Average catch pressure for the three islands based on estimated catch volume is 219 kg/km^2, which is less than 5% that of Majuro, and only about 20% of that of Arno. Basically, since there is room to increase the catch pressure to about half that for Arno, we estimate that in the three islands there is an annual spare productive capacity of more than 500 tons. In Maloelap, Aur and Jaluit, fish production become commercial only upon the MIMRA fish collection boats visit the atolls, and other fishing is purely subsistence. According to the results of an interview survey of the Outer Island’s fishers, they have a strong desire to increase fish production,

and given the fact that even in the present plan the total annual collection volume for the three islands will not exceed 100 tons (20.5 tons from Aur, 20.0 tons from Maloelap, and 38.8 tons from Jaluit), increasing catch volume by increasing the number of calls by fish collection boats would present no real problem.

Table 2-5 Estimated capacity for increasing annual production

Island	Atoll area (km^2)	Estimated population (people)	Atoll area per head (ha)	Estimated catch volume (kg)	Catch pressure (kg/km^2)	Capacity for production increase (tons)
Majuro	295.1	23,844	1	1,427,882	4,839	－
Arno	338.7	2,084	16	346,213	1,022	－
Jaluit	689.7	1,681	41	226,935	329	118
Aur	239.8	541	44	73,035	305	47
Maloelap	972.7	862	113	116,370	120	370
Total for 3 islands	1,902.2	3,084	(average) 62	416,340	(average) 219	535

In Arno, in addition to selling to MIMRA, fishermen and middlemen also sell directly to customers in Majuro. However, for fishermen who do not have means to transport the fish by themselves, or live in areas where middlemen do not come for fish collections, MIMRA collection is a precious source of income, and they strongly desire to continue MIMRA's fish collection operations. On the other hand, there is also the issue of depleting natural resources, and so it is also hoped that while collection operations continue, a balance is struck to maintain them. For Arno Atoll, MIMRA operates fish collection with the outboard motorboat "Jolok", which they have no plans to change, and so under the present plan there should be no increase of catch volume there.

3) Level of Demand in Majuro

The provisional calculation of total catch volume in Majuro in 2005 was 3,260,482 lbs (1,467,217 kg), and since probably very little of this was taken out of Majuro, we can assume that it was almost all consumed on the island. In addition, of the catch volume in Arno, 531,398 lbs（239,129 kg) of it was commercially distributed in markets, and since there is no fish market on Arno, it is likely that most of this was also sold on Majuro.

Table 2-6 Fish catch in the Majuro Atoll and Arno Atoll （2005）*[1]

		Majuro Atoll			Arno Atoll		
		Total catch volume	Self-consumption	Volume of fish distributed	Total catch volume	Self-consumption	Volume of fish distributed
Reef fish	lbs	3,173,070	506,621	2,666,449	769,363	306,224	463,139
	(kg)	(1,427,882)	(227,979)	(1,199,903)	(346,213)	(137,801)	(208,412)
Miscellaneous pelagic fishes	lbs	87,412	13,851	73,561	83,672	15,413	68,259
	(kg)	(39,335)	(6,233)	(33,102)	(37,652)	(6.935)	(30,717)
Total	Lbs	3,260,482	520,472	2,740,010	853,035	321,637	531,398
	(kg)	(1,467,217)	(234,212)	(1,233,005)	(383,865)	(144,736)	(239,129)

On the other hand, the volume of fish bought from the Outer Islands by MIMRA in 2005 was

[1] Based on the results of the RMI Natural Resources Survey and Management Project (2002-2006) conducted by MIMRA/OCFC

59,937.95 lbs, and the volume of which excluding fish purchased by the AAFA[2] was 20,737.05 lbs (9,332 kg). In addition, according to the manager of MIFV, the company distributed an average of approximately 800kg of tuna and by catch per month in Majuro, which amounts to an estimated 9,600kg a year.

Table 2-7 Volume of fish purchased by MIMRA from the Outer Islands (2005~2007) （lbs）

	2005				2006				2007			
	AAFA	COFDAS	JAFP	Total	AAFA	COFDAS	JAFP	Total	AAFA	COFDAS	JAFP	Total
Jan.	3,066.00	0.00	0.00	3,066.00	2,596.00	2,435.00	0.00	5,031.00	2,584.00	0.00	0.00	2,584.00
Feb.	2,365.00	0.00	0.00	2,365.00	3,534.00	0.00	0.00	3,534.00	1,505.00	2,217.00	1,739.00	5,461.00
Mar.	6,030.00	0.00	2,767.40	8,797.40	3,553.00	2,061.00	1,521.00	7,135.00	1,714.00	2,688.00	1,284.00	5,686.00
Apr.	3,252.00	0.00	2,525.40	5,777.40	3,327.00	1,166.00	1,668.00	6,161.00	2,071.00	0.00	0.00	2,071.00
Mai	2,090.00	1,286.00	0.00	3,376.00	2,626.00	2,391.00	3,145.00	8,162.00	2,216.00	5,161.00	0.00	7,377.00
Jun.	5,793.90	1,333.00	0.00	7,126.90	1,388.00	2,308.00	2,536.10	6,232.10	1,748.00	2,029.00	1,614.50	5,391.50
Jul.	1,662.00	2,420.00	0.00	4,082.00	1,450.00	1,274.00	3,135.00	5,859.00	712.00	2,499.00	0.00	3,211.00
Aug.	3,300.00	2,360.25	1,535.00	7,195.25	1,270.00	2,587.00	2,423.00	6,280.00	2,168.00	1,669.00	3,143.00	6,980.00
Sep.	2,647.00	2,492.00	0.00	5,139.00	3,485.00	1,254.00	0.00	4,739.00	3,143.00	1,200.00	-	4,343.00
Oct.	4,037.00	2,749.00	0.00	6,786.00	2,774.00	1,227.00	8,107.40	12,108.40	4,772.00	1,397.00	-	6,169.00
Nov.	2,605.00	1,269.00	0.00	3,874.00	1,490.00	1,046.00	1,519.00	4,055.00	829.00	936.00	-	1,765.00
Dec.	2,353.00	0.00	0.00	2,353.00	1,302.00	1,378.00	0.00	2,680.00	976.00	0.00	-	976.00
Total	39,200.90	13,909.25	6,827.80	59,937.95	28,795.00	19,127.00	24,054.50	71,976.50	24,438.00	19,796.00	7,780.50	52,014.50

Source: MIMRA materials

From the above, the volume of fish consumed on Majuro Atoll in 2005 is estimated at 3,833,950 lbs （1,725,278 kg), and dividing that by the estimated 2005 population of 23,844[3], we can estimate that annual consumption of fish per head is approximately 160.1 lbs (72.4 kg).

Table 2-8 Estimated fish consumption on Majuro Atoll (Annual)

Majuro Atoll catch volume	3,260,482 lbs	1,467,217 kg
Volume of fish distributed from Arno Atoll	531,398 lbs	239,129 kg
Volume of fish distributed from other islands	20,737 lbs	9,332 kg
Distribution from MIFV	21,333 lbs	9,600 kg
Fish consumption on Majuro Atoll	3,833,950 lbs	1,725,278 kg

The annual volume of fish sent to OFIMC to date has averaged at 27 tons. Accordingly, the annual fish volume is expected to increase by 75 tons under this project. Since the estimated annual volume distributed in Majuro in 2005 was 1,725 tons, 75 tons would constitute a 4.3% increase. According to the 1999 census, the rate of population increase in Majuro between 1988 and 1999 was 1.9%. By current estimates of the fish consumption per head, without increasing fish imports and with no change in fish collection volume, fish supply will be short by 5.7% within three years. Furthermore, according

[2]Excluded because AAFA purchase volume is included in the figure for distribution volume from Aruno

[3] According to the Statistics Bureau, the estimated population of the RMI in 2005 was 51,201, calculated using the ratio from the 1999 census.

to a questionnaire survey of fish retailers in Majuro, the demand for fish has increased due to factors such as trends in health consciousness and increases in imported meat prices, and many retailers say there is a shortage of supply of fish. Moreover, over 70% of consumers would want an increase in fish purchasing if fish prices were reasonable, so potential demand seems to be fairly large. It is likely that an increase in the volume of fish collected would be easily consumed in Majuro.

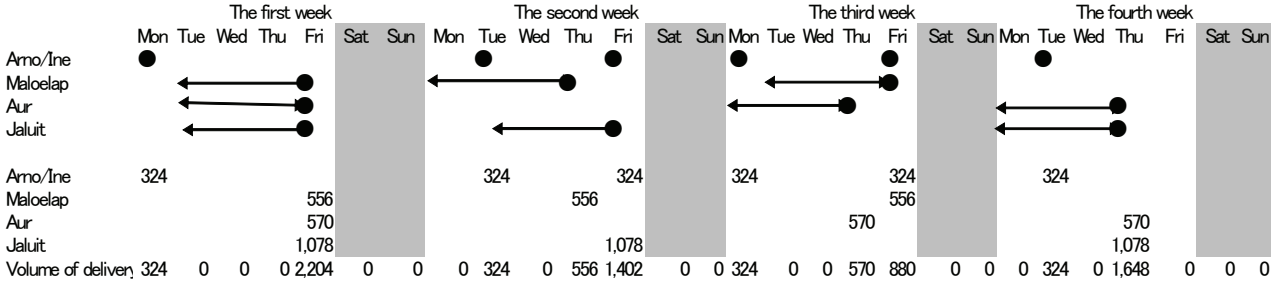
4) Maximum Daily Consignment

The size of the planned market facilities should be determined by the maximum daily incoming volume of fish. The volume of fish collected over 5 years by the three existing fish collection boats amounts to 1,542kg a day, as shown in Table 2-4. With the deployment of the planned boats, there will be four boats for collection of fish, which will increase the chance of them arriving at the dock on the same day. Assuming fish collection boats from Jaluit, Maloelap and Aur are arriving at the dock on the same day, and as can be seen in Table 2-4, average volume for each one is 1,078kg, 556kg and 570kg respectively, we can calculate 1,078kg＋556kg+570kg ＝ 2,204 kg per day is the maximum daily incoming volume in the market.

(2) Required Quantity of Ice

In order to calculate ice requirements for planned market facilities, we have established the boat deployment plan, average incoming volumes and forecasts for a typical month's deliveries.

Table 2-9 Delivery forecast for one month



After the delivered and offloaded fish has been weighed and categorized, it will be packed in ice inside insulated tanks and preserved in the fish handling area. However, fish from the islands will be delivered by storing them in fish collection boat holds at 0C°. Some of the fish will be temporarily stored in the fish handling area, and then packed in insulated containers to be delivered and sold to volume customers, such as retail shops, supermarkets and restaurants, by MIMRA staff. However, some fish will be put on display to sell in the retail and wholesale areas in the market. Accordingly, ice requirements for the planned facilities are

1) ice for the insulated tank
2) ice for the displays in the sales areas
3) ice for insulated containers for sales deliveries

Thermal loss from inside the containers has been calculated as follows.

Thermal loss = heat transfer surface area x heat transfer coefficient x temperature difference

assuming average external temperature 27.3C˚, fish handling area temperature 25C˚, temperature inside tank 0C˚, water source temperature 27.3C˚, specific heat of water 0.59, latent heat of melting ice 80kcal/kg, and thermal conductivity of insulating material 0.0034kcal/m²hC˚[4].

1) Ice for insulated containers

Using a insulated container (550 liter) measuring 1370×840×745mm and with insulating material which is 40mm thick,

Heat transfer surface area (including lid) =

(1.37×0.84) × 2 + (1.37×0.745) × 2 + (0.84×0.745) × 2 =5.595m²

Internal thermal loss ＝ 5.595m² × (0.034kcal/m²hC˚/0.04) × (25C˚－0C˚) ＝118.9kcal/h

Accordingly, thermal melting of cold storage ice by time for one container is

118.9kcal/h÷80kcal/kg＝1.4862kg/h≒1.49kg/h

In addition, if fish is stored in water ice using a 1:1 ratio by volume, then 550kg÷2＝275kg of fish can be stored in one tank, but to be able to separate the four main categories of fish, as well as other not categorized fish, and bivalves and cephalopods, a minimum of six tanks will be necessary. If fish are delivered late on Friday night, they can be stored in insulated containers before being sold on Monday morning.

The amount of ice required per unit weight of raw water for cold storage ice is calculated as follows.

water (fish) weight×0.59× (27.3C˚－0C˚)÷80 ＝ water (fish) weight×0.2013kg

2) Ice for displaying fish in the sales area

Purchases under the purchasing unit of 50lbs（22.5kg) sold to customers at OIFMC totaled 9,261lbs（4,201kg) in 2007, and since there are 74 delivery days at OIFMC, this amounts to an average of 57kg per retail customer per day. The center is open for 8 hours, so to display twice as much fish as the average amount purchased

57kg×2× (25C˚－0C˚)×8h÷80kcal/kg＝285kg of ice is required per day

3) Ice for insulated containers for sales deliveries

Assuming insulated containers for sales deliveries measure 568×361×264 and have insulation 40mm thick、and the outside temperature is 47.3 C˚ (average temperature of 27.3 C˚＋direct heat radiation from sun of 20 C˚),then the heat transfer surface area is (0.568×0.361) ×2+ (0.361×0.264) ×2+ (0.568×0.361)×2=0.9006m².

Thermal loss per hour of ice per one container is

[4] From Expanded Polystyrene Foam Manufacturing Association data

0.9006m² × (0.034kcal/m²h C˚/0.04) × (47.3 C˚－0C˚)＝36.21kcal/h、

Accordingly, thermal melting of ice per hour for one container is 36.21kcal/h÷80kcal/kg=0.453kg/h, and over one business day of 8 hours is 0.453kg/h×8h=3.624kg.

Assuming a specific gravity of fish of 1.08, after the ice has been put in, each container will hold 22kg of fish.

Based on the above calculations and fish quantities in Table 2-9 above, the results of calculations for ice requirements for the planned market facilities are given in Fig. 2-3. The maximum ice volume required in one day will be 1,892kg, and the average volume required for a weekday is 836kg. Consequently, we will need an ice making machine capable of producing 1 ton of ice per day.

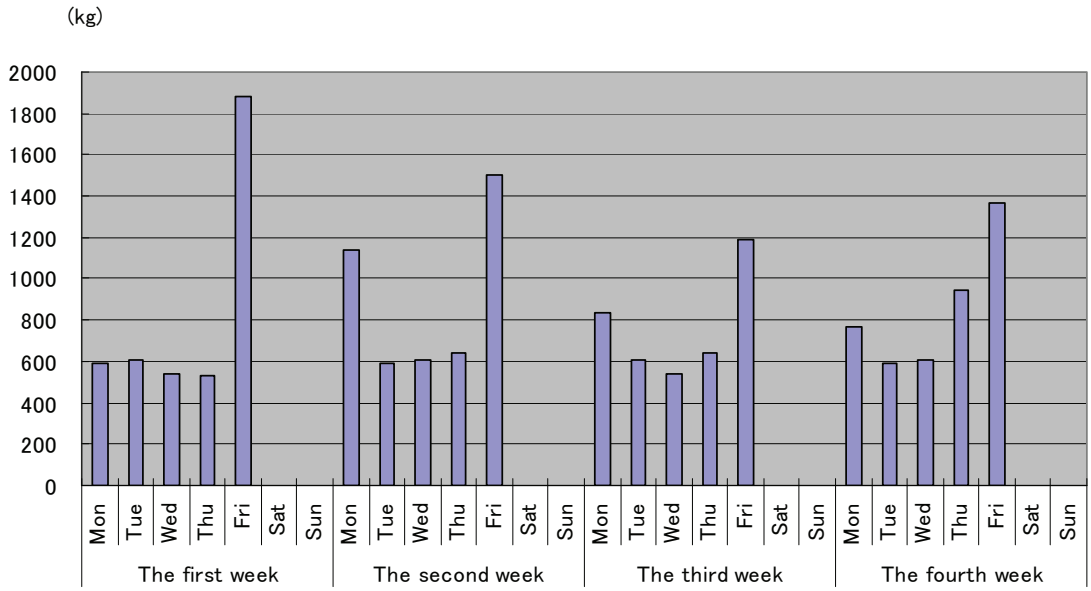


Fig. 2-3 Ice requirements for the fish market center

Since maximum value from a 2 day moving average is 1,208kg, we will need an ice storage container capable of holding 2 tons.

Table 2-10 2 day moving average for ice requirements

	The first week							The second week							The third week							The fourth week						
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Ice requirements	593	609	542	534	1882			1139	593	609	642	1499			833	609	542	645	1186			767	593	609	949	1364		
2 days		1202	1151	1076	2416	1882		1139	1732	1202	1251	2141	1499		833	1442	1151	1187	1831	1186		767	1360	1202	1558	2313	1364	
Moving average		601	576	538	1208	941		570	866	601	625	1071	750		417	721	576	593	915	593		384	680	601	779	1156	682	

(3) Chilled Storage Requirements

Bivalves, cephalopods such as squid and octopus, lobster and other shellfish are not appropriate to be kept in ice water, of which the maximum volume per day sent to OIFMC in 2007 was 538kg. Chilled storage is necessary to preserve such products.

2-2-2-2 Basic Plan of Civil Engineering Facilities

2-2-2-2-1 Dock Extension and Normal Line

1) Expected Boat Forms

The largest boat expected to dock in the wharf is the same as the largest fish collection boat used by MIMRA.

Table 2-11 Principal Particulars of Fish collection boats

Name of Vessel	Lentanir	Laintok
Length（m）	16.11	16.11
Breadth（m）	3.66	3.66
Draft（m）	1.0	1.0

Source: MIMRA

2) Dock Extension

There will be a total of 4 fish collection boats for use, 2 of which will be procured under this project (16m class), adding to one existing 16m class boat (of the two existing boats, 1 boat is due to be reassigned to the KAFMC), and a small boat for Arno Atoll (9m long, powered by outboard).

As it is very likely that all fish collection boats returning from the Outer Islands will arrive at some time in the late afternoon or evening, there will be occasions when 2 or more boats will need to dock at the same time. Furthermore, since 2 or more boats having to moor side by side may obstruct manoeuvre of other boats, we plan to extend the dock to allow 2 boats to dock alongside at the same time.

Dock berth lengths have been calculated as follows.

Berth length= boat length (L) + margin (0.15L)

Source) 'Fish Port and Fisheries Facilities Planning Manual 2003' (Fisheries Agency, Japan)

The extension required for dock:

dock extension ＝（16.11＋0.15×16.11）x 2 boats

＝18.53m/boat x 2 boats

＝37.06m→ 40m

Standards for the facility plan and design were given hearing by the RMI Port Authority and their response was

- there are no design standards in the RMI
- US projects have used US standards, ADB projects have used ADB standards and Japanese projects have used Japanese standards for planning and design
- as there have been no problems to date caused by using Japanese standards, there will no problem using them for planning and designing these facilities

Consequently, we decide to use 'Fish Port and Fisheries Facilities Planning Manual 2003' (Fisheries Agency) in planning and design for this project.

3) Water Depth

Water depth, taking into account the largest boat which will moor in the dock, has been calculated in the plan as follows.

Planned water depth in dock = water depth required for largest boat + margin

Source) 'Fish Port and Fisheries Facilities Planning Manual 2003'

The sea floor at present is a firm coral bed so

planned water depth = 1 + 0.5m or more

In addition, as the planned water depth at the Delap site dock, where existing fish collection boats are moored, is 2m, and the bay in front of our site is also 2.0m deep, we will make the water depth for the plan 2.0m.

4) Crown Height of the Dock

The crown height of the dock will take into account boat shape, tide level and wave height. Particulars of the Boat for planning the Dock should be that of the planned fish collection boats. Generally speaking, it should be added the standard values given in Table 2-12 above the high water level (HWL) depending on use and the difference of tidal level, and then give separate consideration to unusually high tides, waves, the height of nearby docks and so on.

As the planned dock is for a tidal level difference of 1.95m and small boat (10 G.T.) use, a height of 0.6m added to the high water level (DL +1.95m) would be standard. However, the crown height of Uliga Dock in front of the site is DL +2.84 to +2.90. And, after gathering information about various boats and ease-of-use of other docks in the RMI, and considering the landing conditions in our plan, we will use a crown height of DL +2.80m. For user's convenience, we will also build steps into the dock, similar to the ones in the dock in front of the site and the one at the MIMRA site at Delap.

Table 2-12 Calculations for crown height

Tidal level difference (H.W.L.－L.W.L.)	Vessel（G.T.）
	0～20t
1.0～1.5m	0.7m
1.5～2.0m	0.6m
2.0～2.4m	0.6m

Source: "Fish Port and Fisheries Facilities Planning Manual 2003"

5) Normal Lines

i) Normal lines

To ensure the water area be secured as wide as possible, we will run the dock normal line parallel with the normal line of the existing Uliga Dock.

We will ensure the water area in front of the site is wide enough for boats to turn around, that is 3L (where L is boat length, so 3L = 3 x 16 = 48m). (from “Fish Port and Fisheries Facilities Planning Manual 2003”)

We will ensure the north seawall normal line does not affect the rainwater drainage channel at the base of the boundary with the adjacent land.

ii) Position of the dock

A dock of 40m width and 2.0m depth will be necessary. We will position the dock normal line on the north side so as to allow enough water area for boats to maneuver, but also, given the topography of the existing sea floor, to ensure the minimum dredging and underwater construction (digging, mounding, leveling etc.) as possible.

The dock plan is shown in Fig. 2-4.

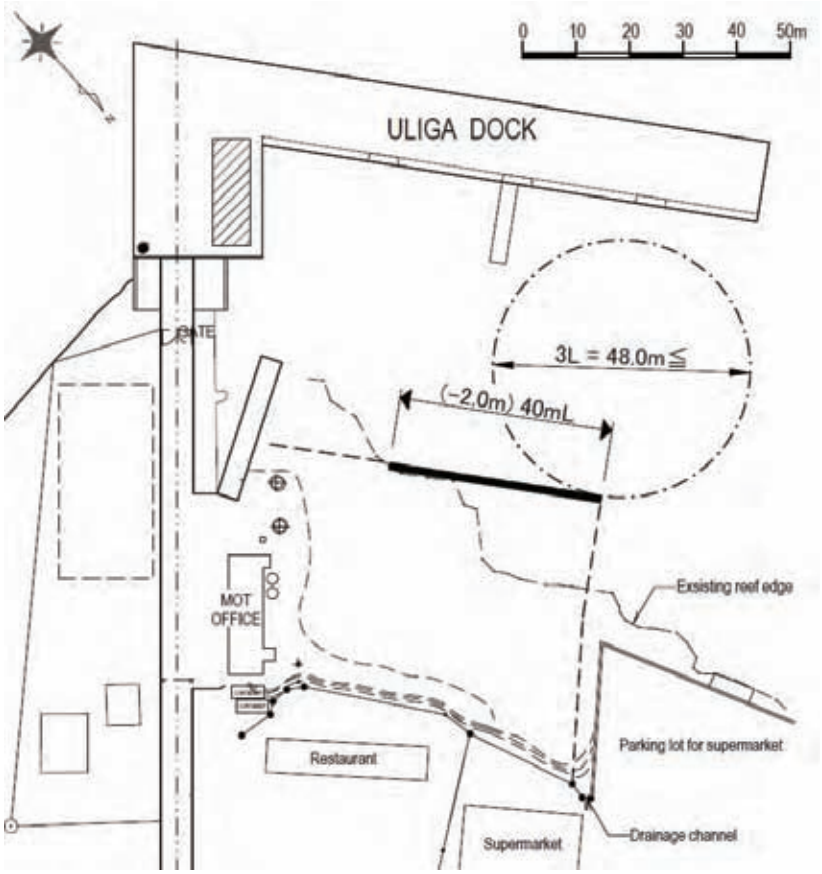


Fig. 2-4 Dock Plan

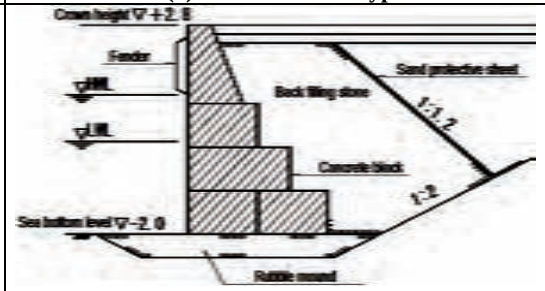
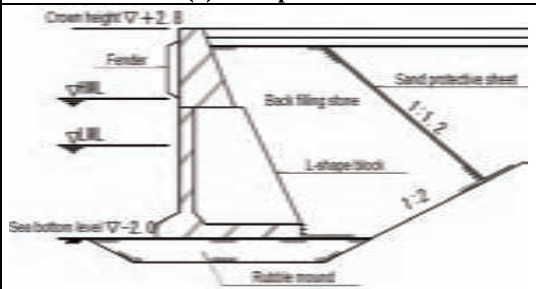
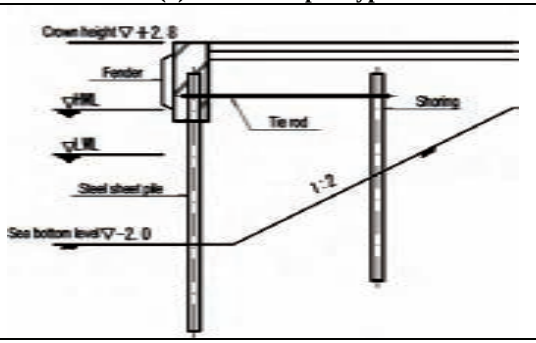
2-2-2-2-2 **Structure Plan**

A comparative analysis for the dock structures is given in Table 2-13.

Taking into account the following local conditions, we have decided that a steel sheet pile structure would be the most appropriate for the dock.

- securing a yard for the manufacture and storage of concrete blocks will be difficult
- the heavy machinery necessary for building with L-shaped concrete block can be hardly procured locally
- a concrete block structure will require underwater construction (trenching, leveling, mounding and so on for structural foundations), which will need installing a pollution control barrier, however, the water area in front of the site is currently in use, and installing such a pollution barrier without hindering transportation in the water area is difficult.
- there are concerns about the pollutions by underwater construction, which might effect on the coral communities living in the front water area.

Table 2-13 Comparative analysis for dock and sea wall structural form

Point under consideration	Gravity type		Steel sheet pile type
	(1) Concrete block type	**(2) L-shaped block**	**(1) Steel sheet pile type**
Scale section drawing			
Characteristics	Structure established on suitable ground for blocks made of concrete. Uses on a good ground.	Structure established on suitable ground for blocks made of concrete. Uses on a good ground	Structure fronted with steel sheet pile with shoring at the rear. Common in reclaimed land sea walls
Ease of use in landing	No specific problems	No specific problems	No specific problems
Geological requirements	Suitable for hard sand gravel bed. Suitable for ground in this plan.	Suitable for hard sand gravel bed. Suitable for ground in this plan.	Can also be used on sand beds and soft ground. Suitable for ground in this plan.
Safety level	No specific problems	No specific problems	No specific problems
Water depth/ topographic requirements	Not suitable for deep water	Not suitable for deep water	More suitable to a degree with respect to water depth
Durability	No specific problems	No specific problems	Slight problems with corrosion
Ease of construction	Investigation confirming safety are necessary. Can work on shore. Underwater construction is necessary. Concrete block manufacturing yard is necessary.	Investigation confirming safety are necessary. Can work on shore. Underwater construction is necessary. Concrete block manufacturing yard is necessary.	Simple structure which is easy to construct. Can work on shore.
Procurement of construction machineries	Heavy machinery required to install concrete blocks. Difficult to procure such machinery locally.	Heavy machinery required to install concrete blocks, which will be difficult to procure locally.	Crane and vibrator hammer required for installation of steel piles. Vibrator hammer must be procured from Japan.
Economic efficiency	Can be built using local materials. A lot of concrete work. Heavy machinery must be imported. Construction cost: 1.2	Can be built using local materials. A lot of concrete work. Heavy machinery must be imported. Construction cost: 1.2	Steel piles etc. must be imported. Construction cost: 1.0
Problems with	Block manufacture/storage yard difficult to secure.	Block manufacture/storage yard difficult to secure.	Noise and vibrations during piling.

Point under consideration	Gravity type		Steel sheet pile type
	(1) Concrete block type	**(2) L-shaped block**	**(1) Steel sheet pile type**
construction in this locality	Pollution control barrier necessary during underwater construction, and fact that front water area is in use, make it a difficult option.	Pollution control barrier necessary during underwater construction, and fact that front water area is in use, make it a difficult option.	
Environmental effects.	Large effect of seawater pollution on coral communities	Large effect of seawater pollution on coral communities .	Little seawater pollution. Noise and vibrations during piling.
Overall rating	**Medium** (But could be used for foundation of north side sea wall)	**Medium** (But could be used for foundation of north side sea wall)	**High**

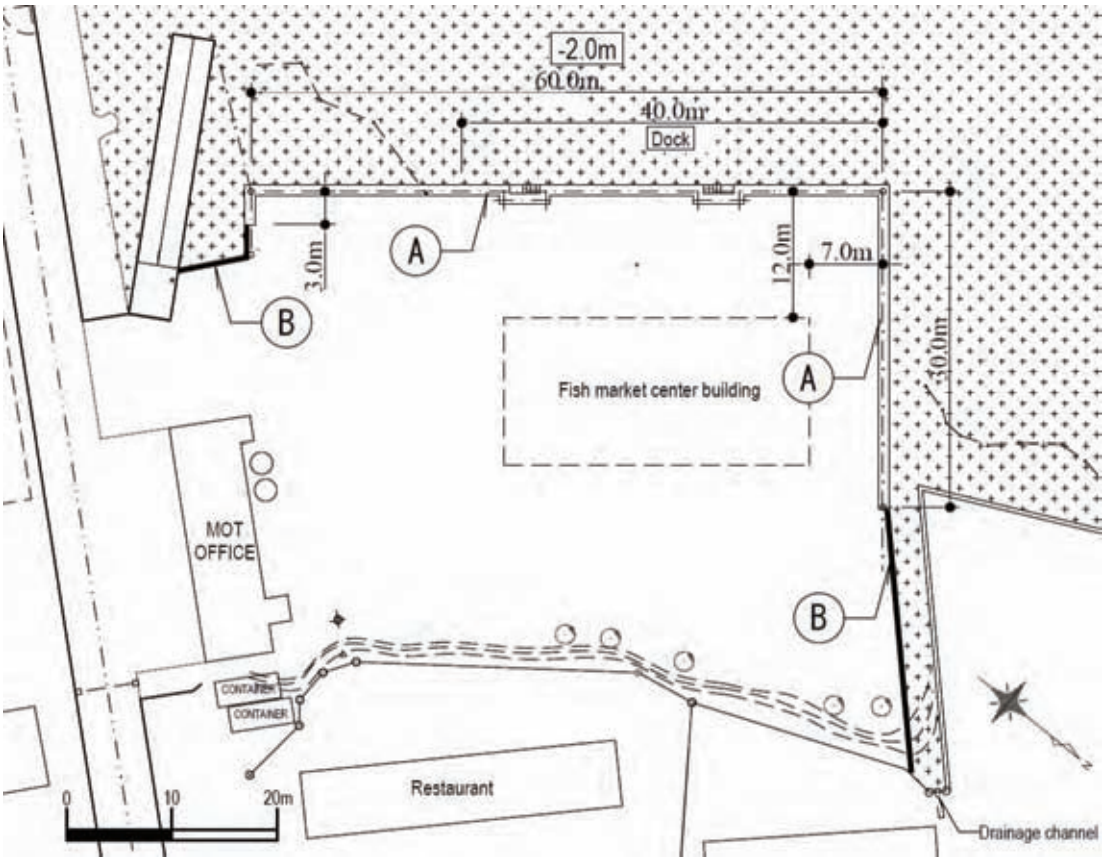
2-2-2-2-3 **Dock and Sea Wall Layout Plan**

The structural form of the dock and sea wall on the planned site perimeter, are as follows.

(i) We will use a steel sheet pile structure for the west sea wall (60m), which includes the dock (length 40m), providing enough stability for the planned water depth of 2.0m necessary for boat landing.

(ii) For the north side of the site, we will use a steel sheet pile structure to ensure a high degree of stability for the 30m length in deep water, starting from the point where the drainage channel outlet is located. For the landward part, which is at a ground elevation of DL +0.50m or more, we will use an economical cast-in-place concrete structure.

(iii) For the south sea wall, where the existing ramp is located, we will use a steel sheet pile structure of approximately 3.0m where it meets the west sea wall (at the corner section), and from there, in the landward side area with a ground elevation of DL +0.50m or more, we will use a cast-in-place concrete structure.



Legend: A = steel sheet pile structure, B = cast-in-place concrete structure

Fig. 2-5 Dock and sea wall structure plan

2-2-2-2-4 **Dock Specifications**

(1) Standards conformity

Design of the dock will be based on the following standards.

- ”Fish Port and Fisheries Facilities Planning Manual” (2003) National Fisheries Association, Japan
- ”Technical Standards and Commentaries for Port and Harbour Facilities in Japan” (1999 and 1989 editions), Japan Port and Harbour Association

(2) Plan and usage specifications

1) Plan specifications

i) Plan water depth D.L. -2.00m (dock)

ii) Design water depth D.L. -3.00m (dock)

iii) Plan crown height

Dock: D.L.+2.80m

Sea wall: D.L.+3.00m

iv) Dock length 40.0m

v) Apron width 10.0m

2) Usage specifications

i) Intended boat

Table 2-14 Boat intended for use in dock

Kind of vessel	Length (m)	Breadth (m)	Draft (m)	Gross tonnage (GT)
Fish Collection Boat	16.11	3.66	1.0	10

In addition, in line with the Fish Port and Fisheries Facilities Planning Manual, we will use a displacement tonnage (DT) of three times the gross tonnage, that is, 30 DT.

ii) Mooring speed

Mooring speed will be in line with Fish Port and Fisheries Facilities Planning Manual, that is, 50cm/s (at a gross tonnage of less than 20 tons)

3) Life of structures and corrosion measures

i) Life 50 years

ii) Corrosion measures

A coating will be applied and steel sheet pile thickness will be increased.

iii) Coating

Anti-corrosive coating will be applied to the front of steel sheet piles, from the bottom of the superstructure to 1.0m below the sea floor.

We will use corrosion allowance for the back surface.

iv) Corrosion rate

We will use the following general ratings given in the Fish Port and Fisheries Facilities Planning Manual.

Table 2-15 Standard corrosion ratings for steel materials

Corrosive environment		Corrosion rating (mm/year)	Corrosion amount (mm)
Seaward side	Above H.W.L	0.3	15.0
	H.W.L to L.W.L.-1m	0.2	10.0
	L.W.L.-1m to water depth of 20m	0.15	7.50
	In sea floor mud	0.03	1.50
Landward side	In air	0.1	5.0
	In ground (above residual water level)	0.03	1.5
	In ground (below residual water level)	0.02	1.0

(3) Natural Conditions

1) Tidal level

i) Mean Higher High water Spring H.W.L. D.L. +1.95m

ii) Mean Water Level M.W.L. D.L. +1.07m

iii) Mean Lower Low water Spring L.W.L. D.L. +0.00m

2) Current sea floor height

i) Dock area D.L. -1.70m to D.L.-3.00m

ii) Sea wall area D.L. +0.50m to D.L.+3.00m

3) Soil conditions

We have conducted a soil test by boring at two points at the existing dock base sea wall (BH-J1) and the dock breakwater (BH-J2).

The results of the ground test will be used as the soil conditions in the plan and are shown in Table 2-16 and

Table 2-17.

Table 2-16 Soil conditions for plan (dock area)

Ground height	Soil conditions	Average N value	Unit weight (kN/m^3)	Angle of internal friction (degrees)	Cohesion C (kN/m^3)
D.L.-3.0	Sand	5	1.8	28	—
D.L-5.5	Sand	14	1.8	33	—
D.L-7.0	Sand	26	1.8	38	—

Table 2-17 Soil conditions for plan (sea wall area)

Ground height	Soil conditions	Average N value	Unit weight (kN/m^3)	Angle of internal friction (degrees)	Cohesion C (kN/m^3)
Ground level	Sand	19	1.8	35	—

4) Design seismic coefficient

Seismic activity has never been recorded in RMI and so we will not consider seismic force in this design.

(4) Main Materials Specifications

1) Steel materials

Material	Allowable stress (N/mm^2)
Steel sheet pile (SY295 equivalent)	180
Tie rod (high tensile steel 690) (ordinary steel SS400)	176 (high tensile steel 690) 94 (ordinary steel SS400, 40mm or less)
Reinforcements (SD295A, SD345 equivalent)	179(SD295A)、196(SD345)

2) Concrete

Material	Allowable stress
Reinforced concrete σck=24	24 N/mm^2
Unreinforced concrete σck=18	18 N/mm^2

(5) Load Specifications

1) Concrete unit weight

i) Unreinforced concrete γc＝22.6kN/m3

ii) Reinforced concrete γc＝24.0kN/m^3

2) Vertical load

We will use a vertical load of 10 kN/m^2 for the landing dock, as given in the the Fish Port and Fisheries Facilities Planning Manual.

In addition, we will use vehicle load T-25 for moving load.

3) Boat tractive effort

As the boats to be used are 10 GT, we will use a tractive effort of 30kN based on fishing port technical standards.

2-2-2-2-5 **Dock Basic Design**

(1) Design Typical Cross-section

A standard cross-section for the dock is given in Fig. 2-6.

(2) Calculation Results

1) Fender design

Berthing energy

E'＝W･V2/(4g)＝157.8×0.502/(4×9.8)＝1.01 kJ

Table 2-18 Fender specification and absorbed energy and counterforce (assuming a contact length of 50cm when berthing)

Fender type	Height (m)	Length (m)	E_R(kJ)	R (kN)	
V-100H	0.100	0.50	1.10	40	＞E'
V-150H	0.150	0.50	2.48	61	
V-200H	0.200	0.50	4.41	81	
V-250H	0.250	0.50	6.89	101	
V-300H	0.300	0.50	9.92	121	
V-350H	0.350	0.50	13.51	141	

Total length of fender will be 2.0m in consideration of tide level and boat shape.

From the above, we will use V-100H×2000L for fenders.

2) Dock design

Table 2-19 Dock design specifications and results overview

Point under consideration		Set value & calculated value
1. Design specifications		
(i) Design ground height		D.L. +2.80 m
(ii) Superstructure crown height		D.L. +2.80 m
(iii) Steel sheet pile crown height		D.L. +1.50 m
(iv) Tie attachment height		D.L. +1.20 m
(v) Design sea floor height		D.L. -3.00 m
(vi) Design tide level	H.W.L	D.L. +1.95 m
	L.W.L.	D.L. +0.00 m
(vii) Residual water level	R.W.L.	D.L. +1.30 m
(viii) Vertical load		10 kN/m^2
(ix) Corrosion allowance (one side)	in ground above residual water level	0.03mm/year × 50years ＝ 1.50mm
	in ground below residual water level	0.02mm/year × 50years ＝ 1.00mm
2. Calculation results		
(i) Anterior steel sheet pile: steel sheet pile SP-ⅢA(SY-295)		stress intensity 46.2≦180 N/mm^2 OK
		Embedment depth －6.50m Embedment safety factor F＝1.74≧1.50 OK
(ii) Tie rod：φ36mm High tensile steel 690		stress intensity 129.5≦176.0 N/mm^2 OK
		required length 5.66m≦length to use 6.0m
(iii) waling： SS400 2[150×75×6.5×10		stress intensity 115.7≦140.0 N/mm^2 OK
(iv) Shoring：steel sheet pile SP-Ⅱ(SY-295)		stress intensity 44.3≦180 N/mm^2 OK
		Required embedment －3.69m ≦Embedment to use －4.00m
		distance from the front sheet pile 6.0m≧5.66m

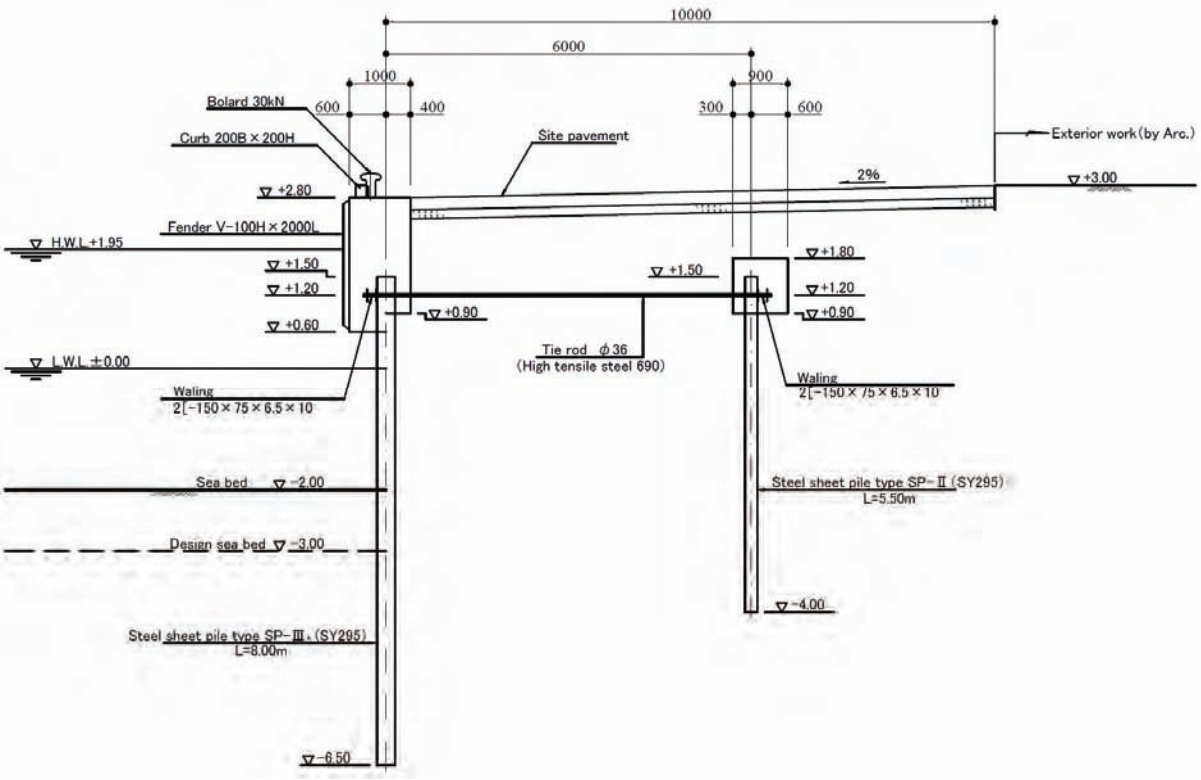


Fig. 2-6 Dock typical cross-section

2-2-2-2-6 **Ancillary Facilities**

The following ancillary facilities will be necessary for the dock.

1) Bolard

A suitable bolard size and number for the intended boats will be used based on standards in “Technical Standards and Commentaries for Port and Harbour Facilities in Japan” (edited by the Ports and Harbours Bureau, the Ministry of Land, Infrastructure, Transport and Tourism).

2) Fenders

A suitable fender size and number for the intended boats will be used based on the above standards.

3) Curbs

Since cars will be able to drive on the dock, we will install curbs at the edges to prevent them from falling off.

4) Derrick crane

We will install a 500kg derrick crane for loading to and offloading from fish collection boats.

2-2-2-3 Basic Plan of Building Facilities

2-2-2-3-1 Fish Market Center Building Plan Policy

Basic policy for the building facility plan is described in 2-1-3, but we would like to make sure that the plan does not overlap with the function of the Delap facility.

Furthermore, we have referred to the market plan proposed by MIMRA during the field study, concerning each room, arrangement and process flow shown in Fig. 2-7 to establish layout, facility structure, specifications and so on.

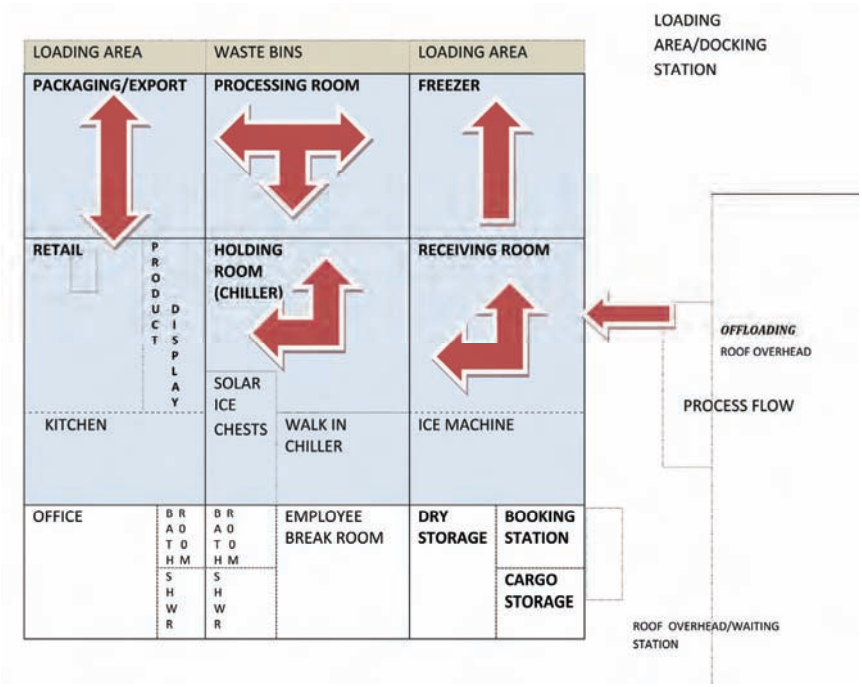


Fig. 2-7 Market arrangement plan made by MIMRA

Source: MIMRA materials

The fish market is a facility for the wholesale and retail sale of fresh fish, in which they are sorted into categories after being landed from fish collection boats. A supply of ice will be necessary for the sorting, storage and retail sale of the fish. The boats which collect the fish from the Outer Islands may arrive at the weekend, and a number of days are required from landing to sale, so we will also need facilities for temporary storage of the fish.

In addition, various rooms will be necessary for the staff to manage operations, sort and weigh the fish, record the cash book and so on, as well as a staff room, changing rooms, storage and other rooms. The flow of fish and arrangement of the planned fish market center facilities are shown in Fig. 2-8.

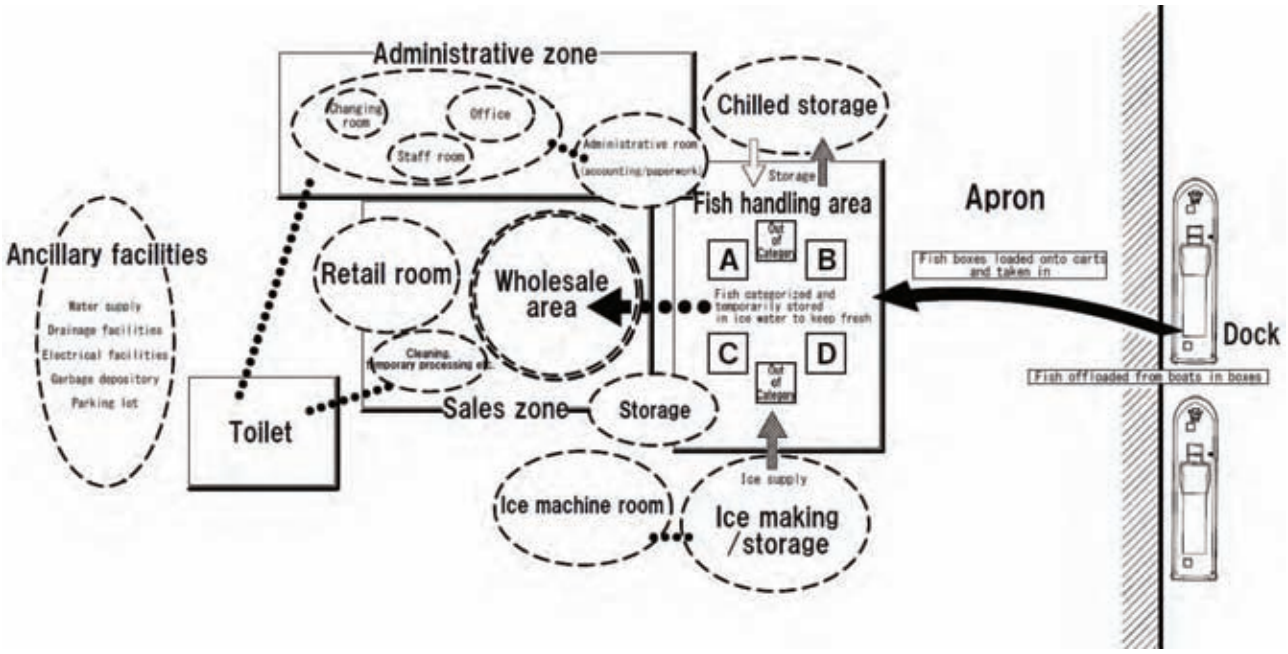


Fig. 2-8 Planned fish market center facility arrangement

Table 2-20 below shows the rooms necessary for the functioning of the fish market described above.

Table 2-20 Planned rooms for market facility

Room/facility for plan	Details
<Market building>	
Fish handling /sales area	Fish is sorted into 6 categories here, after being landed from fish collection boats, and kept in insulated tanks. The area is also used for wholesale sales.
Preparation room	Primary treatment of fish and cutting of large frozen fish.
Retail room	Retail sale of fish to the general public.
Storage	Storage for parts and materials.
Electrical switchboard/Ice making machine room	Area containing the electrical switchboard, solar power system control board, ice making machine etc., as well as spare parts for the ice making machine, tools etc.
Market manager's office	Room for market manager's work, customer services, and for a safe of cash.
Office	For general market administration, documentation etc. Will also include enough space for staff meetings and discussions.
Cashier's office	For recording cashbooks and accounts for wholesale and retail sales.
Staff room	Common room for market staff.
Changing room	Changing rooms for market male & female staff, showers are equipped in Male's.
Ice making machine/ice storage	For supply of ice for fresh fish.
Chilled storage	Chilled storage for shellfish and cephalopods.

Room/facility for plan	Details
<Ancillary facilities>	
Toilet	Toilet for staff and customer use.
Water catchment tank	Water catchment tank for rainwater.
Elevated water tank/pump room	For supply of city water and rainwater.
Garbage depository	Storage area for market waste , separated into general and garbage etc.

The following sections examine the size and surface area of the various rooms and facilities in the plan.

2-2-2-3-2 **Scale of Facilities/Rooms and Floor Plan**

1) Fish Market Center Building

i) Fish handling/sales area

With a view to efficiency, hygiene, and preserving freshness, the current system of sorting the catch on fish collection boats should be revised, and the fish handling should be conducted indoors in the plan.

Fresh fish delivered to the fish handling area would be sorted into the following six categories

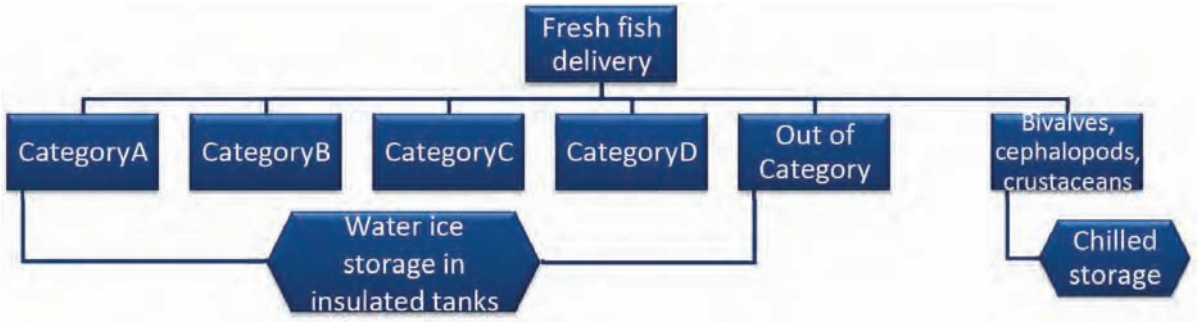


Fig. 2-9 Classification of fresh fish

Fresh fish should be sorted by categories A–D or an "out of category" and weighed, then stored in ice water in an insulated tank. bivalves, cephalopods, and crustaceans, for which ice water treatment is not appropriate, should be packed in a fish box-tray after weighing and kept in chilled storage. Fish landed at weekend should be stored this way for two days (Saturday and Sunday), while fish landed on weekdays should be sold on the same day.

For bulk purchasers, sales directly from insulated tanks are more efficiently, and it is proper in this case to use the fish handling area as the sales area.

There is neither rule nor regulation to determine the size of fish handling and sales areas in RMI. In Japan, the Ministry of Agriculture, Forestry and Fisheries publishes guidelines and calculation formulas for determining of surface areas for fish handling and sales areas, but these guidelines and calculation formulas do not fit in with the local fish handling methods, local bulk sales system, and

handling volumes that we have studied during the field survey. Therefore, the scale plan should be established taking into account such factors as the line of flow for workers and buyers, and equipment size and layout.

<Scale requirements>

- Daily volumes in the handling area should be 2.2 tons as in Item 4 of Section 2-2-2-1 (1).
- Judging by current working conditions, landing work requires 3 men[1] to transport the catch from the boat to the handling area and 4 men[2] to sort and weigh the fish inside the facilities.
- A total of 10 insulated tanks must be laid out as handling equipment, comprising 2,550-liter insulated tanks each for fresh fish categories A–D (about 850 cm wide x 1,400 cm long x 750 cm high) and 1,550-liter tank each for out-of-category fresh fish and shellfish.
- Fish carrying boxes (24 l: about 450 cm wide x 600 cm long x 300 cm high) are transported from the dock by carts, and the volume of one transport load should be 12 boxes (stacked 4 boxes in 3 columns) based on the size of the cart platform (about 850 cm x 1,400 cm). The unloaded boxes should be lined up in the center of the handling area, where the fish will be sorted and weighed.
- The maximum number of bulk buyers is 16[3]. On weekdays, the buyers will gather around the perimeter of the work area to determine their purchase items and to weigh them.

*1: No. of boat crews, *2: number of fish market staffs

*3: Maximum number of customers per day (80) x share of bulk purchasers (20%)

Based on these requirements, the scale of the floor area for the fish handling/sales area should be follow Fig. 2-10 below.

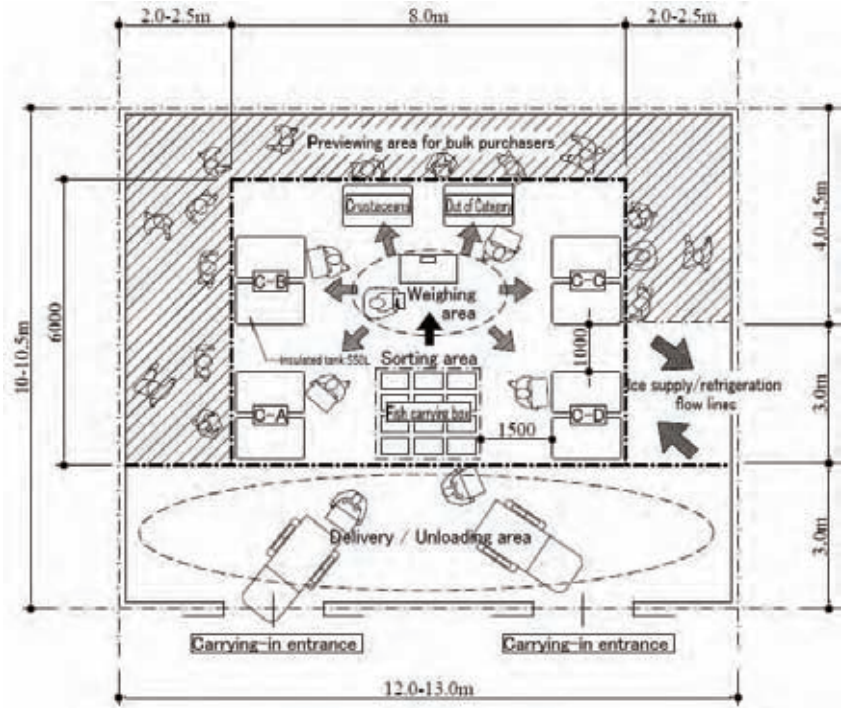


Fig. 2-10 Floor plan of fish handling/sales area

According to the table of "Building area per occupant" from the *Building Design and Materials* series (edited by the Architectural Institute of Japan), the required floor area per person is 7-12 m^2 in a workplace or factory and 2-3 m^2 at retail premises.

The 8.0 m x 6.0 m sorting area, including the weighing area, yields an effective floor space of roughly 30 m^2 after excluding the equipment. Assuming 4 staff, the work area comes to approximately 7.5 m^2 per person—a valid value according to the standards.

Also, the area for bulk purchasers to preview and select their items for purchase is 35–47 m^2. At a projected count of 16 bulk purchasers, this floor area comes to 2.1–2.9 m^2 per person, which is in the valid range for retail premises.

On top of that, accounting for a 3.0-m wide unloading area for the carts and space for ice supply/refrigeration flow lines brings the required scale of the fish handling/sales area to 120–136.5 m^2.

However, if the incoming load comes to less than half of its maximum value, the plan calls for devices like vinyl curtains to be used as partitions for the purpose of reducing expenses for air conditioning. Also, insulated tank specifications that include castors would be appropriate in consideration of their mobility.

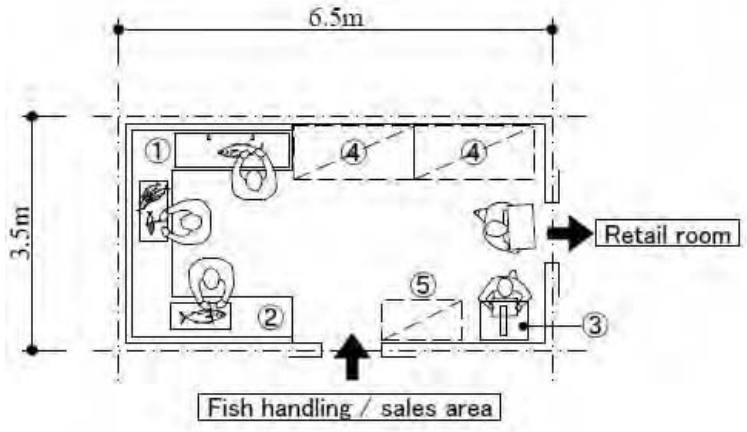
ii) Preparation room

The preparation room is used for removal of gills and intestines, slicing and other treatment requested by customers. Here, large frozen fish are cut into pieces with a band saw as well.

The plans for the preparation room should provide for fish cleaning with the required sink and a worktable (length: 60 cm) where two staff can work. Space should also be included for a cutting table (120 cm x 60 cm) with a band saw on the side and chest freezers (180 cm x 80 cm: space only).

The layout and location of the preparation room allows for access to the retail room and from the fish handling and sales area. Also, the floor needs to be able to have water washing after the fish have been gutted.

Based on the considerations above, the preparation room should have a floor area of 22.8 m^2 due to the layout of the work line and equipment, as shown in Fig. 2-11.



(1) Sink

(2) Workbench

(3) Band saw

(4) Chest freezers

(5) Worktable (portable)

*Dotted lines indicate install location for equipment prepared by MIMRA

Fig. 2-11 Floor plan of preparation room

iii) Retail room

Plans also include a retail room for small-lot purchases. It should be set up in a location that provides for easy access from the outside for retail customers and be kept separate from the other market facilities. In other words, it is vital that the layout and location provide for access by retail consumers without having to pass through other areas.

<Scale requirements>

- The retail room should handle an average volume of 114 kg/day.
- The maximum number of customers visiting the retail room is 64 people[1] per day. After the market goes into operation, we believe the number of customer may grow, but this additional growth is not accounted for in these plans.
- We believe customer visits to the purchasing area will be concentrated around noontime and in the evening. The purchasing area should be large enough to handle the case where 10–20% of daily visitors (6–12 people) are present at the same time.[2]

*1: Maximum number of customers per day (80) x share of retail customers (80%) = 64 people

*2: Maximum retail customers per day (64) x 10–20% = 6–12 people

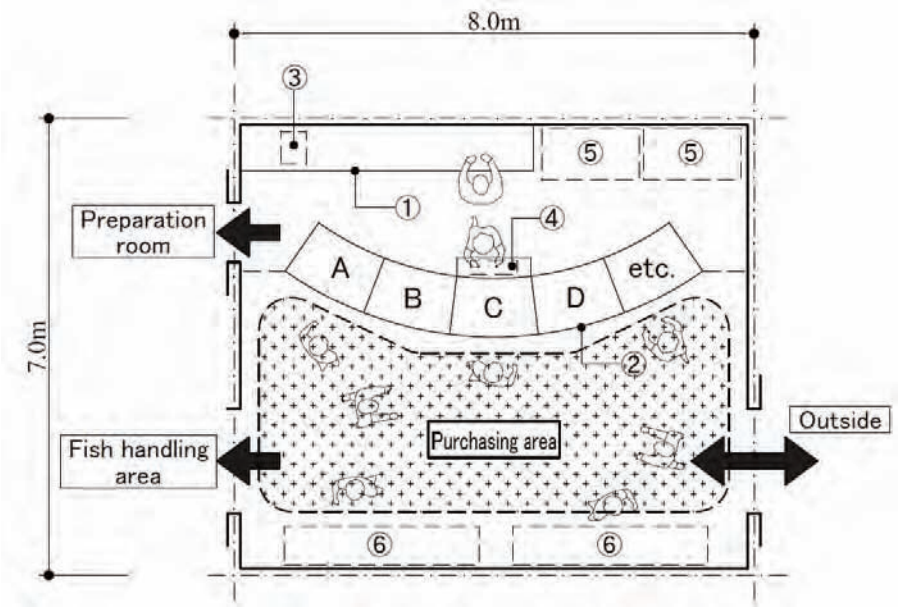
One of the methods of displaying fish is to arrange them on top of a bed of ice and spread crushed ice on top. Though it depends on the size of the fish, this type of display allows for about 20 kg/m^2 of fish to be displayed at the local supermarkets and other stores. Thus, in order to handle 114 kg of fish per day, the fish display stand must be 6 m^2 (114 kg / 20 kg/m^2 = 5.7 m^2). MIMRA expressed a desire to have a display for each category of fish.

The sales stand (depth of 90 cm) is a fixed stand that allows washing with water to preserve freshness and is made from a material that is easy to clean, such as tile or stainless steel.

Using 2–3 m^2 per person as the formula for calculating store floor space, the shopping area size should be 12–36 m^2 in order to accommodate 6 to 12 people. In this plan, average size of 24 m^2 is adopted.

The floor space layout will allow for a sales stand on which the fresh fish to be viewed from the shopping area, and a shelf on which displaying the processed products produced by MIMRA.

Based on the above, and considering the work space, customer traffic patterns, and product placement, the retail sales floor shall be 56.0 m^2 as shown in Fig. 2-12.



(1) Sales counter
(2) Fresh-fish sales stand
(3) Register
(4) Scale
(5) Product storage (chilled storage etc.)
(6) Processed foods shelf space

Shopping area: about 24 m^2

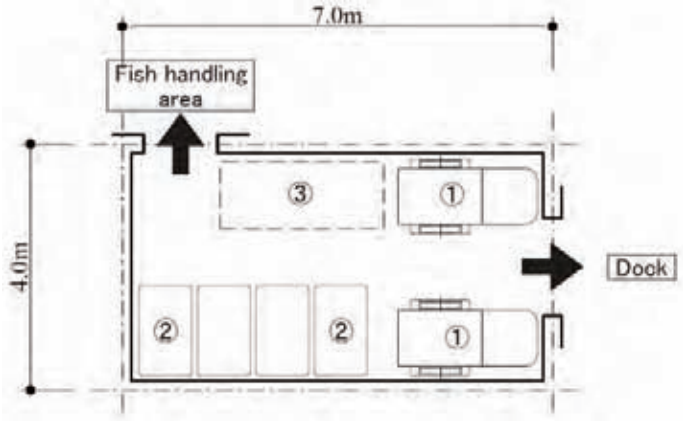
* Dotted line delineates the space for furnishings to be supplied by MIMRA.

Fig. 2-12 Retail room floor plan

iv) Storage

The plan includes storage for all the materials and equipment used at the market. Primarily, this material and equipment consists of a hand cart (length 210 cm, width 120 cm), insulated tank (about 850 x 1,400 x 750 cm), fish-carrying boxes, and cleaning equipment. This material and equipment will be used both outside and in the fish-handling area, and thus this space will have a door allowing access from both areas.

To accommodate the storage of these materials and the traffic flow into and out of the space, the storage space shall be 28.0 m^2 as shown in Fig. 2-13.



(1) Cart storage space
(2) Insulated tank
(3) Cleaning equipment space

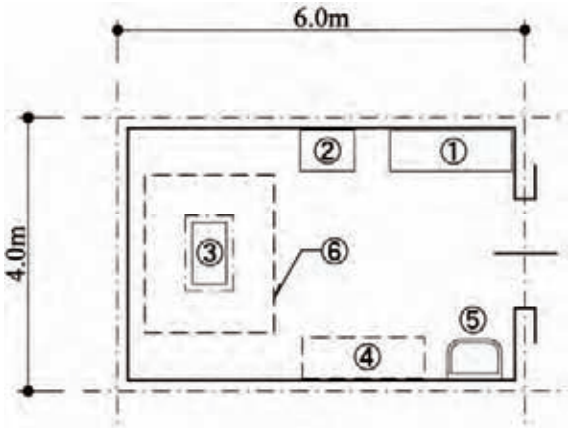
Fig. 2-13 Storage floor plan

v) Electric room & ice-making machine room

The plan includes a machine room that serves as an electric room cum ice-making machine room that contains the power distribution panels and solar power system control panels as well as ice-making

equipment. The machine room will contain the electric power distribution panel and ice-maker operation panel as well as the spare parts and maintenance tools for the ice-making machine. The plan includes sufficient space around the ice making machinery (minimum of 60 cm on all sides) for maintenance activities.

Taking these requirements into consideration, the Electric room & Ice-making Machine room shall be 24.0 m^2 as shown in Fig. 2-14.



(1) Electric power distribution panel

(2) Ice maker operation panel

(3) Ice maker compressor

(4) Spare parts and tool storage space

(5) Sink

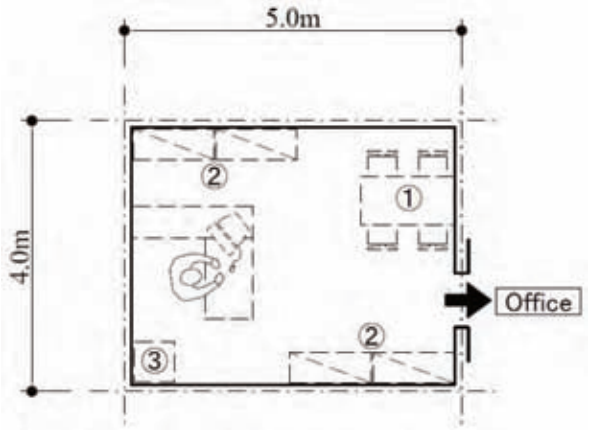
(6) Maintenance space

Fig. 2-14 Electric room & ice making machine room floor plan

vi) Market manager's room

The market manager's room is used to conduct the business of and receive guests for the market manager and should accommodate 1 market manager and 2 to 3 guests. This includes a desk, bookshelf, and guest-receiving area. The space will be designed to allow easy access to the office for efficient management.

To accommodate the furniture and traffic flow, the market manager's room shall be 20.0 m^2 as shown in Fig. 2-15.



(1) Guest reception space

(2) Bookshelf

(3) Safe

*Dotted line delineates the space for furnishings prepared by MIMRA.

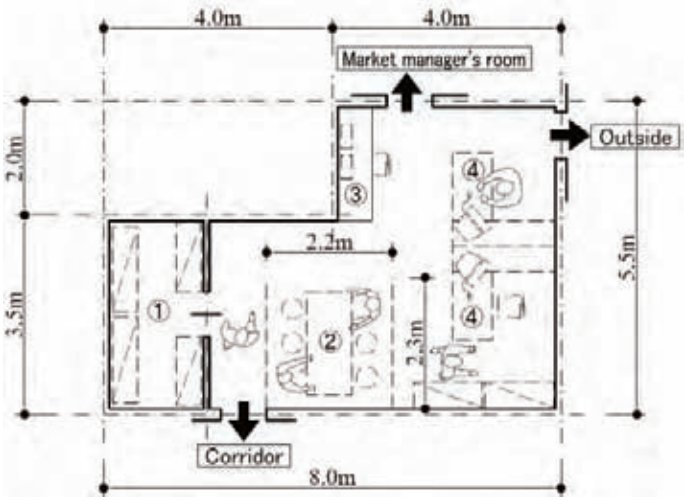
Fig. 2-15 Market manager's room

vii) Office

The plan includes an office that accommodates 2 office personnel. Since the site is far from the MIMRA Head Quarter office, the office will include a meeting space where the staff can have meetings (about 5 m^2). The office will also contain a book storage space for work logs and records

(about 6 m^2) and a counter for the SSB/VHF radiotelephones (about 180 x 60 cm).

To accommodate the furniture and traffic flow, the office will be 36.0 m^2 as shown in Fig. 2-16.



(1) Book storage

(2) Staff meeting space

(3) Radio telephones

(4) Staff desks and chairs

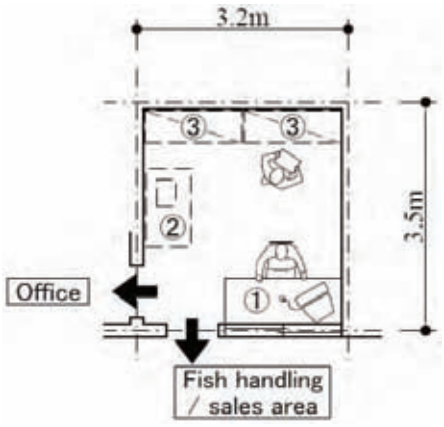
* Dotted line delineates the space for furniture to be prepared by MIMRA.

Fig. 2-16 Office floor space

viii) Cashier's room

The plan includes a cashier's room that accommodates 2 people. Catch records will be stored, receipts issued, and cash accounted for in the cashier's room. The cashier's room will be located next to the fish handling/sales area, and will provide easy access to the office. There will also be a window from which the fish handling/sales area can be observed. A counter (about 180 x 70 cm) will be installed facing the window, and there will be space for a cash register table (120 x 70 cm) for collecting cash, and a bookshelf (about 150 x 50 cm).

Considering the furniture and traffic flow, the cashier's room shall be 11.20 m^2 as shown in Fig. 2-17.



(1) Counter

(2) Register table

(3) Bookshelf

* Dotted line delineates the space for furniture to be prepared by MIMRA.

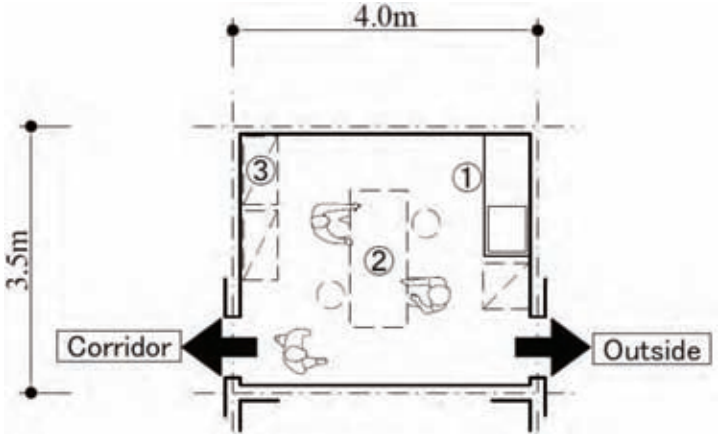
Fig. 2-17 Cashier's room floor plan

ix) Staff room

The plan includes a staff room to accommodate the 1 market staff and 1 mechanic. The staff room can also be used as a temporary waiting area for the fish collection boat crew (3). Thus, this room should have a maximum capacity of 5 people. There will also be a sink (about 160 x 60 cm) in the

room. A table and chairs (about 180 x 70) will be set up in this space as well as a bookshelf (about 120 x 50 cm) for storing manuals and other materials.

To accommodate the furniture and traffic flow, the staff room shall be 14.0 m^2 as shown in Fig. 2-18.



(1) Sink

(2) Chairs and table

(3) Bookshelf

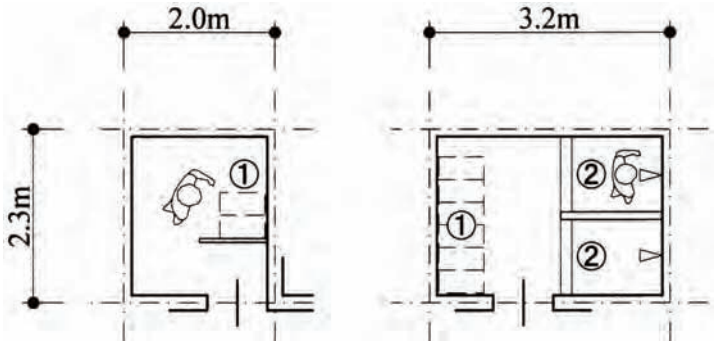
* Dotted line delineates the space for furniture to be prepared by MIMRA.

Fig. 2-18 Staff room floor plan

x) Changing rooms

Changing rooms for respective male and female staff are planned. The male changing room will accommodate a maximum of 8 people, with shower booths attached (each booth measuring approximately 130cm x 90cm) for the employees to use after work. The female changing room is planned to accommodate a maximum of 2 staff.

Considering the space required to install the lockers, the shower booths and space for people to move around in, the floor area is to be 7.36m^2 for the male changing room and 4.60m^2 for the female changing room, as shown in Fig. 2-19.



Changing room (female) Changing room (male)

(1) Locker

(2) Shower booth

* Dotted line delineates the space for furniture to be prepared by MIMRA.

Fig. 2-19 Floor plan for changing rooms

xi) Ice making machine and ice storage

The equipment to be provided are an ice-making capacity of one ton per day and an ice storage capacity of two tons.

The open type plate ice-making machine, will comprise an ice-making unit, a compressor and an

air-cooled condensing unit. The ice-making plates are housed in the ice-making machine which is installed on the ice storage. Since the machine generates vibrations, the machine space shall be planned at ground level and will be installed on a concrete slab. And as the condenser generates heat, it is planned to install it in an open area outside the building. The planned positioning of the machinery takes into consideration to avoid direct exposure to sea breezes.

In the case of plate ice, the ice storage capacity in cubic meters can generally be calculated as 2.5 times the weight of the ice in tons, or

2 tons x 2.5 times = 5.0 m^3

The dimensions of the ice storage bin that will accommodate 5.0m^3 of ice are as set out in Table 2-21 and Fig. 2-20 shows the dimensions based on Table 2-21 in plan view and cross section.

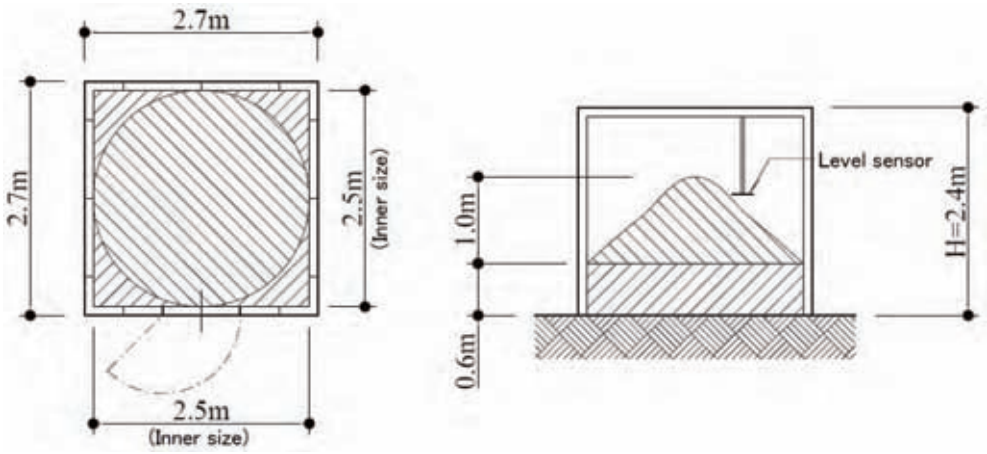


Fig. 2-20 Ice storage in plan view and cross section

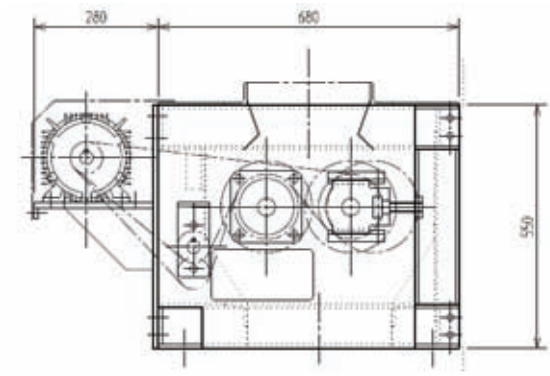
Table 2-21 Ice storage dimensions (volume and area)

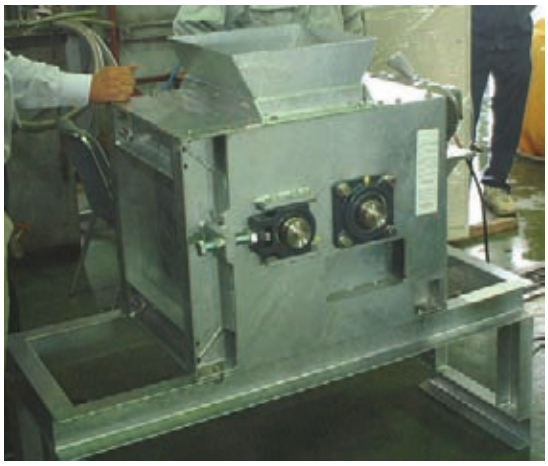
Space	Calculations of Required Area and Volume	Volume/Area
2 tons by weight of ice storage = 5m^3 by volume	Wall to wall storage capacity: 2.5m×2.5m×0.6m(H) Conical storage capacity: $1/3\times\pi\times(2.5/2)^2\times1.0$m(H)	3.75 m^3 1.63 m^3 Total:5.38 m^3
Ice storage bin dimensions	Required external dimensions: width 2.7m x length 2.7m x height 2.4m	Approx. 7.3 m^2

The ice storage is planned to be of prefabricated construction with excellent heat resistance properties, and to be easy to operate, maintain and use. As is the case with the existing MIMRA facility, it will have a compact unit cooler internally installed to reduce thawing during periods of hot weather. The panel thickness will be 100mm, which is a standard product size sold by a number of manufacturers.

A second stage ice crusher is to be installed for fish retail use. The ice crusher will break up the plate ice that is produced into a form close to flake ice (5mm or less), and will be installed in the retail room.

Fig. 2-21 illustrates the shape and form of the ice crusher.





Front elevation

Specifications: Twin drum type
Crushing capacity 1t/h
Electric motor （2.2kW×220V×60Hz）

Fig. 2-21 Diagram and photograph of second-stage ice crusher

xii) Chilled storage

Necessary temporary storage volume of bivalves, crustaceans, cephalopods in the chilled storage will be 538kg. To enable 538kg of product to be manually brought in and out of the chilled storage, it is planned that the seafood will be held in 20kg fish storage boxes, which will be stacked on shelves and on the floor near the chilled storage doorway. The details of the planned storage layout are as follows.

Dimensions of fish storage boxes: Approx. 550mm x 370mm x 200mm (height)
Number of fish storage boxes stored: 538kg ÷20kg = 26.9 ≒ 27 boxes
Stacked height: Up to 1.5 ~ 1.8m (based on workability)

Fig. 2-22 illustrates the floor area and volume space required for the chilled storage, based upon the above.

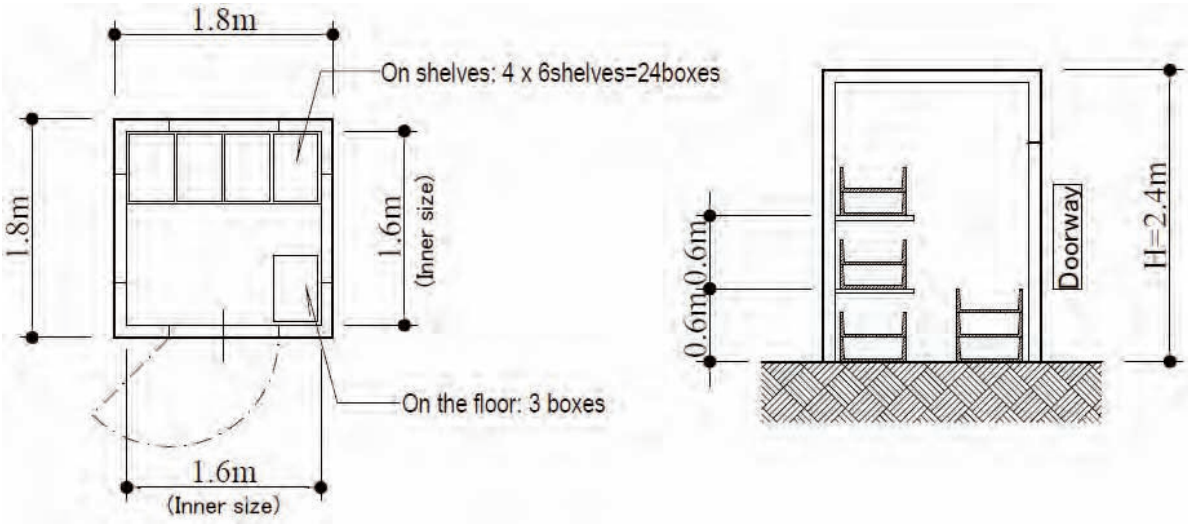


Fig. 2-22 Chilled storage in plan view and cross section

Like the ice storage, the chilled storage is planned to have excellent heat resistant properties, and to be made from prefabricated panels which are easy to install and maintain. It will be fitted with a drainage outlet to allow the interior to be washed out to remove fish debris and odors.

In considering the floor plan for the fish market center building based upon the details of the various rooms and equipment items discussed in 1) to 12) above, the following points are to be noted.

Floor Layout: Points to Note

- Separate working spaces are to be clearly allocated for landing fish and for administration and service to avoid congestion and confusion.
- All rooms will have windows opening to the outside, and no windowless rooms will be built, so as to minimize the use of electric lighting during daytime.
- The office areas are positioned away from noisy rooms such as the machine rooms.
- Pathways along which moving fresh fish and heavy ice are planned to be as short as possible.
- The floor plan keeps the offices and administrative areas concentrated together.

Fig. 2-23 shows the planned floor layout of the market based on a consideration of the above points.

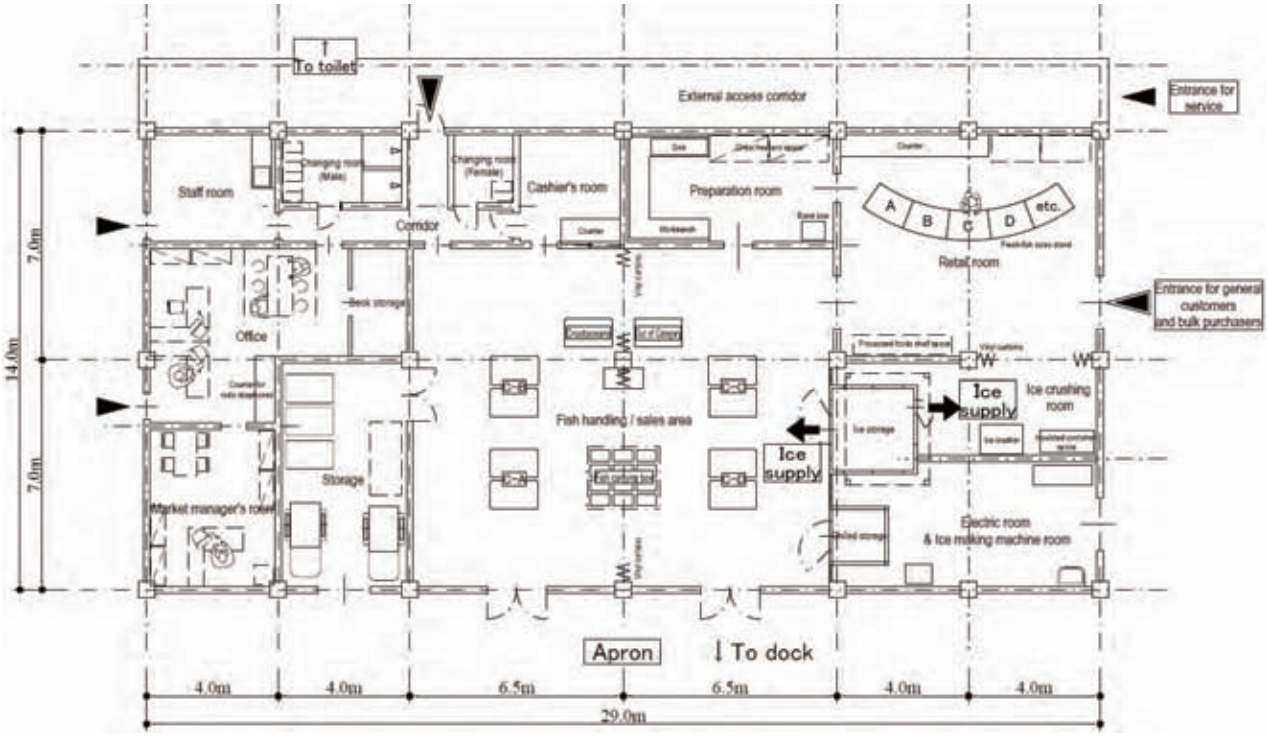


Fig. 2-23 Market center building floor plan

[Outcomes of the Floor Plan]

- The dock apron section shall avoid congestion from the passage of ordinary vehicle traffic, and

has been limited to the space required for landing fish. Access paths into the various administrative rooms have been clearly segregated by installing an external access corridor behind the market, which is parallel with the building.

- The retail room has been positioned closest to the parking lot and the entrance to the site, thus enhancing the convenience of general customers while maintaining the independence of the retail room from the various other rooms.
- A door has been installed in the back of the ice storage to send ice to the crusher for supplying second crushed ice to the retail room. This feature of the plans has made it unnecessary to store crushed ice and to make a detour ice movement, thus enhancing work efficiency.
- The pathways along which fresh fish moving have been simplified by placing the preparation room and fish handling/sales area directly adjacent to the retail room.

2) Ancillary Facilities

i) Toilets

Separate male and female toilets are planned for market staff and for visitors. These are planned to be in separate structures from the main fish market center building, and therefore are to be closed at night and lockable.

The users of the toilets will comprise the nine market staff plus approximately 80 visitors per day. The number of toilet fixtures to be installed will be as per the minimum standards for both men and women under the reckoning chart for required numbers of sanitary fixtures published in *Building Design and Materials* series by the Architectural Institute of Japan. Under this, the male toilet will have two toilet bowls, two urinals and a wash basin, and the female toilet will have two toilet bowls and a wash basin. The male and female areas are separated internally, and there will be two entrances to be locked up at night. The toilet equipment to be installed and the finishing will be of a style and construction that is durable and easily cleaned.

Since most customers will only be visiting the market for a short time, it is planned to enhance overall convenience by positioning the toilets where they are easily accessed by the market staff who will be main users.

As Fig. 2-24 shows, the floor area of the male toilet shall be 16.7m^2, the floor area if the female toilet shall be 9.1m^2, and the total area shall be 25.8m^2.

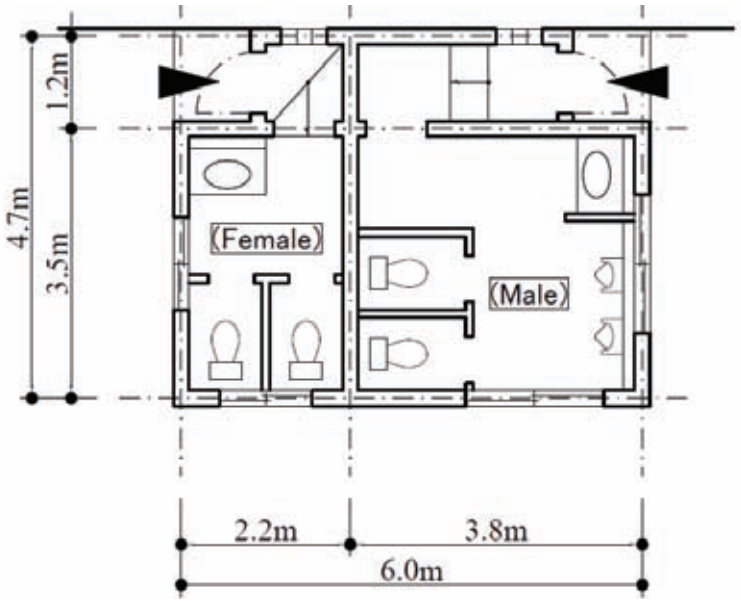


Fig. 2-24 Floor plan of the toilet building

ii) Water catchment tank

Since there are limitations on the supply of the city water, and in order to reduce operation cost, positive use will be made of rainwater, and a tank is planned to store rainwater collected from the roof of the facility. Since the tank will be positioned at ground level below the roof, it is necessary to place it where it will not interfere with other equipment or impede working access paths, and where it can collect rainwater efficiently. The size of the rainwater tank will be considered in the facility plan.

iii) Elevated water tank and pump room

Due to the lack of pressure in the city water and the inability to obtain adequate water pressure from the rainwater tank, an elevated water tank will be installed so as to provide a gravity-type water supply system. It is planned that the storage pump to deliver city water and rain water from receiving tanks to the elevated water tank will primarily operate during solar power is available.

It is planned that the effective installation height of the elevated water tank shall be maintained at 9.5m in order to attain the necessary water pressure.

◆Determination of the height of the elevated water tank

H : The height of the elevated
H1: Necessary water pressure minimum=7.0m
H2: Piping loss 20kPa×safety margin1.1=2.2m

H≧H1+H2
H≧9.2m
The elevated water tank will be maintained at 9.5m.

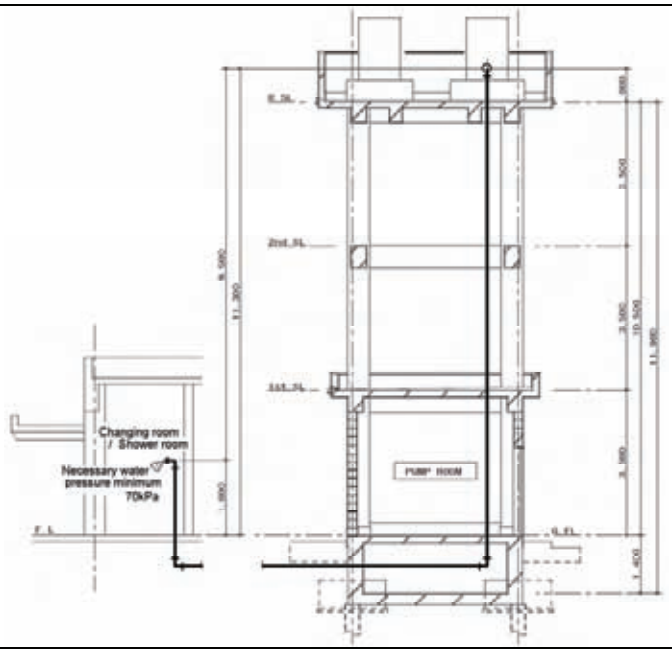


Fig. 2-25 Determination of the height of the elevated water tank

iv) Garbage depository

A garbage depository will be installed so that fish remains and general garbage can be collected, sorted and held until it is removed by a garbage collector.

It is planned that the garbage depository will have a roof and will be concealed on three sides by a block wall. It will be set up adjacent to a driveway within the premises to allow easy access for garbage collection vehicles.

v) Site pavement and parking lot

It is planned to install the minimum necessary area of site pavement. This will be laid around the buildings, on the connecting paths between the buildings, on the apron section of the dock, and in the parking lot.

The parking lot is planned to accommodate five staff vehicles, one commercial vehicle (compact truck), and five vehicles for bulk buyers who visit the market (30 percent of the expected daily maximum of 16 people). Although it is conceivable that the parking facilities will not be sufficient when there is a concentrated rush of visitors, it is planned that the paved apron section near the slipway side of the building will be used as a “buffer zone” for temporary parking.

2-2-2-3-3 **Layout Plan**

The layout for the facilities will be planned in line with the following policy.

- ◆ The layout plan will make the access between the dock and the fish handling area a priority, and allow a simple, straight line of flow from landing the fish to bringing it into the building.
- ◆ The apron directly behind the dock is the area which gets most congested during landing, and so we will ensure there is enough space.

- The most suitable place for the site entrance is between the MOT office and the existing slipway. Removing the existing bushes and relocating the antenna tower shall be done by the RMI authority in accordance with the Minutes of Discussions.
- We will keep paving to the necessary minimum, that is, the dock apron, around the building and the parking lot. Trees and other plants shall be planted by MIMRA around the site in unpaved areas to keep dust out.
- The parking lot will be as near to the entrance road as possible to ensure a minimum of car movement within the premises.
- The Garbage Depository will be positioned to enable easy vehicle access for collection.
- The planned facilities will be as far away as possible from the nearby restaurant in order not to spoil the view from it. To reduce the impact of the facilities on the adjacent land and surrounding area, trees and shrubs shall also be planted by MIMRA to act as a buffer zone between them.
- Since there are no options for expanding the site, the layout plan will be a straightforward one with respect to adding to the facilities in the future.

A layout of the facilities in line with the above policy is shown in Fig. 2-26.

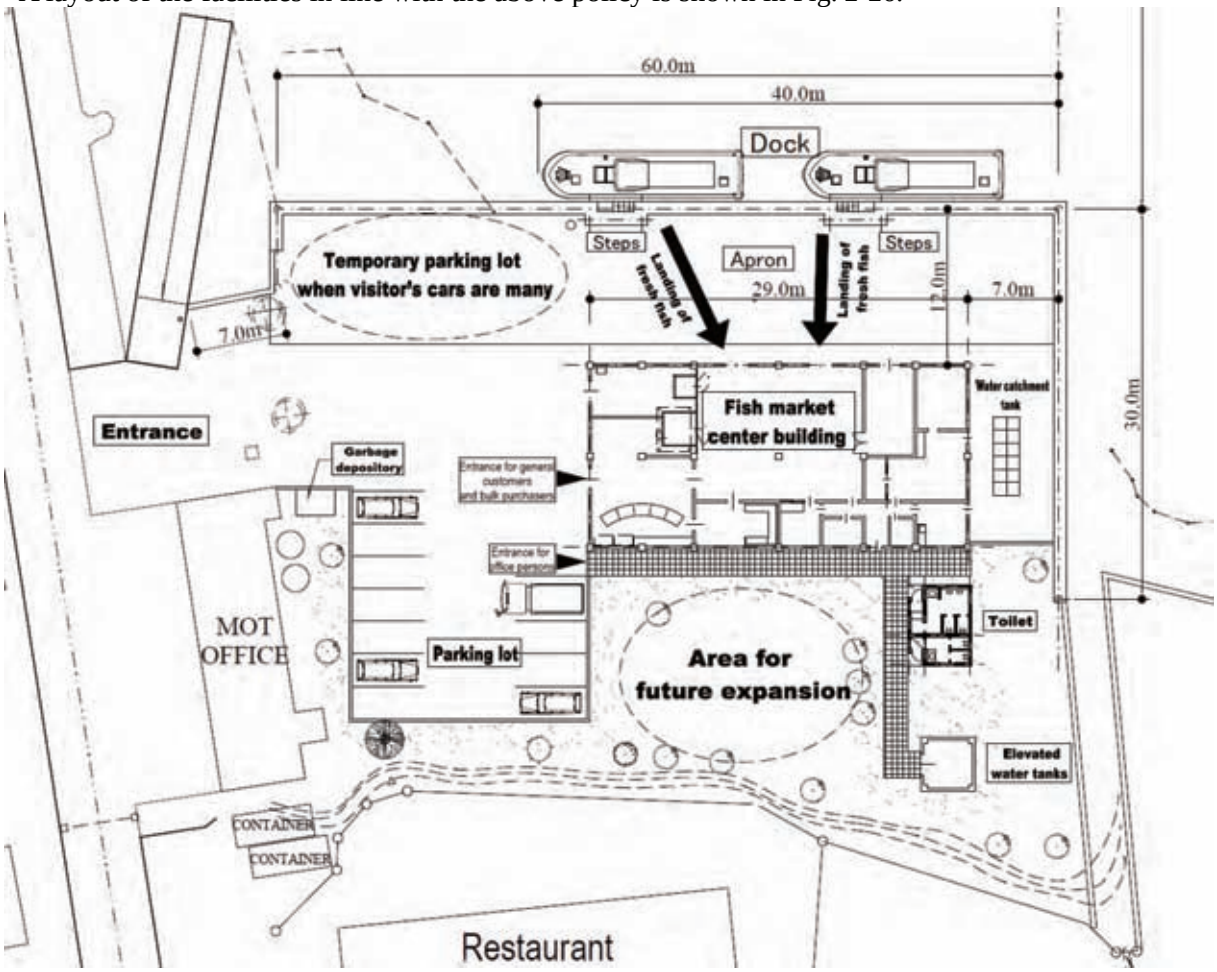


Fig. 2-26 Proposed layout plan for the facilities

Following the layout and floor plans above, surface areas for the facilities are shown in Table 2-22.

Table 2-22 Surface areas of buildings and facilities

	Facility/room etc.		Floor area (㎡)	No.	Total area (㎡)
A	Fish market center building				406.00
	Fish handling/sales area		136.50	1	136.50
	Retail room		56.00	1	56.00
	Preparation room		22.75	1	22.75
	Ice crushing room		12.00	1	12.00
	Electric room/Ice making machine room		32.00	1	32.00
	Storage		28.00	1	28.00
	Market manager's office		20.00	1	20.00
	Office		36.00	1	36.00
	Cashier's room		11.20	1	11. 20
	Staff room		14.00	1	14.00
	Changing room (male)		7.36	1	7.36
	Changing room (female)		4.60	1	4.60
	Other rooms/corridors		25.59	1	25.59
B	Other facilities				43.00
	Toilet	For men and women	25.80	1	25.80
	Elevated water tank area	Municipal/rainwater use	16.00	1	16.00
	Garbage depository	Single location	6.00	1	6.00
B	Parking/exterior facilities etc.	Paved areas			1,630
	Parking lot	11 cars/includes access road	230	-	230
	Other paved areas	Includes apron and roadway	1,400	-	1,400
E	Equipment and machinery	Size/weight/capacity			
	Ice making machine	1 ton/day		1	
	Ice storage	2 ton capacity		1	
	Chilled storage	0. 5 ton capacity, 1. 8 x 1. 8m		1	
	Water catchment tank	20 ton		1	

2-2-2-3-4 **Section Plans**

Since dock height will be 2. 8m above DL and the ground level (GL) of the area around the facility will be 3.0m above DL, the floor level (FL) of the fish market center building itself will be 3. 2m above DL in order to avoid flooding during intense rainfall (squalls). The distance between the dock and the fish market will be approximately 12. 5m, so there will be a downwards slope of about 3%. This incline should not prove a problem for using carts to bring the fish or interfere with rainwater drainage.

The market building is single-storied, but the area containing the ice making equipment must be approximately 5m or higher because the ice making machine will be installed on top of the ice storage bin. The height of this section shall leave sufficient room for maintenance at the height of the installed ice making machine. The ice making machine's condenser (air-cooled type) will be installed on the roof outside in open air, not far from the equipment in the machine room. The condenser will be

installed where it will not be affected directly by sea breezes.

Taking this into account, the area containing the ice making machinery and the north side of the retail room will both be flat-roofed, as shown in Fig. 2-27.

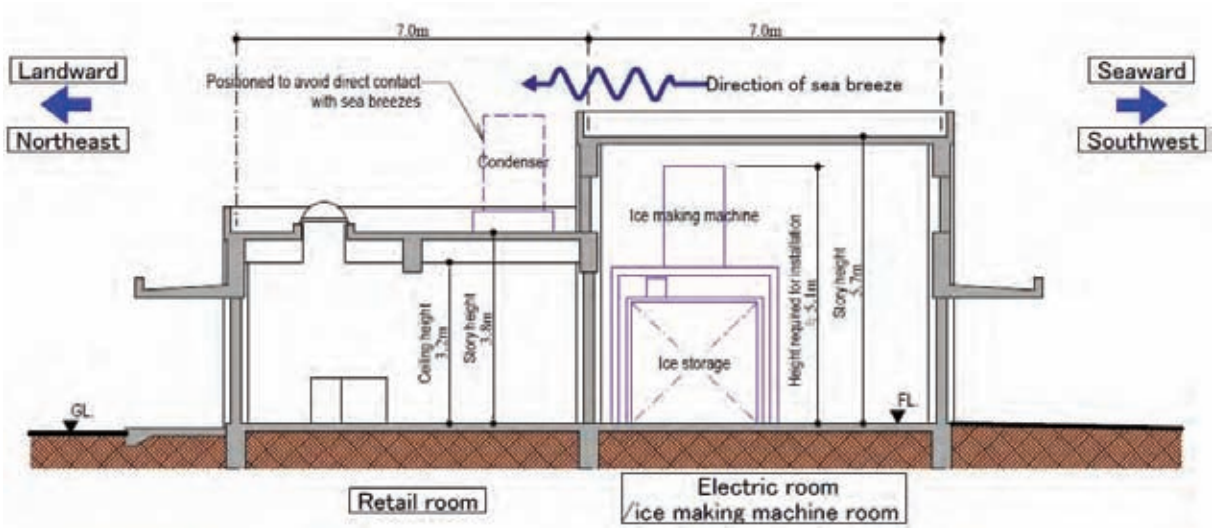


Fig. 2-27 Cross section of ice making machine installation area

An examination of the roof form of the main area, including the fish handling and sales areas, is shown in Fig. 2-28. After consideration, we plan to use a gabled roof form to enable shelter from prevailing winds. Using a gabled roof allows solar panels to be installed facing south, giving improved power generation efficiency, and it provides enough ceiling height for good air circulation.

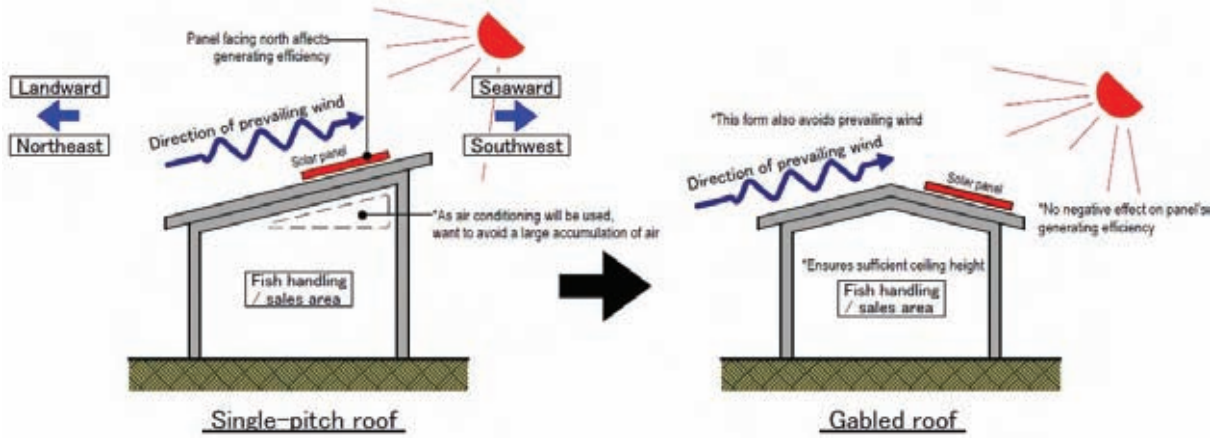


Fig. 2-28 Examination of roof form

In addition, in RMI the direct sunlight is extremely strong and there are occasional heavy squalls. In addition to using heat insulating roof material to reduce heat conduction through roofs, we will also fit deep eaves around the building to minimize the amount of direct sunlight entering rooms. These eaves can also provide weather protection and also serve as a collection gutter for the rainwater that falls on the roof, channeling to the tank on the ground.

Fig. 2-29 shows a cross-section of the main fish market center including the fish handling area.

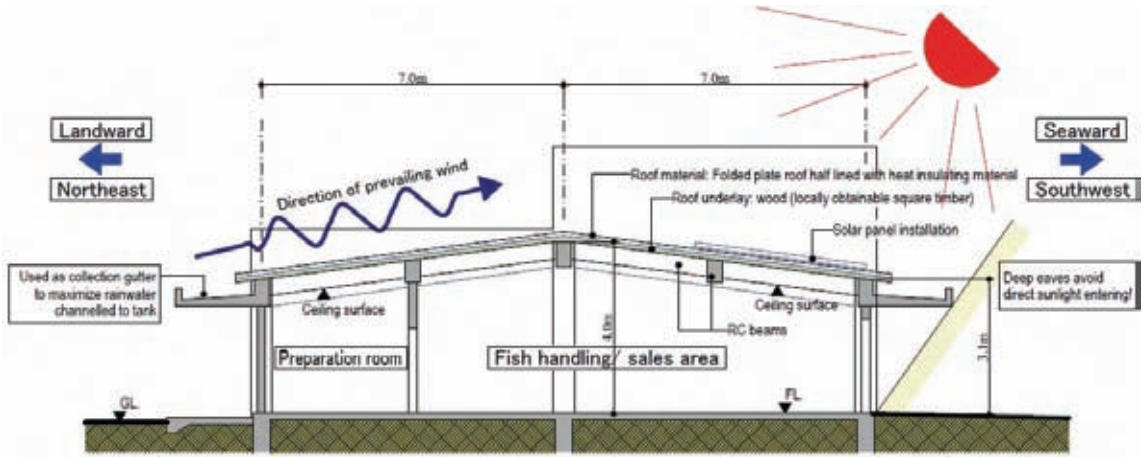


Fig. 2-29 Cross section of main area including fish handling area

2-2-2-3-5 **Structural Plan**

RMI has not established structural design standards, and all construction done as a part of grant aid projects follows the structural design standards of the donors.

As with the plan presented here, existing facilities of MIMRA, such as the chilled storage at Delap, and the facilities at the Uliga Dock, and Majuro Hospital completed in 2007, were all designed using Japanese standards, and to date they have had no structural problems. Consequently, we plan to use Japanese standards.

In addition, since this plan is part of a Japanese grant aid project, a Japanese construction company shall be a contractor. Accordingly, Japanese standards will ensure that the construction is done efficiently and economically.

In terms of natural phenomena, there are no earthquakes in RMI, so they do not need to be taken into account. Wind load effects will be taken into account using Japanese standards.

(i) Structural Material Requirements

We plan to use the following structural materials.

➢ Structural concrete	specified concrete strength	21N／mm^2
➢ Reinforcements	deformed reinforcements (JIS G3112) or equivalent	tensile strength 295A (Epoxy coated)

(ii) Foundations

We will use spread foundation for the planned facilities based on scale and geological conditions. The spread foundation method will depend on the building form and load conditions: the fish market center building will use independent footing, the toilet building will use continuous footing, and the elevated water tank building will use mat foundation.

(iii) Super Structure

We will choose the most suitable structure for this plan with the following in mind.

- We will use local materials and construction methods as much as possible, while choosing

structures which meet functional requirements

- In terms of both size and function this will become an important public building in the center of Uliga, and so we plan to use a structure suited to local conventions and weather and climate, and which will also be highly durable.
- Being in a coastal area, the structure will be built with specific natural conditions in mind, by using salt damage prevention treatments and so on
- We plan to use locally available construction materials and other supplies as much as possible
- The structure shall be easy to maintain.

The super structure of the facility will use reinforced concrete using materials which are locally available in sufficient quantities. We plan to use reinforced concrete (RC) rigid frames for posts and beams and concrete block walls. The fish market center building roof span is comparatively long, and so we are planning to use a folded-plate roof rather than concrete slab, in order to save weight and to cut back on falsework materials/formwork and so on. Girders and beams will be concrete, but in order to avoid salt damage, we will use locally available wood sections for the main and other building roofing underlays.

2-2-2-3-6 **Equipment and Facilities Plan**

(i) Electrics

Power for the facilities in this plan will be supplied by the Marshall Energy Company (MEC). There is an MEC stationary transformer at the side of the access road leading up to the site from the main road which supplies a 220/120V, 60Hz power source. We plan to wire a power supply from there to inside the facilities.

Electrical installations will include lighting and wall sockets. The minimum lighting necessary to provide natural lighting will be installed. In addition, selected lighting fittings and wiring shall be easy to maintain locally and be protected from salt damage.

Internal light fittings will be fluorescent lamps since they provide good illumination and low power consumption. Lighting will follow the luminous intensity standards shown in Table 2-23.

Table 2-23 Luminous intensity of indoor lighting

Offices/general	300 lux (1)
Toilets/corridors etc.	150 lux (1)
Fish handling area	150 lux (2)

*1 using JIS illumination standard JIS Z9110-1979
*2 using the standard of illumination for 'General Work' in the Japanese Occupational Safety and Health Standards Article 304

In order to enable landing early or late in the day and to prevent crime, there will be five exterior lights in total, three around the dock, one near the access entrance and one in the parking lot.

As for the telephone line, we plan to install the conduit pipe only, connection and installation shall be

the responsibility of RMI.

Power consumption figures (provisional) for facility lighting and power outlets are shown in Table 2-24.

Table 2-24 Planned power consumption of various installations/equipment (provisional)

Type of installation/equipment	Power consumption (kW)
Lighting	3.5
Power outlets	4.0
Water supply and drainage	2.5
Ventilation	0.3
Air conditioning	11.0
Ice making machine	12.0
Others	3.0
Total	36.3

(ii) Solar Power

i) The RMI solar power program

Solar power systems had been supplied to RMI as a part of the 'Project for the Improvement of Fish Marketing System in the Outer Islands' under the Japanese grant aid in 1991. They were installed in three locations, the atolls of Ailinglaplap, Namu and Likiep. After the battery cells had reached the end of their expected life (approx. 7 years), they were replaced in the follow-up project in 2006.

Table 2-25 shows the condition of the systems 13 years after installation according to the follow-up inspection result in 2005.

Table 2-25 Results of follow-up inspection of condition (2005)

Site	System	Condition
Ailinglaplap	LINE1	Not functional (battery cell malfunction)
	LINE2	Not functional (battery cell malfunction)
Namu	LINE1	Functional
	LINE2	Functional
Likiep	LINE1	Not functional (battery cell /inverter malfunction)
	LINE2	Functional

Source: Follow-up Program Report for "the Project for the Improvement of Fish Marketing System in the Outer Islands in 2005"

Battery cell life is usually around seven years after installation. According to the inspection report, however, the system had been still functioning at some sites, and even at sites where the system had stopped functioning when inspected, it was evident that it had been running for ten years or more until 2002. The follow up program report wrote the reasons, "having the maintenance procedures clearly on display at each site, both MIMRA and each site manager following such procedures, and people are appreciating the solar power system overall".

In the follow-up program, battery cells were replaced, used-up cells were disposed of (electrolyte

neutralization, lead recycling), and wirings were repaired, as well as a routine maintenance training was given.

ii) Solar power installation policy

According to the 2005 follow-up report, one problem with using solar power in RMI is the replacement and disposal of battery cells. The maintenance system has been deemed excellent, since maintenance does not require a lot of work and users are handling the system properly in appreciation of its indispensability.

Given that the fish market's operates mainly during the day time and considering the problems with maintenance and renewal costs and discarding, we will not use battery cells for the solar power system for the current project. Instead, the solar system will just serve as an auxiliary power source during the day time, when the solar panels can receive sunlight.

iii) Outline of the planned solar power system

In general, the planned system will supply power generated by solar arrays laid on the roof to the main switchboard via a power conditioner (regulator cum DC/AC inverter) and a transformer. This will be combined with electricity from the commercial power supply company at the switchboard, and supply power to the electrical installations (lighting, power outlets, air conditioning, ice making machine and so on) in the Market. This system's main characteristic is that the solar system does not allocate the specific equipment to be supplied, but it can supply to the entire electrical system in the Market as a supplement to the commercial power. In Japan and the developed countries, power companies would buy back surplus power generated by the user’s solar system, but in RMI there is no such system, so if the amount of power generated exceeds usage, there will be power loss.

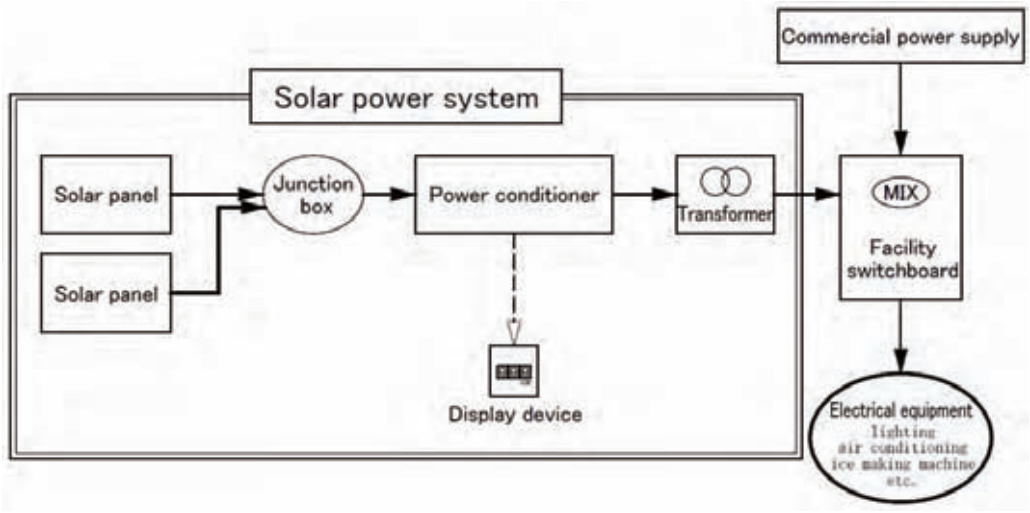


Fig. 2-30 Schematic of solar power system

Maintenance for this system requires only routine operation checks. Since the RMI gets sufficient rain, there is no need to clean the solar arrays. And almost no expendable supplies are needed.

According to manufacturers, solar panels start to lose 5-10% efficiency after around 20 years, but over that time nothing requires replacement.

Table 2-26 summarizes the system characteristics.

Table 2-26 Summary of planned system characteristics

Characteristics	・ reduces commercial power consumption using a solar power system combined with the existing power supply ・ when at night or at times with little sunlight, it can use the conventional power system ・ it reduces carbon emissions ・ battery cells are not used in the system
Advantages	・ it does not take up space ・ no battery cells 1) it reduces maintenance works and costs 2) no environmental damage as no disposal of batteries ・ it does not emit carbon dioxide
Disadvantages	・ it can not generate power at night ・ if the system has small capacity of power generation, it may be relatively expensive

iv) System composition and how to use

<System composition>

The system comprises solar arrays, a junction box, a power conditioner, a display unit, transformer, a protecting device and other parts.

(i) The solar arrays (polysilicon solar cells) generate DC power from the sun's rays. A single module (approx. 1.0m x 1. 5m in size) has a maximum output of approximately 205W, and 12[5] of these are connected together in a line to make a single string. Accordingly, the maximum output of one string is 2.46kW. These strings are arranged in rows and determine total output.

(ii) The power conditioner converts the DC power to synchronized AC with the same voltage, frequency and phase as the commercial power source, and supplies power to electrical equipment. Using a connection protection device, the connection is blocked if there are anomalies in the system or the power conditioner.

(iii) The display unit enables the user to check output and whether the equipment is functioning well. Setting the unit in a room where someone is normally present allows that person to check the equipment is functioning and also to raise awareness about energy saving.

<How to use>

The power conditioner is completely automatic as outlined below.

(i) The solar generator is monitored, and when a certain output is reached, the power conditioner

[5] The number of arrays varies depending on the manufacturer. Basic design was made using specifications given in the fisheries cooperation component development project led by OFCA (Overseas Fisheries Consultants Association) in 2007.

automatically starts.

(ii) If the output goes below a certain value, it will automatically stop.

(iii) The power to equipment provided by the solar power system is generated during the day time only. If solar radiation is not enough for the system it will automatically stop operating.

(iv) There is a time interval between the automatic shut down of the solar power generation by the output monitor and restarting it to avoid unnecessary high-frequency pumping (switching on and off).

(v) If there were a problem in the AC system, or the power conditioner broken down, the system will disconnect immediately with the commercial power grid and it will be shut down safely.

(vi) If there were a failure in the commercial power supply, the system will be automatically restored ensuring recovery after a certain time, and start operating again.

v) Examination of the planned system capacity

The planned facility's power consumption will be roughly 36.3kW. Daytime demand (at normal times and not including peak times) will be approximately 13-18kW. Since there is no incentive program in RMI for buying-back the surplus electricity by the power company, when the solar power system generates more electricity than required, there will be a loss. To reduce this kind of loss as much as possible, about 40% of daytime usage (excluding peak times) to supplement the commercial power supply for the power generated by the solar system is recommended.

Accordingly, from the point of view of needs and cost effectiveness, the optimum capacity of power of the solar power system shall be roughly 5kW-7kW.

Since maximum output from one string is 2. 46kW, we will compare and weigh up the outputs of a two string array (4. 92kW) and a three string array (7. 38kW).

<Estimated annual power generation>

Estimates of annual power generation, based on the amount of solar radiation on Arno Atoll near Majuro Atoll, are given in Table 2-27.

Table 2-27 Estimated annual power generation

		Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ir：Amount of solar radiation (kwh/m^2/day)		5.26	5.10	4.59	4.22	4.09	4.25	4.25	4.79	4.46	4.50	4.28	4.74	
Tm：Maximum Temperature (℃)		29.7	29.9	30.2	30.6	30.1	30.0	30.2	30.4	30.7	30.8	30.2	30.2	
Ep：Estimates of power generation (kWh)	2 modules (4.92kW)	529.4	462.8	459.5	407.2	408.8	411.6	424.9	479.4	430.6	448.8	414.1	474.8	**5,351.9**
	3 modules (7.38kW)	798.4	698.1	693.6	615.0	617.4	621.6	641.6	723.3	650.1	677.4	625.3	716.5	**8,078.3**

* Estimated using the amount of solar radiation on Arno Atoll. Majuro and Arno Atoll are both at roughly the same latitude of 7° north.

Estimated generated power with two strings is 5,352kWh and 8,078kWh with three strings.

<Comparison of costs and environmental impact>

Reduction in annual power costs (based on estimates of annual power generation), environmental effects and initial costs (estimated roughly) are shown in Table 2-28.

Table 2-28 Comparison of costs and environmental impact by number of strings

	2 string array	3 string array
Solar generated output	4. 92kW	7. 38kW
Estimated annual power generation	5,352kWh	8,078kWh
Reduction in annual power costs [1]	2,569 US$ (100%)	3,877 US$ (151%)
Annual amount of oil substitution [2]	1,300 liters	1,963 liters
Annual carbon dioxide emissions reduction[3]	1,008kg	1,522kg
Initial costs [4]	13,500,000 yen (100%)	15,500,000 yen (115%)

*1: Generated output be fully used without loss, 1kWh = 0. 48 cents (as of June 2008)
*2: Calculated with the equivalent unit in oil-fired power plant in Japan (0. 234liters/kWh).
*3: Calculated with the equivalent unit in oil-fired power plant in Japan (0. 18842kg-C/kWh).
*4: Estimated amount. Equipment costs only (does not include installation, labor or overhead costs)

<Conclusions concerning the capacity>

From Table 2-28 we can see that reduction in annual power costs is approximately 2,500US$ and 3,800US$ respectively. These are 4.1% and 6.3% respectively of MIMRA's annual budget for the Utilities, costs for electricity and water supply (including ice making equipment, chilled storage, and market facilities) of 60,000US$ for the Coastal and Community Service, which means reductions in electricity costs from the planned solar system can be significant. Furthermore, in terms of cost/capacity ratio, a 3 string array would bring 50% more reduction in electricity costs than a 2 string array, but only a 15% increase in initial costs. Because there is difference only in costs for number of solar arrays for a 2 and 3 string array.

From these comparative results, we believe using a 3 string system generating 7. 38kW would provide the best cost performance for the current plan.

<Installation point/equipment specification>

The solar arrays will be installed on the south facing roof of the main fish market center building. They measure approximately 18m by 3m. The power conditioner and transformer will be installed in the electric room cum ice making machine room. The display unit will be installed in the office to allow constant monitoring.

The main equipment specifications (provisional) are as follows.

Solar arrays : Polysilicon panels, 36pcs. (@205W)
Solar array platform : Hot-dip galvanized 'C' type steel, anchor bolts
Power conditioner : Indoor, freestanding type

Transformer : Indoor, freestanding type

(iii) Water Supply Facilities

Rainwater will be used as a main source of water supply in the market center for the purpose of reducing operation costs. The city water will be used for the washstand and potable water in the staff room. Seawater, which is lower cost, will be used for toilets as a normal practice in Majuro.

Although average annual rainfall in Majuro is approximately 3,300mm, January through April have a low rainfall, and in the past there have been dry years, for example 1992, recorded only 18mm in the three months, February through April. Consequently, for avoiding possible shutdown of the market operation in the dry season, it is essential to be able to continue its operation using the city water supply only.

Water supply requirement for one day is 4.0m^3, as shown in Appendices “7-3 Water requirement for the planned facility.”

1) Seawater supply

There is a seawater supply pipe running underground along the site access road. The main pipe is 6-inch (150mm) diameter. A branch pipe will lead up to the site from the main pipe. Seawater supply water pressure is high at 0. 4MP[6], and we plan to use a direct connection to supply seawater to the necessary parts of buildings using the existing water pressure in the main pipe.

2) City water supply

There is a city water supply pipe running underground along the site access road. The main pipe is 3-inch (75mm) diameter. A branch pipe will lead up to the site from the main pipe. City water supply pressure is very low at 0.08-0.1 MP, so we plan to use an 'elevated water tank system' for the city water supply, in other words, storing water from the main pipe in a receiving tank and then pumping it up to an elevated tank and using gravity to supply water to necessary parts of buildings.

Since the main pipe water pressure is low, we will install the receiving tank in a low place such as in the building's foundation.

3) Rainwater supply

We plan to install a tank at ground level to reserve rainwater collected from the main fish market center building roof, and as with the city water supply system, will pump it up to an elevated water tank to use gravity to supply water.

Storage capacity of the receiving tanks and elevated water tanks for the city water supply and

[6] Standard water pressure in Japan is 0. 2-0.5 MPa.

rainwater are given in Table 2-29.

Table 2-29 Receiving tank and elevated water tank storage capacity

City water	Receiving tank 16.0 m^3 (4 day's supply[1]) 4.0 m^3x 4 days = 16.0m^3	Elevated water tank 4.0 m^3 (one day's supply[2]) 4.0 m^3x 1 day = 4.0 m^3
Rainwater	Rainwater reservoir tank 20m^3 (5 day's supply[3]) 4.0 m^3x 5 days =20.0 m^3	Elevated water tank 4.0 m^3 (one day's supply[2]) 4.0 m^3x 1 days = 4.0 m^3

*1: water supply is restricted to twice a week (Monday and Friday), so enough water for 4 days shall be stored

*2: one day's supply of water shall be stored for economizing operational costs, as the water can be pumped up to the tank during the daytime using the solar power system

*3: on account of the dry season, 5 day's supply of water shall be reserved to cover a whole week of market operation (Mon-Fri)

(iv) Drainage (waste water) Facilities

Connection to the public sewerage (operated by MIWSC) for toilet sewage and other waste water is controlled by the RMI' 'Toilet and Sewer Facility Regulations', in which there is no drainage (waste water) standard, such as those regulating discharge concentrations.

Although there is no drainage standard in RMI, the present plan aims to reduce environmental impact by using simple primary treatment of drainage from the market. As shown in Fig. 2-31 treatment involves removing solid matter from the drainage from areas where fish are handled (the fish handling area, preparation room, and retail room) using a basket in the catch basin. The drainage then passes through a grease trap to separate oils and fats from it before being released into the public sewerage.

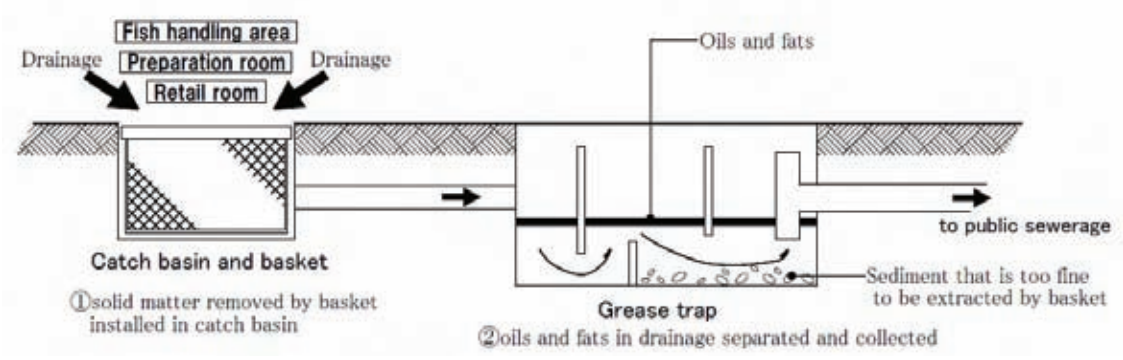


Fig. 2-31 Schematic of drainage plan

For rainwater drainage on the site, we will rely on natural percolation on the unpaved areas, and on the paved areas, buried piping and guttering down to the shore front.

(v) Air Conditioning and Ventilation

Mechanical ventilation is planned to deal with odors, humidity and the heat generated by the various machines in each room. Rooms for installation are as follows.

・ Fish market center building : Electric room cum ice making machine room, Changing room

with shower

・ Elevated water tank building : Pump room

Other rooms where mechanical ventilation will not be installed will use natural ventilation. Accordingly, windows will be installed to allow air circulation.

In the facilities presented in this plan, rooms will be classified according to their use and air conditioning or a ceiling fan only will be installed as appropriate. Separate air conditioning units for each area will be installed so that they can be individually controlled when they are not needed or when no-one is present. We will choose the latest air conditioning models which comply with low-energy consumption/environmentally friendly standards in order to reduce power usage.

・Air conditioning : Fish handling area, Retail room, Market manager’s office, Office
・Ceiling fan : Cashier’s room, Staff room

(vi) Ice Making Machine/Storage and Chilled Storage Facilities

Ice making machine and storage will be fully automatic using a plate ice making machine installed on a stand on top of the ice storage bin. The produced ice will pass through a crusher before dropping freely into the ice storage bin below. The compressor and control panel which make up part of the equipment will be installed in the adjacent machine room to facilitate maintenance. The condenser produces heat during heat exchange, so it will be installed outside allowing heat to exchange more efficiently. However, to avoid direct contact with sea breezes, it will be installed where it can be shielded from the sea, such as behind a building.

The chilled storage will have a cooler unit installed in the ceiling and will be equipped with shelves for fish boxes. The operating panel of it will be installed in the machine room.

For coolant of the refrigerating machineries, MIMRA's existing ice making machines use Freon R-22, which has a high ozone depletion potential, and its manufacture is banned by the Kyoto Protocol. To ensure the availability in the future the coolant chosen for this plan is R404A, which is not subject to regulation by the Kyoto Protocol.

This coolant works with existing coolant equipment and their components without any change in quality, and handling and maintenance works requires the same, and the survey team confirmed that coolants such as R410A and R404A can be obtained in Majuro and the price of them are almost same as R-22.

Provisional specifications of Ice making machine, ice storage and chilled storage are shown as follows.

<Conditions>

Power supply	: 220V three phase, 110V single phase, 60Hz
Ambient air temperature	: ＋35°C relative humidity 80%
Raw Water temperature	: ＋28℃city water and rainwater
Coolant	: R404A
Condensation system	: air cooled
Installation requirements	: coastal environment (salt-tolerant/resistant equipment and materials necessary)
Thermal insulation	: locally assembled insulated sandwich panel
Chilled storage	: inner temperature -5℃
	: capacity 0.5 tons

The main characteristics of major equipment (provisional) are shown as follows.

<Ice making machine>

Product type of ice	: Plate crushed ice
Production capacity	: 1.0 ton/day
Ice making machine type	: Automatic plate ice making machine
Ice making panels	: Two-ply aluminum (ice making area approx. 3.0m^2)
Harvesting system	: hot water
Refrigeration	: R404A semi-hermetic reciprocal type
Condensation system	: Air cooled, salt damage resistant, stainless steel outer casing

<Ice storage equipment>

Interior temperature	: －5℃
External dimensions	: 2,700×2,700×CH2, 200mm
Type	: Prefabricated insulation panel
Material	: Outer panel 0. 4mm thick color steel sheet, 100mm thick rigid urethane foam thermal insulation
Thermal insulation door	: Manual double swing door, W900× H2,000mm
Internal cooler	: Packaged type cooling unit, ceiling mount type

<Chilled storage equipment>

Interior temperature	: Chilled range
External dimensions	: 1,800×1,800×CH2, 400mm

Type	: Prefabricated insulation panel
Material	: Outer panel 0. 4mm thick color steel sheet, 100mm thick rigid urethane foam thermal insulation
Thermal insulation door	: Manual single swing door, W900× H2,000mm
Internal cooler	: Packaged type cooling unit, ceiling mount type
Internal shelving	: stainless steel, single unit approx. 1,500×700×H1,390mm, 3-tier

<Common equipment and other>

Control panel	: Free-standing indoor type, built-in control device/protection circuit/alarm, operation via board
Secondary ice crusher	: Twin drum type, 2.2kW electric motor, crushes (approx.) 5mm thick plate ice

2-2-2-3-7 **Construction Materials**

Interior and exterior finishing will reflect local natural conditions, and be planned in line with the following policy.

- Use local popular construction methods to facilitate future repairing
- Keep maintenance requirements as low as possible
- Prevent salt damage as much as possible
- Design for a climate with high temperatures and humidity
- Plan with appropriate specifications for the Market to keep clean and hygienic, suitable for the fish market of which major customers are hoteliers and restaurants' owners. Use floor and wall materials easy to wash and keep clean.
- Never use any materials containing asbestos

(1) Exterior finishing

Exterior finishing for each facility is shown in Table 2-30.

Table 2-30 Planned exterior finishing for each facility

A. Fish market center building		
1. Roof	inclining roof section	: Folded-plate roof, half lined with heat insulating material
	flat roof section	: asphalt water proofing + steel troweled concrete
2. Eaves/ceilings	cement board base + EP	
3. Outer walls/supports and beams	multi-layered wall coating (spray tile)	
4. External baseboards	steel troweled mortar	
B. Toilet building/garbage depository		
1. Roof	inclining roof section	: concrete base + steel troweled waterproof mortar
2. Eaves/ceilings	steel troweled mortar base + EP	
3. Outer walls	multi-layered wall coating (spray tile)	
4. External baseboards	steel troweled mortar	
C. Elevated water tank		
1. Roof	flat roof section	: concrete base + steel troweled waterproof mortar
2. Eaves/ceilings	steel troweled mortar base + EP	
3. Outer walls	multi-layered wall coating (spray tile)	
4. External baseboards	steel troweled mortar	

EP: painted with synthetic-resin emulsion paint

(2) Outer Openings

Most regular buildings in RMI and around the planned site use aluminum or wooden doors, and aluminum sash for windows. In factories and warehouses, steel doors are used for openings.

The buildings in this plan situating in the coastal area, are vulnerable to salt damage, and buildings should be airtight for effective air conditioning, so aluminum sashes and aluminum or wooden doors are to be used in general.

For the openings in the retail, fish handling and other areas glass blocks to be used, which has a good transmissivity, allowing uniform lighting to the interiors, and also has the advantage of insulation and proof against sound. Preventing heat loss from openings as much as possible is essential for air conditioning, and using glass block in these rooms will also be advantageous in this respect. These materials can be easily obtained locally.

(3) Interior Finishing

The plan for interior finishing for the rooms is shown in Table 2-31.

Table 2-31 Planned interior finishing for each facility

Building	Room	Flooring	Baseboards	Walls	Ceiling
Fish market center building	Fish handling / sales area Retail room, Preparation room Cashier's room	A-1	—	Lower: B-3 Upper: B-2	C-2
	Ice crushing room	A-1	B-1	B-2	C-3
	Market manager's office/office	A-1	B-3	B-2	C-1
	Cashier's room, changing room Staff room and corridors	A-1	B-3	B-2	C-2
	Switchboard/machine room	A-2	B-1	B-2	C-3
	Storage	A-2	B-1	B-2	C-2
Toilet building	Toilet (men's and ladies')	A-1	—	Lower: B-3 Upper: B-2	C-3
Garbage depository	Garbage depository	A-2	B-1	B-2	C-3
Legend	Flooring	A-1: porcelain tile			
		A-2: steel troweled mortar			
	Walls/baseboards	B-1: steel troweled mortar			
		B-2: painted with synthetic-resin emulsion paint			
		B-3: porcelain tile (glazed)			
		B-4: multi-layered wall coating (spray tile)			
	Ceiling	C-1: sound absorbing painted plasterboard			
		C-2: cement board painted with synthetic-resin emulsion paint			
		C-3: patterned ceiling (steel troweled mortar) + painted with synthetic-resin emulsion paint			

2-2-2-4 Equipment

(1) Fish collection boat

1) Purpose of the boats

The boats sail between Majuro and the Outer Islands, Aur, Maloelap, and Jaluit in the Marshall Islands, to collect fresh fish from the Outer Islands, and to carry passengers, daily goods and atoll products.

2) Boat speed

As the fish collection boats have to pass by shallow channels in the atolls, the boats must run in the daytime for safety reasons to avoid sailing after sunset.

Table 2-32 Sunrise and Sunset Times in Majuro (2009)

Date	Time of Sunrise	Time of Sunset	Daylight Hours
March 1	06:48	18:47	11:59
June 1	06:18	18:48	12:30
September 1	06:28	18:43	12:15
December 1	06:32	18:16	11:44

In order for the boats to sail 130 nautical miles between Majuro and Jaluit, which is the longest distance from Majuro, in about 11 hours during daylight time, the boats speed must be kept around 12

knots.

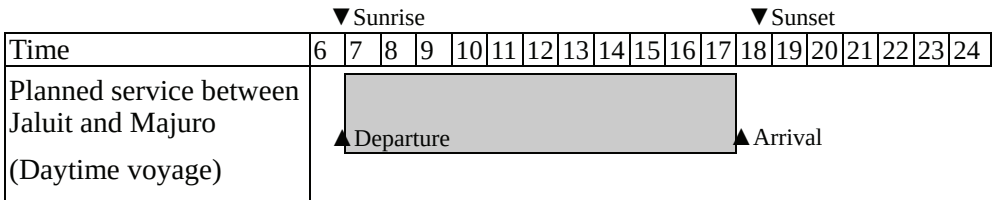


Fig. 2-32 Planned sailing time

Table 2-33 Distance and sailing times between Majuro and the Outer Islands at 12 knots

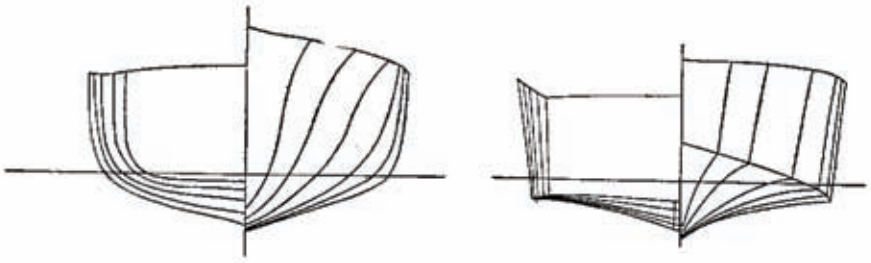
Island name	Jaluit Atoll	Aur Atoll	Maloelap Atoll
Distance from Majuro	130 nm	80 nm	100 nm
Sailing time	about 11 h	about 6.5 h	about 8.5 h

3) Boat hull

The speed length ratio (=$V/\sqrt{L}$, where V is speed in knot and L is boat's waterline length in meters) indicating wave making level of surface vessels should be reasonable for fuel economy, not to produce excessive wave so as not to require big engine.

Given that the plan boat waterline length is 13.8 m estimated from the overall length of 16 m as like existing boats and the boat speed is 12 knots, the speed length ratio is $V/\sqrt{L}$ = 3.20, which is found at the reasonable level from hydrodynamic theory, medium speed semi-planing speed.

Following two kinds of hull form are considered.



Round-bottom form Chine form

Fig. 2-33 Typical boat designs

Round-bottom form: This hull form is the displacement type, and common for small fishing boats and cargo barges in Europe and U.S. Though having seaworthy in rough seas, this form has rather large bottom area and high frictional resistance which requires a high-powered engine for high speed.

Chine form: This hull form is widely adopted in Japan and common for medium and high speed boats. By the work of sharp chine corner, better roll dumping than the round-bottom hull, and better speed performance by the less friction area due to the dynamic lift on the flat bottom surface require less main engine horsepower.

4) Hull materials

Materials commonly used in boat hulls are listed in Table 2-34.

Table 2-34 Characteristics of Hull Materials

Material	Specific Gravity	Against wear (Compared to wood)	Against impact (Compared to wood)
Wood (Waterproof plywood)	0.80	―	―
Fiberglass Reinforced Plastic (FRP)	1.80	Weak	Strong
Aluminum	2.70	Strong	Weak (deforms)
Steel	7.85	Very strong	Strong

For the same hull forms, a lightweight hull allows lower horsepower and thereby requires lower fuel oil consumption. Wooden hulls gradually grow heavier with absorbing water over time and their speed drop accordingly. Weight of the FRP and aluminum hulls are almost the same. Steel hull is superior in strength than others, e.g. against collision with coral reefs and against cargo impact, but the hull weight is heavier by about 50% than that of FRP and thereby speed is considerably lower. The lighter the weight of the boats are, the less horse-power are required, and need the less fuel to maintain a speed of 12 knots. FRP and aluminum material are, therefore, suitable for boats having similar size and speed of the fish collection boats.

For maintenance, steel, wood, and FRP boats can be repaired locally, however, since MIMRA has no experience of using aluminum boat, there are difficulties in repairing aluminum boat locally. For the above reasons, it is concluded that the hull should be made of FRP.

5) Hull dimensions

The hull dimensions of the fish collection boats will be decided by the following factors.

a) Sea conditions

The Outer Islands where fish will be collected, and the destinations of the fish collection boats, are Jaluit, Maloelap, and Aur. Outside of the Majuro atoll is the open sea, where wave heights are observed minimum 1.5 m to 2 m. The mean wave height for the last 10 years is 2.5 m, with the mean wave length of around 100 m. For a boat similar to the size of a MIMRA fishing boats (with waterline length about 14 m), such conditions do not pose a safety problem, but during the inclement weather of winter, the wind speed becomes between 5.0 and 5.9 m/sec on average, and 15 to 16 m/sec at the maximum, and waves are getting short and steep with wave tops whitened by strong wind. In such heavy seas, the passengers and crew of the boat have to endure heavy rolling and pitching for up to 11 hours. The new fish collection boats shall be at least the same size as F/V Lentanir or F/V Laintok class, which are verified as having a number of trips without sea going problem to the Outer Islands in the past, to avoid severer boat motions in the seaways.

b) Fish collection

The main fishing method in the Outer Islands is spear fishing at night. There is no significant variation in the catch volumes in spear fishing by a fisherman per one night. After receiving the supplies of fuel and ice brought by the fish collection boat, fishers are going out for fishing. So the volume of the fish to be collected is the fish caught by those who are able to go fishing on the night the fish collection boat arrives. Therefore, it is difficult for MIMRA to estimate precisely the catch volume when the boat departs from Majuro, so the fish collection boats are loaded with a volume of ice that is based on the average volume of catches in the past.

The average volumes of fish collected in 2006 and 2007, were 2,405 lbs/trip in Jaluit, which is bigger than 1,135 lbs/trip in Maloelap. The maximum volume collected from Jaluit was 3,145 lbs (about 1.4 t). For Jaluit, the first and second holds are packed full with 1.64 t of ice when the boat departs. About 0.61 t of ice is needed for nine 160 lit. cool boxes for the nine working boats operating locally, and the collected fresh fishes are kept in the fish hold with remaining one ton of ice on a 1:1 basis for transportation to Majuro.

Table 2-35 Collection volume of fish and volumes of ice required in Jaluit

Communities	No. of fishing boats	Qty. of ice distributed to boats	Ice used to pack fish	Collection volume	
				Average fish volume	Max. fish volume
Jabwor	5	340 kg	570 kg	602 kg	780 kg
Imroi	2	136 kg	228 kg	242 kg	310 kg
Narmej	2	136 kg	228 kg	242 kg	310 kg
Total	9	612 kg	1,026 kg	1,086 kg	1,400 kg

Although catch weights are weighed by category after being loaded onto the fish collection boat from the fishing boats, they are stowed in the fish holds with ice without any regard for category.

The work process is: Upon departure from Majuro, ice are put into the first and second holds, and after arriving the atoll, ice are supplied to fishing boats from the first hold and so on, received and weighed fish are stowed in such a way as to maintain proper trim of the boat. The specific weight of fresh fish in ice is 0.47 t/m^3, and the space required to hold the maximum catch packed in ice is 3.0 m^3. However, maintaining an efficient 1:1 fish/ice ratio requires one empty hold for ice transfer. On the boat's return trip, the empty hold is used to carry hand crafts, crops, fruit, livestock, and other items for transportation to Majuro. Since the volume and layout of the holds on the existing boats are found adequate, similar arrangement should be adopted in the new fish collection boats.

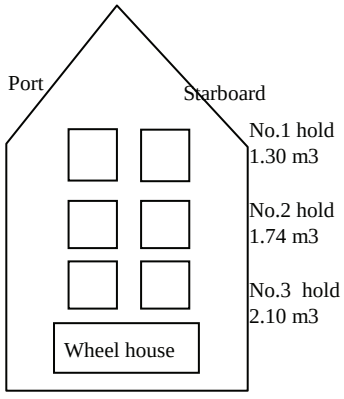


Fig. 2-34 Fish hold layout

However, when fish are stored in the holds, the fish in the upper part of the hold crushes and

damages those fish below them, and the sorting of the collected fish into different categories is done on board the fish collection boat under the glaring sunlight, which degrade the quality of the fish. In this basic design, the fish in the fish hold is subdivided with fish boxes to prevent such damage, and after arriving Majuro, the fish in fish boxes are offloaded, and transported to the handling space in the plan market, keeping them in the fish boxes to allow rapid transportation, to preserve their freshness.

6) Main engine horsepower

The speed of 12 knots for the boat size of the planned fish collection boat is in a range of semi-planing medium speed. Two charts can be used to calculate the main engine horsepower necessary for running the boats at 12 knots on a loaded draft.

a) "Power Prediction Chart for Medium Speed Craft", commonly used for medium speed boats; and
b) "Powering Chart for Hard Chine Boat", which is the chart of speed/power data on length displacement ratio $L/\Delta^{1/3}$ parameter compiling about 300 experiment results of semi-planing hard chine boats

MIMRA workshop manager points out that because MIMRA fish collection boats run their engines at 11/10 output or at 10/10 full throttle, the engine overheating is frequent. In order to avoid overheating when running, it is concluded that the 12 knots should be planned at 9/10ths of rated power.

To calculate the necessary engine power*, the hull of the plan fish collection boat is assumed being same size as the existing boat of following:

Length overall = about 16 m, registered length = about 14.15 m, waterline length = 13.8 m, Molded breadth = about 3.5 m, and the depth = about 1.01 m

And, other conditions are as follows.

Load condition = lightweight 12.0 t + loading weight 5.3 t (Fuel oil full, collected fish, passengers、crew and general cargoes) = 17.3 t,

(a) From the " Power Prediction Chart for Medium Speed Craft"

(i) Performance curve $Lwl/\Delta^{1/3} = 5.33$

(ii) X axis $\Delta \times Lwl^{1/2} = 3.464$

From (i) and (ii) above, Y axis = 65

Y function $BHP/(0.112\ Lwl) - 3.5 = 65$

BHP = 299 ps

(b) From the "Powering Chart for Hard Chine Boat"

* Refer to Appendix-5 "Power Prediction Chart for Medium Speed Craft" and "Powering Chart for Hard Chine Boat"

(i) Performance curve $Lwl/\Delta^{1/3} = 5.33$

(ii) X axis $V/\Delta^{1/6} = 7.45$

From (i) and (ii) Y axis = 1.43

Y function $BHP/\Delta \cdot V = 1.43$

BHP = 298 hp

The above shows that necessary BHP is about 300 ps, which should be at engine load of 9/10, and thereby about 330 ps (or 245 kW) main engine output is necessary at 10/10 engine load.

The engine should be such type as fitted with maintenance holes at a side allowing engine interior inspection and minor repair in the engine room without removing the engine from the boat.

7) Maritime rules to apply

The following rules and regulations of RMI apply to the plan fish collection boat.

Domestic Watercraft Regulation

Domestic Watercraft Act

The plan fish collection boat falls under fish carrier of non-international voyage in the category of Japanese Maritime Rule. In the Japanese Maritime Rules, JG regulations apply to vessels of 20 gross tons and over, and Small Craft Regulations (JCI) apply to vessels of below 20 gross tons. The gross tonnage of the plan fish collection boat is about 14 tons, and thereby JCI regulations should be referred to for supplementary purpose for the regulations not covered by the above rules and regulations of RMI.

8) Maximum complement on board

RMI regulations do not specify maximum allowable passengers on board. However, number of passengers should be limited practically to the number possible to be accommodated in the stern area where susceptible to shipping water and boat motion, which are severe in the open sea outside atoll, are rather protected. Deducting the area necessary for operating tiller[7] fitted at rudder stock head, in an emergency, from the area in the stern, available area for the passengers will be 4.8 m^2, where 10 people can be accommodated, when JCI regulation, specifying 0.45 m^2 per one person for vessels sailing in the greater coasting seas, is referred to.

As the way of navigation and fish collection in each island will not change significantly from those of existing boats, three crew remains same, and thereby adding 10 passengers total maximum complement should be 13.

9) Fish holds (size, subdivision and hatches)

As the MIMRA existing boats, the plan fish colleting boats should have fish holds, total capacity of

[7] tiller: a bar attached to the head of the rubber stock to steer rudder locally

about 5 m^3, with thermal insulation around. The 5 m^3 fish hold should be subdivided into 6 compartments as existing boats and each hatch should be sized adequate to pass fish carrying box of 570 mm x 400 mm footprint.

10) Fuel oil tank

In the operation of the plan fish collection boat, Ebye is the furthest from Majuro, with the round trip distance of about 470 nautical miles, taking 39 hours by 12 knots sailing speed. Given main engine horsepower of 245 kW (=330 ps) and 220 g/kW/h specific fuel oil consumption, the engine consumes fuel at about 58 liters per hour, and thereby fuel oil tank of the boat should be about 2,500 liters including 10% reserve.

11) Fresh water tank

Japan's Mariners Law requires 20 liters of fresh water per person per day. For standard navigation, the boats depart early in the morning and run to atolls over a period of 11 hours at most. As the boats are able to obtain fresh water (rainwater) from MIMRA atoll fish bases, the fresh water tank of the boat may be sufficient for one way consumption, say half day, of 13 people (3 crew and 10 passengers) .

Theoretical consumption is 130 lit (20 lit/p/day x 13 p x 0.5 day) and adding some reserve fresh water tank capacity of the plan fish collection boat should be 150 lit same as MIMRA existing boats.

12) Cargo gear

All cargoes can be handled manually and no cargo gear is required.

13) Nautical instruments

Existing boats are equipped with a magnetic compass, a GPS plotter, a radar, and an echo sounder in the wheelhouse. Navigation within the shallow water atolls requires echo sounder, and open sea navigation requires GPS plotter and radar. The plan fish collection boats should follow existing boat installation.

14) Radio equipment

Regarding long distance radio communication, the fish collection boats should be, same as existing boats, equipped with a SSB radio to communicate with MIMRA fish bases on islands, all of which under the scope of this project are equipped with SSB radio.

Regarding short distance radio communication, the fish collection boats should be, same as existing boats, equipped with a VHF radio to communicate with Majuro Port Authority, other MIMRA boats and MIMRA offices.

15) Electric generators

In many cases the boats must anchor offshore when arriving at the atolls, and thus requires an electric generator to run a winch hauling the anchor. It is considered adequate to install 1.5 kVA DC generator driven by the main engine similar to the existing boats.

Further, the boats should be fitted with a battery, allowing to use projector light for deck work when fishing boats come to the fish collection boat at night.

16) Tools and main engine spares

RMI regulation requires that the plan fish collection boats shall carry tools and spare parts to allow the crew to effect minor repairs on the boats' main engines. MIMRA holds workshops on repairing outboards and diesel engines, and possesses sufficient tools, so that only tools special for the specific engine should be supplied under the project.

It is known that the major cause of the engine breakdown is the overheating. The overheating influences engines as follows.

(i) Loosening and breakage of bolts etc. for connecting rods. Also, bearing metals get burnt due to insufficient lubrication.

(ii) Due to high combustion pressure, piston, cylinder liner, crankshaft, bearing metal, etc. get worn abnormally.

(iii) Due to torsional vibration of the shaft line, which is the vibration of propeller shaft resonant with combustion frequency, crankshaft, propeller shaft and front drive shaft get broken

Light overheating likely occurs when trying to get through rough seas in a short time, so that risk of rapid wear of piston, cylinder liner, crankshaft, bearing metal, etc. is likely.

It is important to conduct technical instruction on engine operation for crew of the boats, and to conduct periodical inspection of cylinder liner, crankshaft, bearing metal, etc. before breakdown. Spare parts for replacement may be necessary to conduct such periodical maintenance work.

17) Specification overview

The outline specification for the plan fish collection boats is given in Table 2-36.

Table 2-36 Outline Specifications for the Fish Collection Boats

Item	Specification
1. Main particulars	
Boat type	Fish Collection Boat
Hull material	FRP (Fiberglass Reinforced Plastic)
No. of boats	2
Sailing Area	Domestic waters of the RMI
Cargo	Mainly fresh fish, but also passengers, general cargoes, and special products
Rules to apply	Maritime Rules of Marshall Islands Domestic Watercraft Regulation Domestic Watercraft Act JCI (Japan Craft Inspection Organization Code) to supplement RMI rules and regulations
Length overall	about 16.0 m
Breadth (molded)	about 3.2 m
Depth (molded)	about 0.9 m
Gross tonnage	about 14 ton (International)
Cruising speed	about 12.0 knots or above
Main engine	about 245 kW (330ps)
Complement	13 persons (crew x 3, passenger x 10)
Tank capacity	
Fuel tank	2.5 m^3
Fresh water tank	0.15 m^3
Fish hold capacity	about 5 m^3 (Divided into 6 compartments)
2. Accommodation	
Beds	2
Mini-kitchen	Propane gas range x 1, Fresh water hand pump x 1
Lavatory	Seawater flushing
Awning	2, at fore and aft
3. Deck machinery	
Mooring equipment	1 x Electric capstan 1 x Anchor roller 1 x Bow bit, 2 x stern bit 1 x Steering gear: hydraulic, actuated by the main engine, with emergency tiller
4. Lifesaving / fire extinguishing equipment	
Liferaft and lifebuoy	1
Lifejackets	13 + 1, US Coast Guard specifications or equivalent
Lifebuoys	1 x US Coast Guard Type IV specification or equivalent
Other	Rescue beacon, fire extinguisher, etc.
5. Ventilation	
Engine room	1 x electric fan
Cabin	1 x electric fan
6. Engine room machinery	
Main engine	about 245 kW (330ps) Supercharged, fitted with inspection holes at side
Bilge pump	1 x Electric pump, 1 x hand pump
Seawater pump	1 x Main engine driven
Fuel filter	1 x Diesel fuel filter / Oil separator
7. Electric equipment	
DC generator	1 x 1.5 kVA. Main engine driven
Battery	3 x 24V DC for starting main engine, onboard machinery, projector light
8. Sailing Equipment	
Clear view screen	1

Item	Specification
Horn	1
Searchlight	1
Projector	Quantities as necessary
Navigation equipment	1 x Magnetic compass 1 x GPS plotter 1 x Radar 1 x Echo sounder 1 x Main engine remote control 1 x Steering control
9. Radio equipment	
SSB radiotelephone	1 x 150 W
VHF radiotelephone	1 x 25W
Emergency position indicate radio beacon (EPIRB)	1

(2) Equipment for the fish market

Following are equipment to be used in the fish market area.

Table 2-37 List of equipment

No	Item	Use	Outline specifications	Quantity
(1)	Fish carrying box	To stow fish on board fish collection boats	External dimensions: about 570 × 400 × 260 mm	200
(2)	Cart	To carry fish boxes to the fish handling area	Cart size: about 1,210 × 850 × 450mm	3
(3)	Insulated tank	Sorting and storing landed fish	External dimensions: about. 1,370 × 840 × 745 mm	10
(4)	Fish storage box	Stowed in the chilled storage	Usable dimensions: about.440×300×160mm	30
(5)	Insulated container	Used for outside retail	External dimensions: about. 568×361×264mm	20
(6)	Band saw	Cutting large fish	SUS material, table type	1
(7)	High pressure water washer	Cleaning the fish handling area	Commercial use	1
(8)	Scale	Platform scale	kg-lb dual scale 330lbs (150kg)	1
		Desktop scales	kg-lb dual scale 40lbs (20kg)	1
(9)	SSB radiotelephone	Long distance communication with atolls and fish collection boats	150W	1
(10)	VHF radiotelephone	Short distance communication with atolls and boats	25W	1

1) Fish carrying box

To prevent damage to the fishes on the bottom of the hold by the fish weight on the top when loaded into the fish collection boats' holds, stowage of fishes in fish boxes is planned. On the boats' return to Majuro, the fish can then be offloaded and carried to the fish handling area kept in the fish boxes. Handling time will be shorter compared with current way of offloading, in which large insulated container is lifted by crane and carried by truck. This shortened duration will help the fish to retain their freshness.

The fish carrying boxes will be manual portable, 40 lit capacity, plastic material, and stackable. Outside dimensions will be about 570 x 400 x 260 mm, capable of holding about 20kg of fish together with ice. The fish hold dimensions and capacity of the plan fish collection boats will be as follows, taking existing boats hold dimensions into consideration.

Table 2-38 Hold Capacity of the Plan Boats

	Length	Width (one side)	Depth	Volume (one side)	Volume (both sides)
Hold 1	1,200 mm	1,000 mm	800 mm	0.96 m^3	1.92 m^3
Hold 2	1,200 mm	1,000 mm	750 mm	0.90 m^3	1.80 m^3
Hold 3	1,200 mm	900 mm	600 mm	0.65 m^3	1.30 m^3

No.1 hold will be capable of stowing 20 fish carrying boxes (three layers in the center, two layers on each side, in two rows). No. 2 hold will also have the same 20 box capacity, while No. 3 hold will be able to stow 16 boxes (two layers in the center, two layers on the side, in two rows). This gives a total of 56 fish boxes, in which 1,120 kg (=56 x 20 kg) fish can be stowed.

The average collection volume in Maloelap and Aur are 556 kg and 570 kg respectively, with a maximum collected volume of 739 kg, which is well covered by the maximum capacity. In the case of Jaluit, average collected volume 1,078 kg is covered by the maximum capacity, however maximum collected volume in Jaluit was 1,472 kg. In cases where a large catch is predicted, the boat may be possible to cope with such extra volume by carrying 160 lit cool boxes (existing boxes) filled with ice. Accordingly, the necessary number of boxes is 56 boxes x 3 boats (the single existing boat plus the two plan boats) = 168 boxes.

F/V Jolok class boat that collects fish from Arno is the outboard motor boat which has no fish hold. Consequently the catch will continue to be stored in large insulated containers as currently done, and will be transferred to fish carrying boxes for offloading from the fish collection boat. The largest fish volume expected from Arno is 624 kg, thus the number of fish carrying boxes required will be as follows:

624kg÷20kg=31.4 boxes ≒ 32 boxes

Consequently, the total of fish carrying boxes required is 168+32 = 200 boxes

2) Transport cart

The carts are two-wheeled carts for transporting the fish carrying boxes from the fish collection boats to the fish handling area. Cart dimensions should be such as allowing rapid placing of fish boxes. Cart dimensions of 1,210 mm (length) x 850 mm (width) x 450 mm (depth) will allow eight boxes to be loaded in two layers. The cart should also be fitted with a wooden frame to prevent contact between fish boxes and the wheels.

Considering 12 m distance between the market and the proposed dock, three carts will be necessary for offloading of fish boxes from fish colleting boat and offloading of fish boxes from the cart in the fish handling area.

3) Insulated tank

Large insulated tank installed in the fish handling area, used to store fish with ice after they have been offloaded from the fish collection boat and sorted into categories. The 550 lit tank has 85 kg tare weight, while the 1,000 lit tank has 137 kg tare weight. Considering ease of use in the fish handling area 550 lit tank is found suitable. When fresh fish and ice are placed in a tank at a ratio of 1:1, it will hold 550 kg÷2＝275 kg of fish. The maximum fish collected from Jaluit in the past has been 1,427 kg, and considering that four categories are evenly split, weight of each category is about 360 kg, meaning that two insulated tanks are needed for each category of fish.

It is concluded adequate that two insulated tanks of about 500 lit in capacity are needed for each of categories A through D, with one more for other not categorized species of fish, and another for bivalves, cephalopods, and crustaceans, totaling 10 tanks.

The proposed tanks should have a cover to keep cooled, and should be fitted with casters or a flatcar to facilitate easy shifting.

4) Fish storage box

The largest volume collected of sea products unsuitable for preserving in ice water, consisting of bivalves , cephalopods, and crustaceans, is about 538 kg. It is found adequate that to divide them into 20 kg lots and placed in fish boxes of about 440 mm x 330 mm x 160 mm, dimensions that are suitable for storing in the chilled storage manually. The boxes should be loaded onto shelves, and a part of them placed by the doorway.

The number of fish storage boxes required will be 538 kg÷ 20 kg = 26.9 ≒ 27 boxes, with three boxes needed as a margin, a total of 30 boxes.

5) Insulated container

The insulated containers loaded onto a pickup for outside retail shall be handled manually, with external dimensions of about 568 x 361 x 264 mm, with 40 mm thick insulation. Each container will hold ice and about 22 kg of fish. The pickup bed being roughly 1900 x 1400 mm in size, 10 insulated containers can be loaded in a single layer, or 20 containers if loaded in two layers.

The OIFMC receives an average of 357 kg of fish, which means that 357 kg÷22 kg=16.2≒17 containers will suffice. It is concluded that 20 insulated containers are adequate as the number possible to carry on a pickup at a time.

6) Band saw

A single table-type band saw used for cutting the large frozen fish is planned. The band saw is of SUS material, with a cutting width of about 550 mm.

7) High pressure water washer

Majuro suffers from frequent water shortages. It is appropriate for saving water in cleaning the fish handling area, retail room, chilled storage etc in the market to have a high pressure water washer that can wash with a small amount of water in a short period of time. This should be a commercial use cold water high pressure washer with a hose reel.

8) Scale

Two types of scales for weighing of fish are needed, one for upon receiving from the fish collection boats, and one upon selling in the retail room. The scales should be of the following grade:

Platform scale	1 set
	Dual in kg and lb, maximum weight 150 kg / 330lbs
Desktop scale	1 set
	Dual in kg and lb, maximum weight 20 kg / 40 lbs

9) SSB radiotelephone

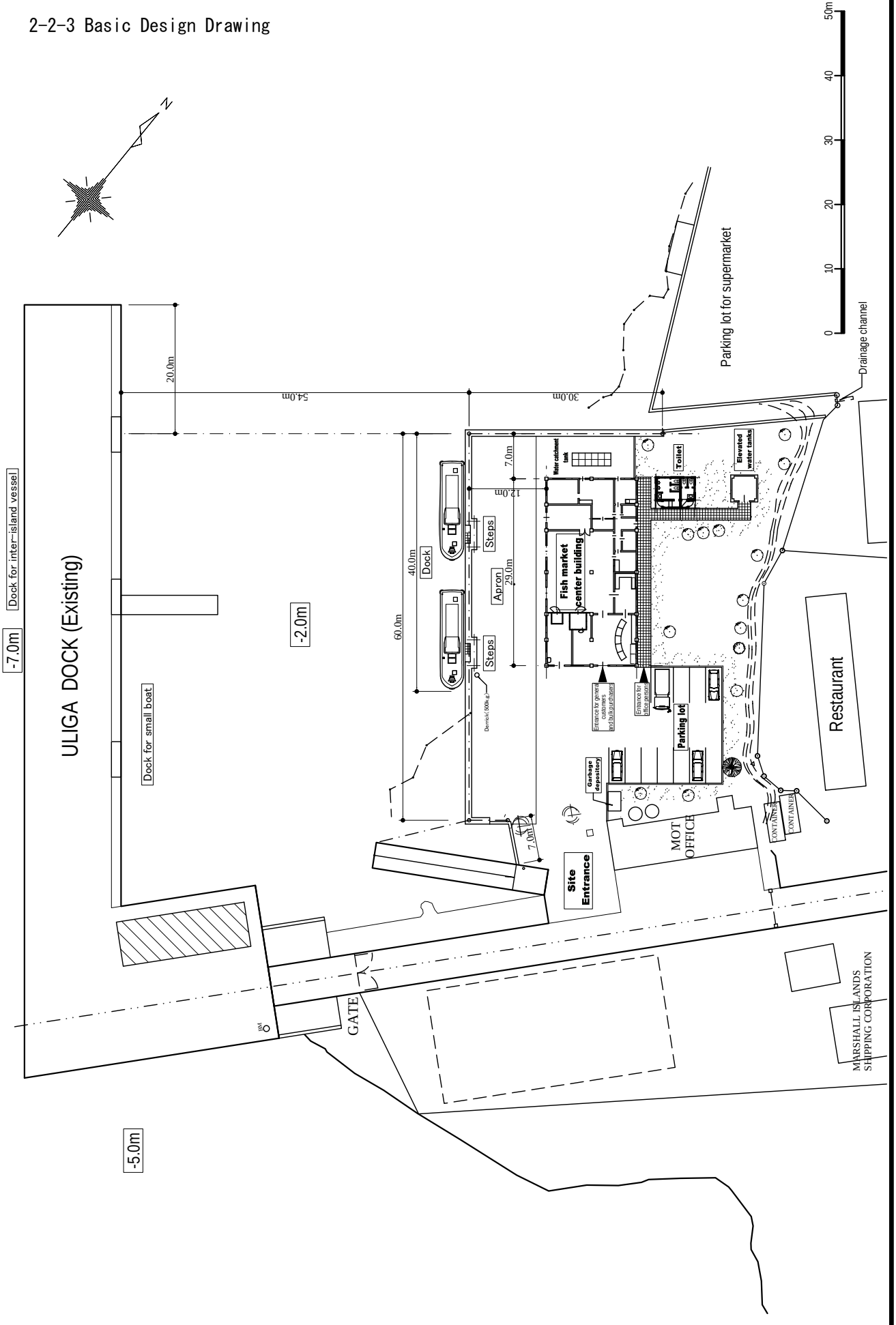
All fish bases of MIMRA in the Outer Islands have a SSB radiotelephone. To communicate with fish bases, MIMRA offices, and fish collection boats, it is found adequate to install a SSB radiotelephone of 150 W output equivalent to the one on board fish collection boats.

10) VHF radiotelephone

It is found adequate to install the same 25W VHF radiotelephone as is used on existing boats for communication with nearby fish collection boats, including the plan boats.

2-2-3 Basic Design Drawing

A-01	SITE PLAN
A-02	FISH MARKET BUILDING. / FLOOR PLAN
A-03	FISH MARKET BUILDING. / ROOF PLAN
A-04	FISH MARKET BUILDING. / ELEVATION & SECTION
A-05	TOILET / ELEVATED WATER TANKS / GARBAGE DEPOSITORY PLAN & ELEVATION & SECTION
C-01	LAYOUT PLAN OF DOCK
C-02	STRUCTURAL PLAN OF DOCK
C-03	STRUCTURAL SECTION OF DOCK

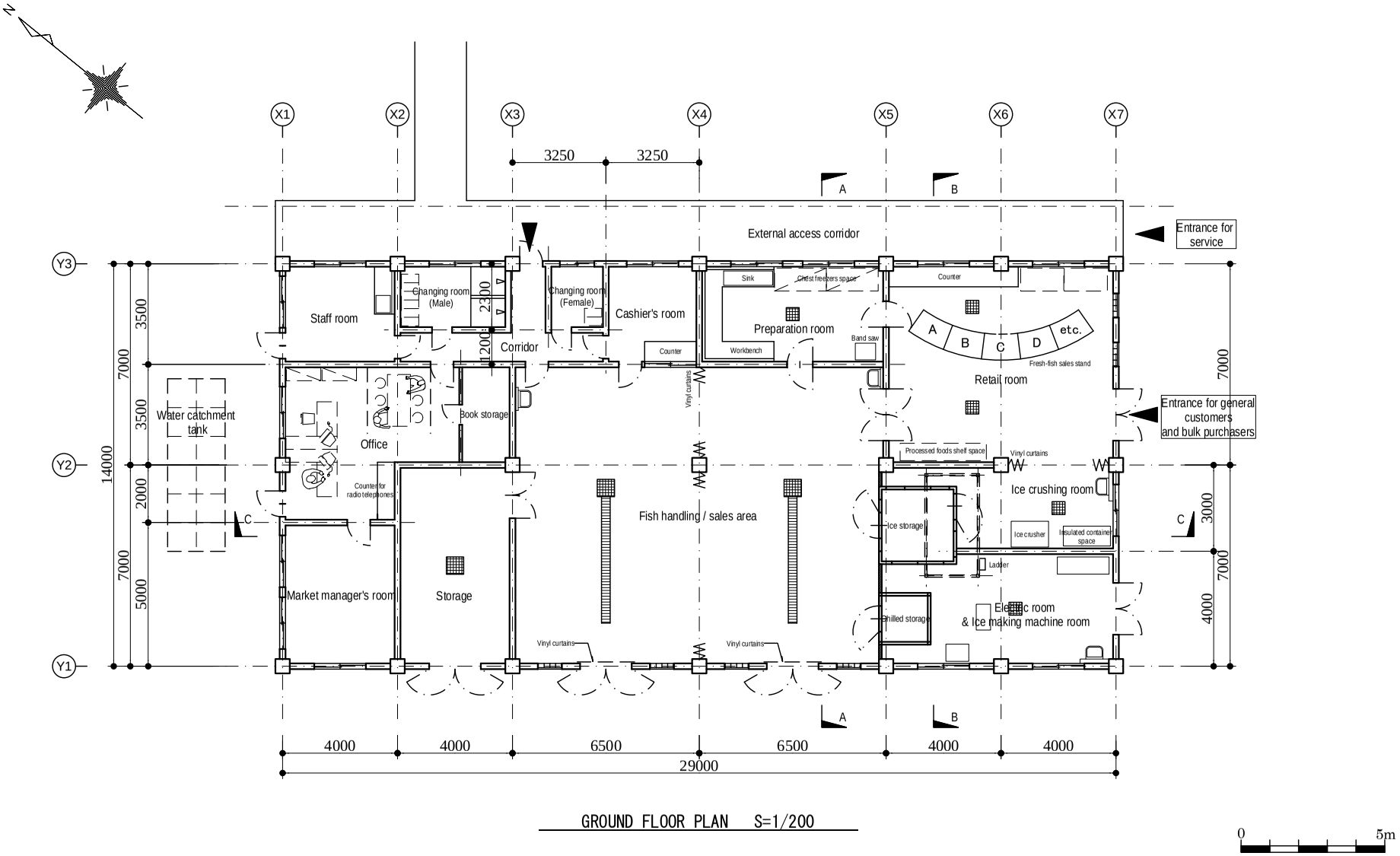


THE PROJECT FOR CONSTRUCTION OF FISH MARKET CENTER AT MAJURO ATOLL

SITE PLAN

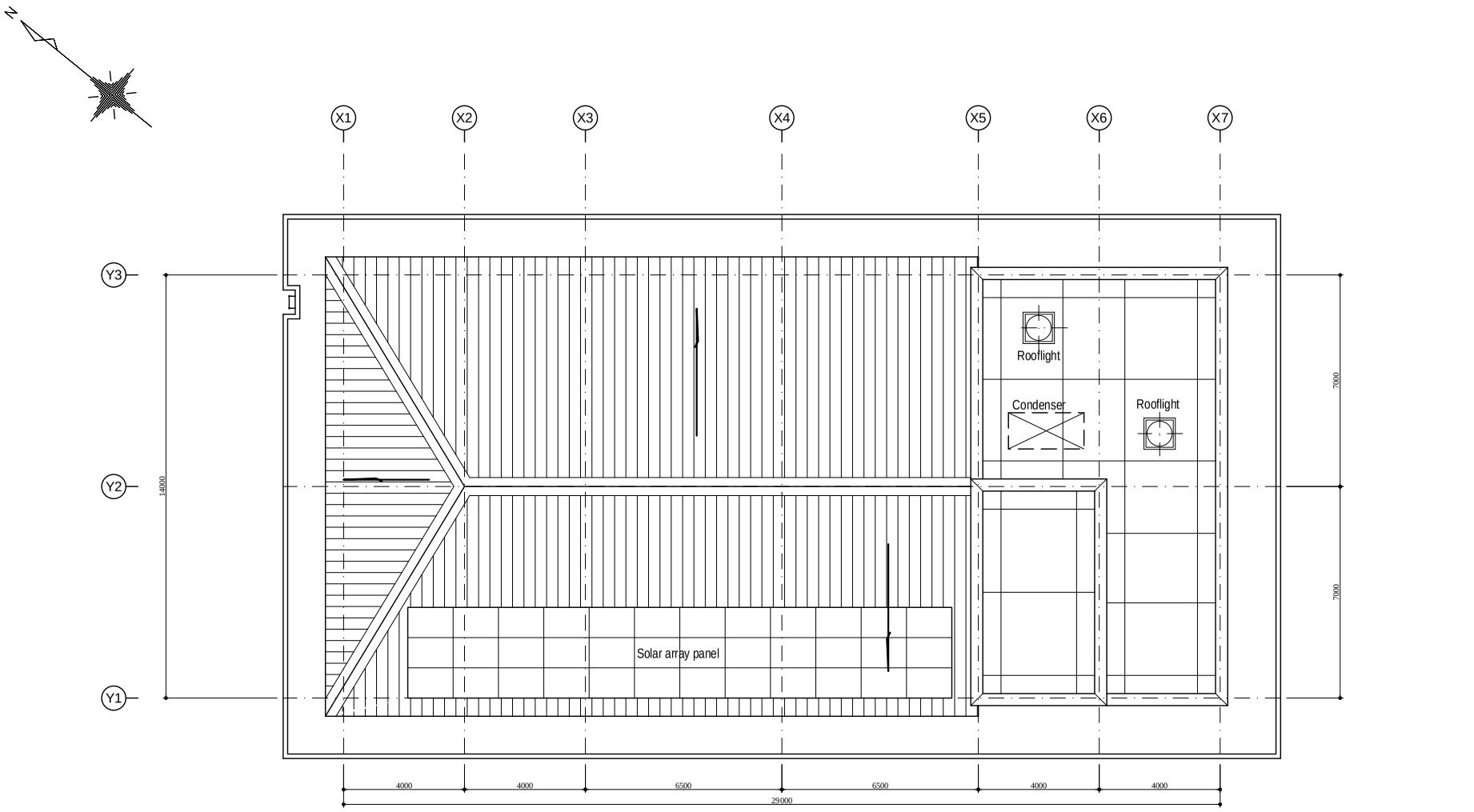
S=1/800

A-01



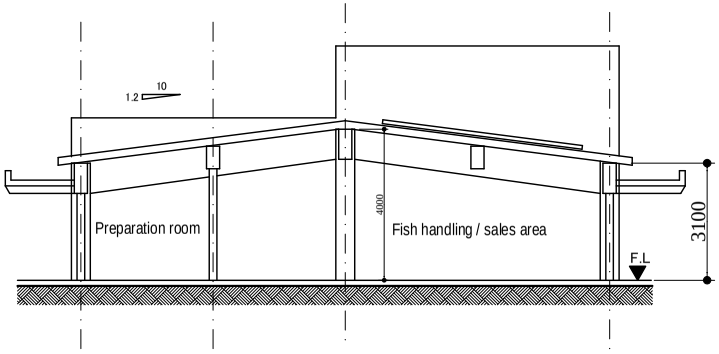
GROUND FLOOR PLAN S=1/200

0 5m

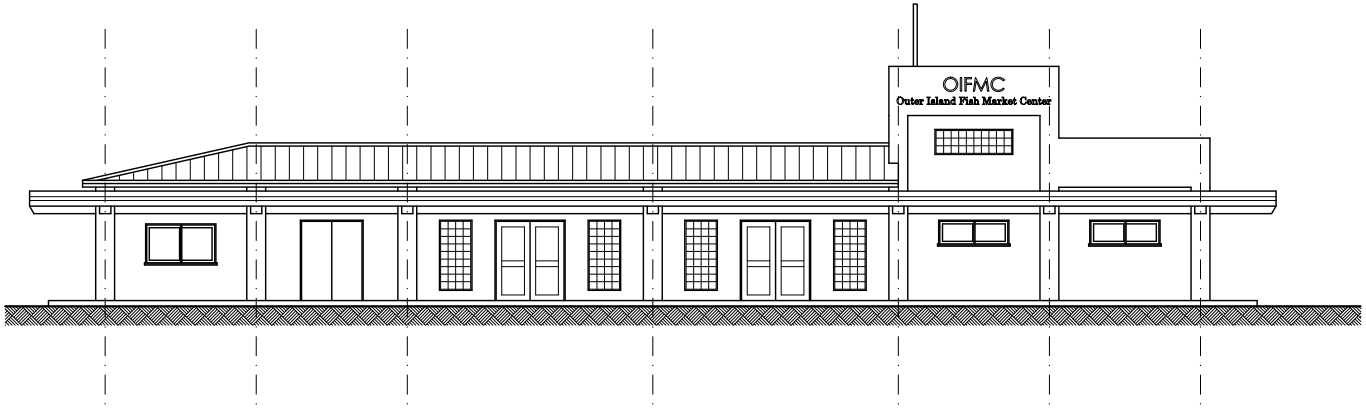


ROOF PLAN S=1/200

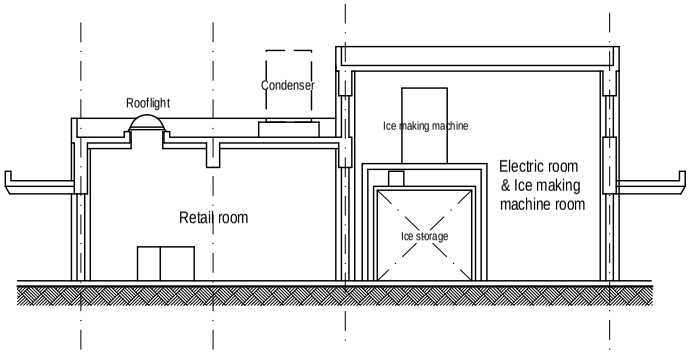
0 5m



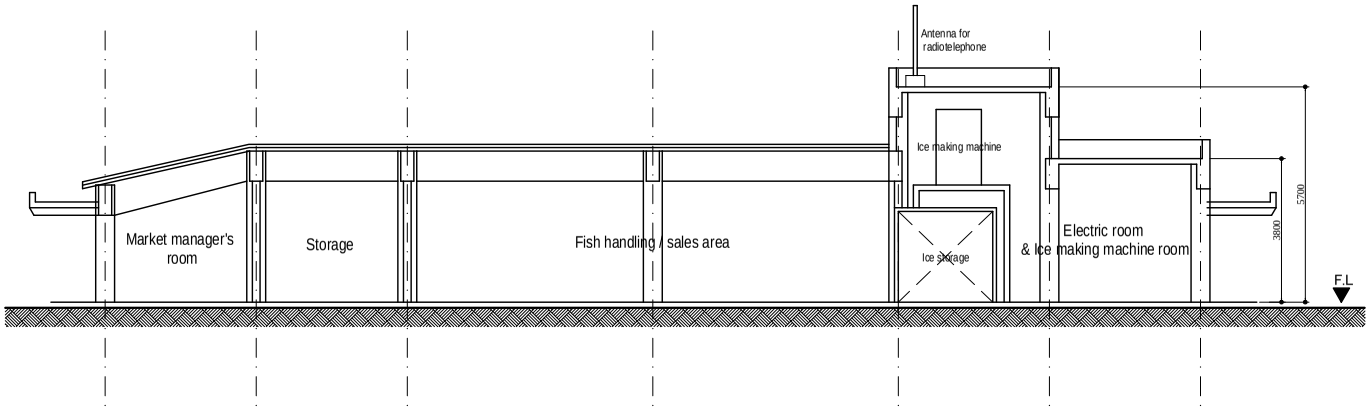
A-A SECTION S=1/200



WEST ELEVATION S=1/200



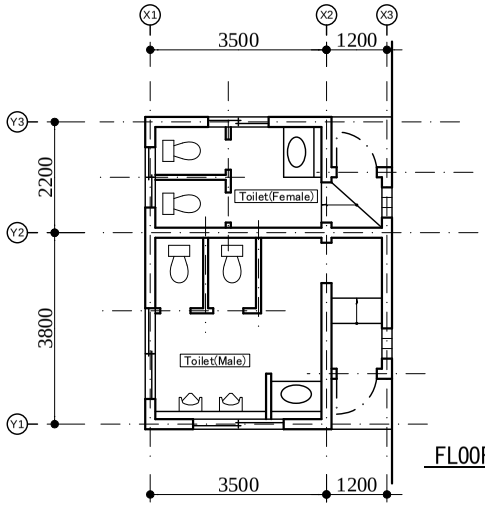
B-B SECTION S=1/200



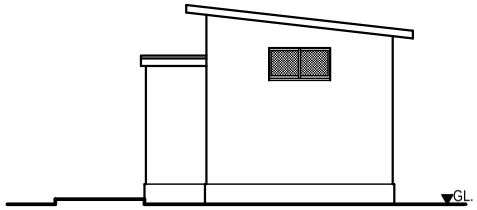
C-C SECTION S=1/200

0 5m

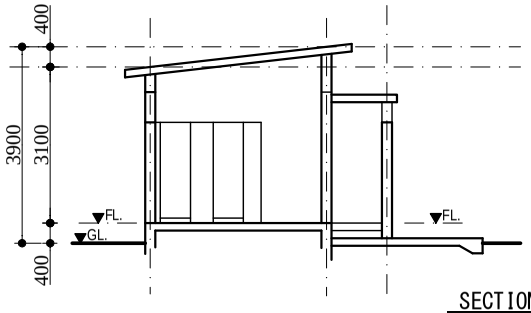
Toilet



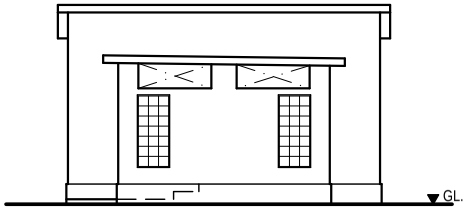
FLOOR PLAN



ELEVATION-1

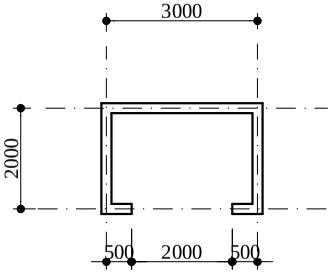


SECTION

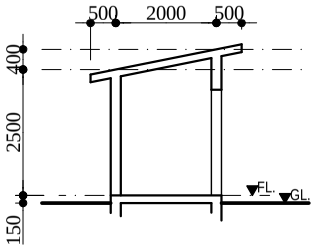


ELEVATION-2

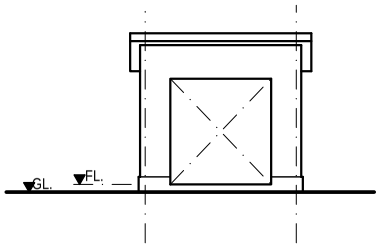
Garbage depository



FLOOR PLAN

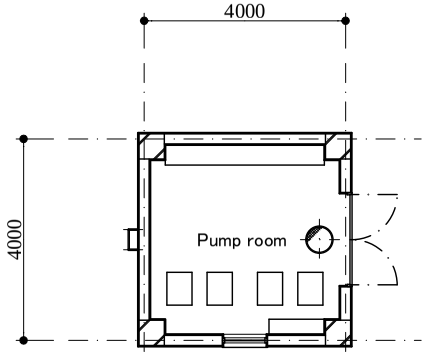


SECTION

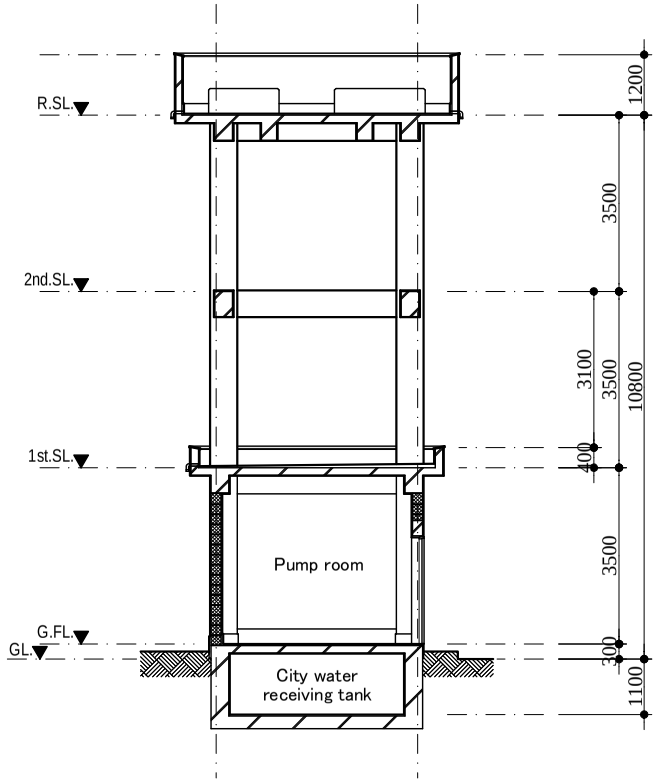


ELEVATION

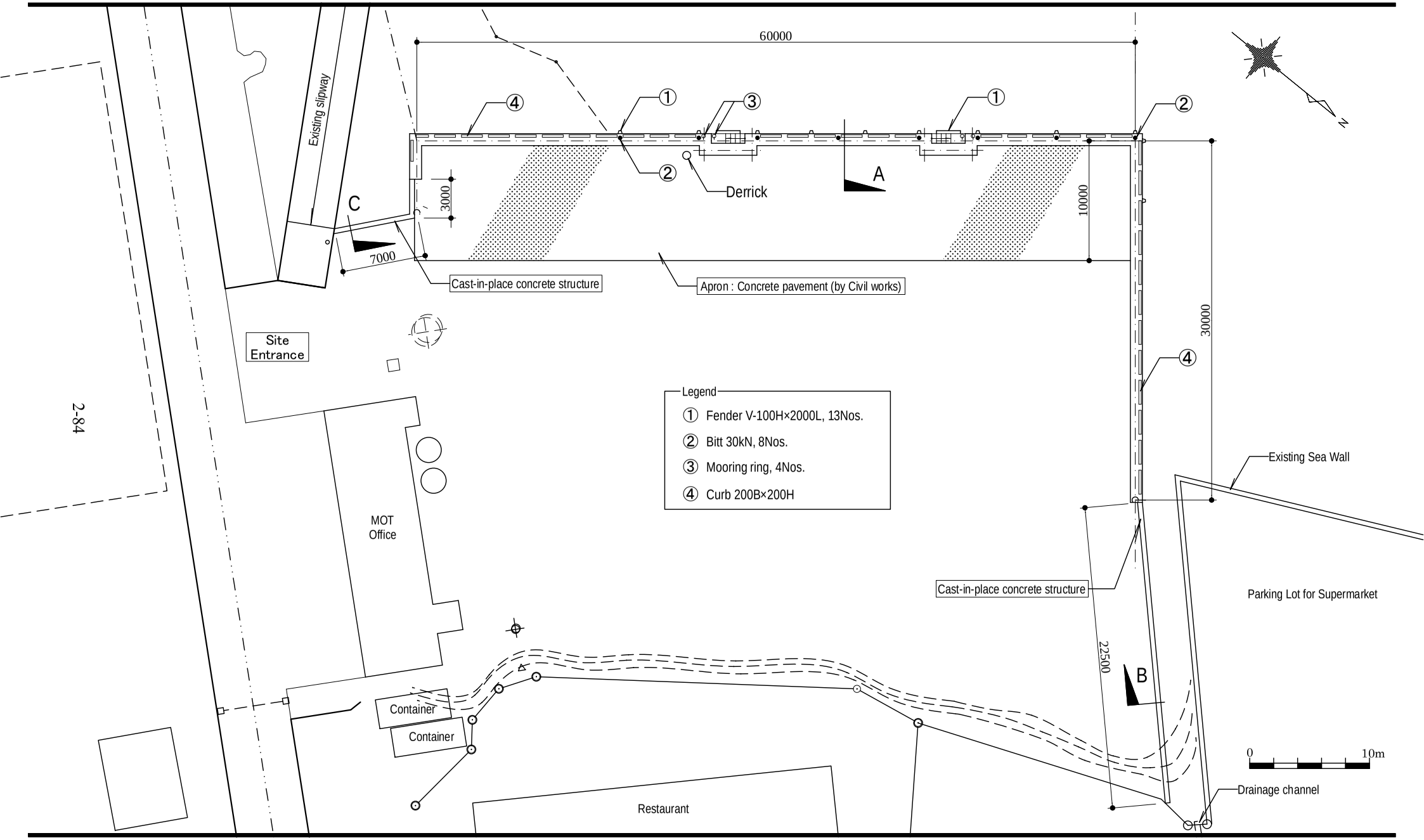
Elevated water tanks



GROUND FLOOR PLAN



2-83

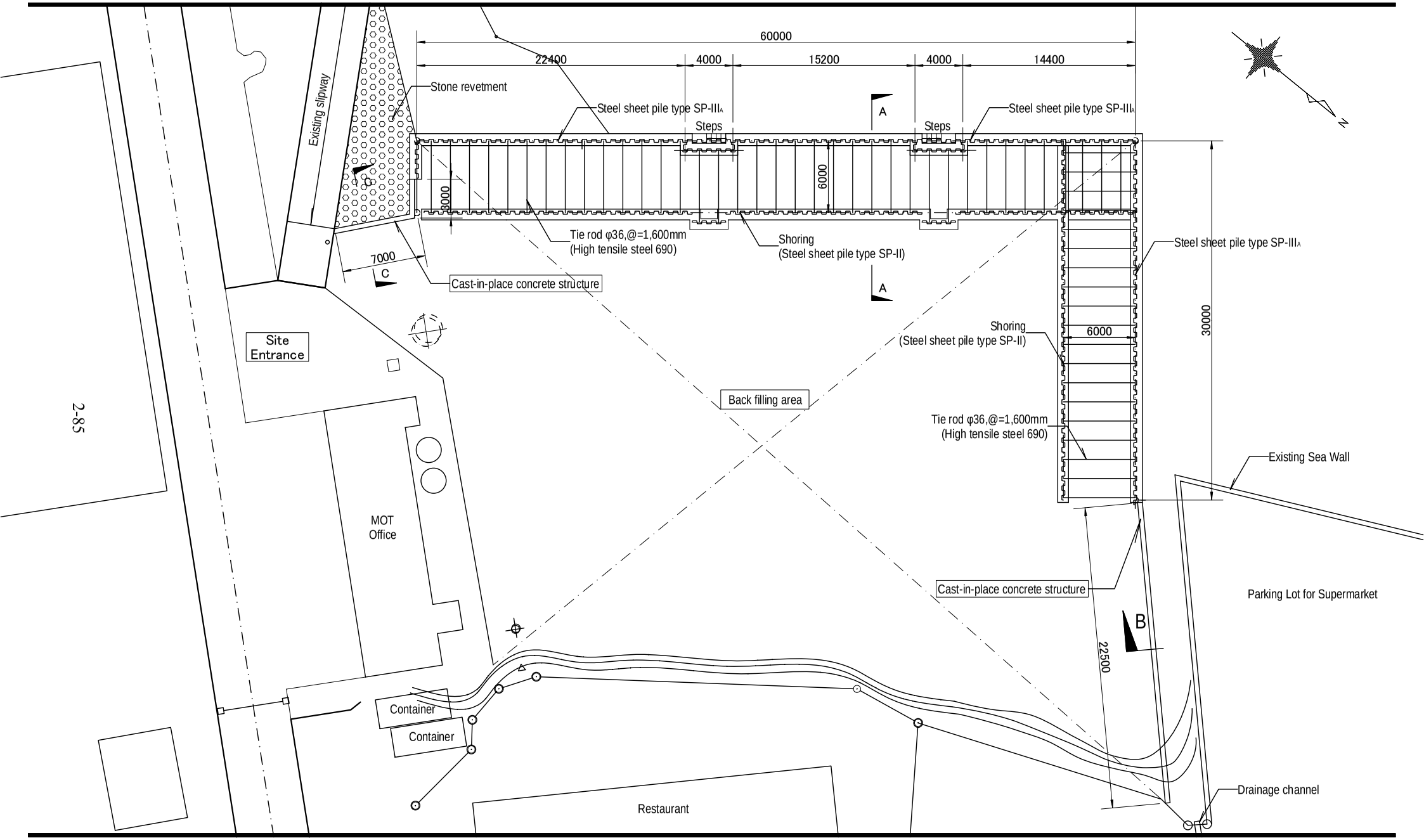


THE PROJECT FOR CONSTRUCTION OF FISH MARKET CENTER AT MAJURO ATOLL

LAYOUT PLAN OF DOCK

S=1/400

C-01

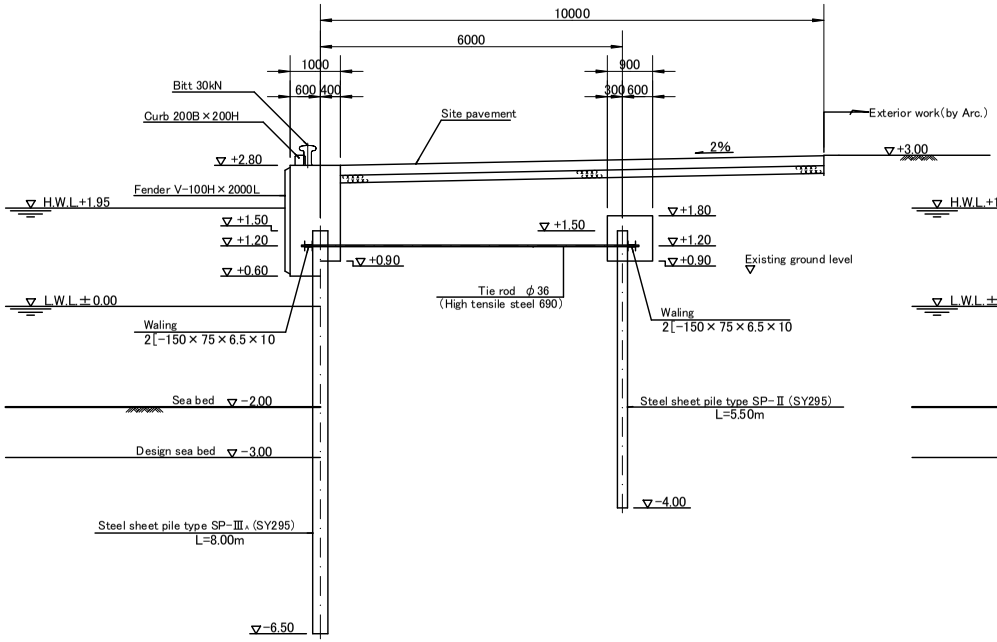


THE PROJECT FOR CONSTRUCTION OF FISH MARKET CENTER AT MAJURO ATOLL

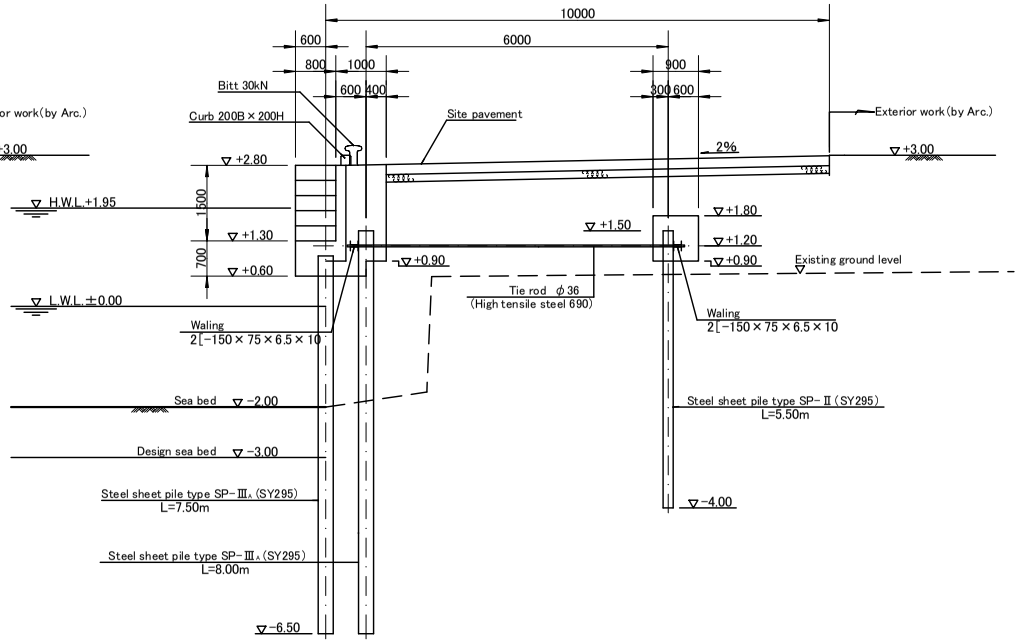
STRUCTURAL PLAN OF DOCK

S=1/400

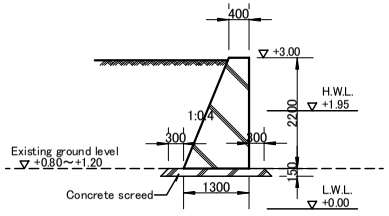
C-02



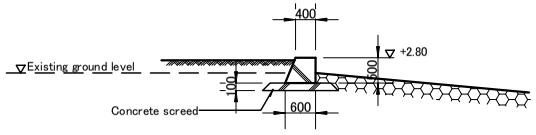
Typical cross-section of dock (A-A)



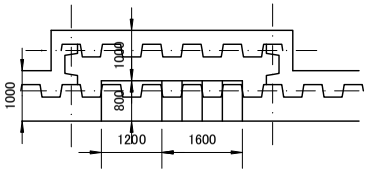
Typical cross-section of dock (Steps portion)



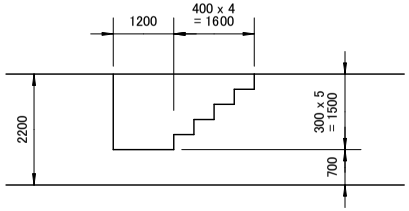
Typical cross-section
of Cast-in-place concrete structure (B-B)



Typical cross-section
of Cast-in-place concrete structure (C-C)



Plan of Steps portion



Section of Steps portion

2-2-4 Implementation plan

2-2-4-1 Implementation policy

2-2-4-1-1 Facilities

(1) Policy on construction methods and period

1) When this plan is to be implemented under the grant aid of Japan, strict observance of a construction period shall be a precondition. Therefore, an appropriate construction period plan shall be prepared so that contractual conditions shall be met within the term of the Exchange of Notes.
2) The implementation plan shall take into consideration the climate of the Marshall Islands and the environmental conditions in the area.
3) Economically appropriate structure and construction methods shall be taken to this plan, as the site is in an island nation, to adopt shortening the construction period and limiting expenses for materials, equipment and personnel which will constitute a major part of the construction cost.
4) This plan is to be implemented while maintaining activities at the existing Dock located near the site. In order not to disrupt these activities and to give maximum consideration to the safety of vessels and passengers during implementation of the work, the implementation plan shall attach particular importance to a short construction period and safety.
5) As the facilities in the plan are complex facilities requiring building work (Market Center) and civil engineering work (Dock), construction methods which enable sharing of equipment, materials and personnel between the two types of work shall be selected.
6) Adequate exchange of opinions shall be maintained among the implementing agency, MIMRA, the consultant and contractors, as a means of facilitating understanding among the parties concerned and to realize trouble-free work implementation.

(2) Policy on procurement

1) General construction materials are commercially available in the Marshall Islands. However, since domestic industries have not developed in the Marshall Islands as it is an island nation, most of the construction materials commercially available in the country are imported from USA, Japan, Philippines and Republic of Korea. Therefore, due attention shall be paid to domestic stocks and the period required for procurement of individual materials in the implementation system.
2) Major construction materials to be used in the project include steel sheet piles, steel columns steel plates, tie rods and fenders, all of which will basically be procured from Japan or a third country by ocean shipping. On the other hand, such items as cement, concrete blocks and timber will be locally procured.
3) Materials containing asbestos shall not be used as construction materials in this plan.

(3) Policy on utilization of local contractors

Construction works in Marshall Islands are contracted by several local constructors as well as carried out by the Ministry of Public Works (MPW), and some of local constructors have working experiences in construction under Japan's grant aid projects as sub-contractors. In view of the plan facilities including the dock construction can be carried out on land basis, a major part of the work could be undertaken by the local engineers and workers. However, supervisors shall be dispatched from Japan for the sheet piling work, which is to be respected to secure accuracy of works and quality requirements.

(4) Policy on operation/maintenance and management

Even though this plan does not include equipment requiring sophisticated techniques, a simple and effective power supply, water supply and drainage facilities are to be selected, avoiding those which require complicated operation and maintenance, in order to be handled by the operation and maintenance team of MIMRA. Consideration will be given to maintenance and management of the equipment. Such consideration includes selection of equipment with parts-compatibility and similar equipment in order to maintain compatibility of equipment.

2-2-4-1-2 **Equipment**

(1) Policy on implementation

1) When this plan is to be implemented under the grant aid of Japan, strict observance of a procurement period shall be a precondition. Therefore, an appropriate procurement period plan shall be prepared so that procurement conditions will be met within the term of the Exchange of Notes.
2) The implementation plan shall take into consideration marine and meteorological conditions of the Marshall Islands.
3) Adequate exchange of opinions shall be maintained among the implementing agency, MIMRA, the consultant and supplier(s), as a means of facilitating understanding among the parties concerned and to realize adequate and smooth delivery of the equipment.

(2) Policy on procurement

1) All of the existing fish collection boats owned by MIMRA are Japanese-made boats. Since there is no boatyard in RMI to build the planned boats, they shall be built in Japan or a third country. Bearing in mind ocean transportation time and costs, a third country in the South Pacific such as Australia, New Zealand, Papua New Guinea or Fiji could be an option. In terms of specialties within the small boat construction industries in these countries, Fiji mainly makes steel boats and imports most of their FRP boats. In Australia and New Zealand, aluminum boat construction is the most widespread, with a low number of small FRP boats. Boatyards in Papua New Guinea build FRP boats, and have close technical ties with Japanese boat manufacturers, but

they are not able to build the size of boat required by this plan.

Table 2-39 shows an outline of the FRP boats required for fish collection boat in the plan, and boats of similar size appearing in the articles in 'Fishing Boat World' in 2005.

Table 2-39 Principal Particulars of FRP boats made by foreign boatyards and of the plan boats

Vessel Type	Nationality	Name	Hull shape	Displacement(t)	Length overall	Breadth	Depth	Engine(ps)	Service speed (cruising speed)
Longline	Sri Lanka	Irosha	Round-bottom	18.0	16.23	4.83	3.40	316	8
Longline	Iceland		Deep V	14.9	11.80	3.70	1.45	640	24
Longline	Iceland	Glettingur	Deep V		11.63	3.61	1.29	644	26
Longline	Australia	Maio 1	Chine	15.0	14.60	4.70	1.50	600	16-18
Longline	Yemen	Lena 2	Round-bottom	42.0	17.00	5.20	1.80	314	10
Longline	Australia	Ocean Explorer	Chine	80.0	22.00	6.20	2.30	600	
Tuna trawling	South Africa	Western Explorer	Round-bottom			5.50	2.40	218	8.5
Lobster Trawl	Norway	Trygg	Round-bottom	35.0	14.95	5.70	3.59		10
Fish collection Boats	Plan boats		Chine	14.0	16.00	3.20	0.90	330	12

The overall lengths of foreign made boats are approximately same as the plan boats. However, comparing with the Japanese boats, most of them have big and bulky forms in terms of width and depth, and even the chine boats have a high horsepower. Boats of similar particulars to the planned fish collection boats may be difficult to find in foreign boat industries. Because of this, FRP boat maker in the third countries shall prepare molds for hull for the plan boat, which will require time and costs, so it have to be depreciated with at least more than ten boats. Should a FRP boat maker in the third country prepare molds for hull only for the two plan boats, the production costs of them would be very expensive. Furthermore, inspections during construction, factory tests, sea trials and other necessary tests carried out abroad and attended by the Consultant would also make building the boats in the third country an unsuitable choice in terms of time and cost. Since existing fish collection boats are all Japanese made, and Japanese boat manufacturers have their own molds for hull ready to use, the best plan would be to build the boats in Japan and to transport them to Majuro by the liner. Construction of the two boats in Japan will probably take about eight months.

2) General Insulated container is locally available in the Marshall Islands, however, they are often inferior in terms of quality of the thermal insulation material and surface material. Careful consideration shall be given not only to the size, but also to the material specifications, to make the procurement plan adequate.

(3) Policy on operation/maintenance and management

Even though this plan does not include equipment requiring sophisticated techniques, simple machineries and system are to be selected, in order to be operated and maintained by crews and mechanics of MIMRA. Consideration will be given to maintenance and management of the equipment.

Consideration will be given to maintenance and management of the engines of fish collection boats and spare parts. Such consideration includes selection of equipment with parts-compatibility and similar equipment in order to maintain compatibility of equipment.

(4) Policy on consultant supervision

1) For trouble-free construction of the boats, the consultant shall maintain close communication and hold due consultation with the relevant personnel of MIMRA from the stage of detailed design to the stage of procurement and implementation to achieve completion of construction of the vessel without delay in accordance with the implementation schedule.
2) In order to carry out smooth procurement of the equipment, the consultant shall maintain close communication and sufficient discussion with the counterparts of MIMRA and the Contractor, and provide adequate advice and instructions as necessary.
3) During construction of the fish collection boats, approving the design plans, inspections of molds and hull construction, inspections in the factories and attendance at sea trials by the Consultant are crucial. The construction supervision system of which necessary engineers in the respective fields allocated shall be established.

2-2-4-2 Implementation conditions

(1) General conditions of the construction site

1) Contractors and suppliers of imported construction materials

Since several local general contractors have their own heavy construction machinery as well as work forces required for the plan construction works, it is believed that they can undertake the plan construction works as the sub-contractor(s). As for the general construction materials, majority of them are available in Majuro.

2) Imported materials and equipment

Other than, concrete blocks, and some wooden fittings which are produced locally, almost all construction materials and equipment are imported from USA, Japan, Philippines and Republic of Korea, and distributed in the Marshall Islands. Since the imported materials and equipment are hard to secure the stable supply, the contractor shall give careful consideration to his procurement plan and keep close relationship with the local suppliers for smooth implementation of the project.

3) Safety control

The access road of the existing dock next to the project site will have to be utilized as the approach route to the plan construction site. However, the dock has been in use by the inter-islands vessels and other smaller boats, there has been heavy traffic of vehicles and passengers on the access road in particularly arriving/departing time of the inter-islands vessels. Since the heavy vehicles for construction work will pass the access road frequently, care shall be taken for safety control during the construction period, including appropriate posting of security guards to secure the safety of third

parties.

(2) Special Considerations during the Construction Work

1) As operations on the existing dock can not be stopped during the construction period, an appropriate temporary yard for the construction materials and equipment and transport route shall be secured for the access to the existing jetty.
2) In Majuro, precipitation and temperature are high throughout the year. The high temperature and precipitation will be taken into consideration for planning the temporary work plan and when implementing safety measures during the work. In addition, sufficient attention shall be paid to curing of the concrete in the concrete work and plaster work to prevent cracks.
3) As the buildings will be located along the coastline and will be subjected to sea breezes and seawater spray all the time, sufficient measures will be taken against salt damage to the structures. There will be a particular need to establish a system which enable on-site inspection of the salt concentration in the aggregate and mixing water, types of cement, concrete mix and quality and thickness of the concrete cover of the concrete for the structure.
4) As to avoid damages to the coral communities existing near the site, appropriate preventing measures against outflow of soils from the site during construction should be taken.

2-2-4-3 Scope of works

Table 2-40 below shows the scope of work in the project.

Table 2-40 Scopes of work of Japan and RMI

	Undertakings in construction, procedures and expenses	Japan	RMI
1	Securing of construction sites (including securing of site for a construction materials depot and an on-site office and matters related to land use rights)		○
2.	Landscaping, planting and provision of furniture and general goods in the facilities after completion of the work.		○
3.	Introduction of power and water supplies to the project site.		○
4.	Application for and acquisition of all the approvals and permits in RMI related to the Project (including authorization of building, use of power and water supply infrastructure, construction license, etc.)		○
5.	Communication and coordination with users of the dock and users and customers of the market during the implementation of the Project		○
6.	Consulting services including detailed design, assistance in the tender process, work supervision, and operation guidance.	○	
7.	Construction of the Dock	○	
8.	Construction of the Fish Market Center facilities.	○	
9.	Procurement of equipment, including fish collection boats, insulated container, fish box, etc.	○	
10.	Import and customs-clearance for the materials and equipment required for implementation of the Project		○
11.	Banking Arrangement (B/A) and bank commissions for the Japanese bank		○

	Undertakings in construction, procedures and expenses	Japan	RMI
12.	Provision of convenience for the Japanese personnel to enter and stay in RMI in conjunction with the implementation of the project.		○
13.	Proper and efficient operation of the facilities and equipment to be provided under the project.		○
14.	Payment or exemption of any kind of value added taxes or domestic levies imposed upon the equipment and materials and also the services to be procured by the contractor(s) of the project in RMI.		○

2-2-4-4 Consultant supervision

2-2-4-4-1 Policy on consultant supervision (facilities)

(1) Policy on consultant supervision

1) In order to conduct the construction without hitch, the consultant shall maintain close communication and sufficient discussion with the counterparts on the RMI side, throughout the detailed design and procurement/construction phases to achieve completion of construction of the facilities without delay in line with the implementation schedule.
2) In order to carry out smooth construction, the consultant shall maintain close communication and sufficient discussion with the contractor(s), and provide adequate advice and instructions as necessary.
3) In the consultant supervision, a supervisor specializing in civil engineering will be resident locally at the site and Japanese engineers specializing in various works will be dispatched in a timely fashion.

(2) Detailed design/Selection of contractors

In implementing the project, following the Exchange of Notes between the Governments of Japan and RMI, a Consultant Contract will be concluded between MIMRA and a consultant of Japanese nationals with regard to detailed design and construction supervision.

1) Implementation Schedule

On the basis of the results of the basic design survey, the consultant will conduct a detailed survey and detailed design of civil engineering and building facilities to be constructed. The detailed design work shall cover the following items.

- Design conditions and standards
- Design report
- Drawings
- Bill of quantities
- Implementation Plan
- Tender documents

2) Selection of contractor

After completion of the detailed design for the construction work, MIMRA will select a Japanese contractor who will undertake the works through tender with the assistance of the Consultant. The consultant shall assist the MIMRA in the following procedures.

- Pre-Qualification notice
- Pre-qualification
- Explanation of tender documents
- Opening of bids
- Tender evaluation
- Contract negotiations

(3) Consultant Supervision

The consultant's responsibilities in implementation supervision are as follows.

1) Assistance in concluding construction contract

The consultant will prepare a draft of the evaluation method of pre-qualification, a draft of tender documents consists of a construction contract, technical specifications and drawings and a bill of quantities for the project costs. The consultant will assist tendering and contract procedures and provide an evaluation of and advice on selection of the contractor and contract conditions.

2) Instructions to contractor

The consultant will examine the implementation plan of the contractor and provide the necessary instructions on the construction methods and work schedule in a timely fashion.

3) Examination and approval of working and shop drawings

The consultant will examine and approve working drawings, shop drawings of the contractor, samples of materials and finishing.

4) Construction Supervision work

The consultant will verify the construction methods and control quality of the work through supervision by a resident engineer and short-term engineers in specific fields.

5) Witness to inspections

The consultant shall perform on-site inspections at interim stage of the construction as necessary, and a final inspection upon completion of the construction.

6) Report on the progress of the work

The consultant will prepare reports on the progress of construction of the facilities, problems encountered, measures taken against the problems and the outcome of the measures taken, and submit the reports to MIMRA and the relevant government organizations of RMI, the Embassy of Japan in the Marshall Islands and JICA.

7) Witness of handover

The consultant shall verify the handover documents at the time of handing over the constructed facilities upon completion of the construction.

8) Confirmation for payment approval

The consultant will assist in confirmation and approval of the amount of work done corresponding to the construction costs payable to the contractor in accordance with the contract, or completion of the work, and examination of the payment documents.

2-2-4-4-2 **Policy on consultant supervision (Equipment)**

(1) Selection of contractor

On the basis of the results of the basic design survey, the consultant will prepare tender documents. MIMRA will select a Japanese supplier and/or shipbuilding company who will undertake the procurement of equipment through tender with the assistance of the consultant. The consultant shall assist the MIMRA in the following procedures.

- Tender (Pre-Qualification) notice
- (Pre-qualification)
- Explanation of tender documents
- Opening of bids
- Tender evaluation
- Contract negotiations

(2) Consultant Supervision

The consultant's responsibilities in procurement supervision are as follows.

1) Assistance in concluding procurement contract(s)

The consultant will prepare a draft of the evaluation method of pre-qualification, a draft of tender documents consists of a construction contract, technical specifications and drawings and a bill of quantities for the project costs. The consultant will assist tendering and contract procedures and provide an evaluation of and advice on selection of the supplier and contract conditions.

2) Instructions to supplier(s)

The consultant will examine the procurement plan and provide the necessary instructions on the boats construction schedule in a timely fashion.

3) Examination and approval of working and shop drawings

The consultant will examine and approve working drawings, shop drawings, samples of materials and finishing.

4) Construction Supervision work

The consultant will verify the procurement methods and control quality of the work through supervision by short-term engineers in specific fields.

5) Witness to inspections

After completion of the boats, the consultant will confirm the performance of the boats, e.g. structural strength, stability, speed, etc. The consultant will be in presence of pre-shipment inspection(s) of equipment by a third party inspection agency.

6) Report on the progress of the work

The consultant will prepare reports on the progress of procurement of the equipment, problems encountered, measures taken against the problems and the outcome of the measures taken, and submit the reports to MIMRA and the relevant government organizations of RMI, the Embassy of Japan in the Marshall Islands and JICA.

7) Witness of handover

The consultant will verify the handover documents upon handing over of the equipment.

8) Assistance in payment to the supplier

The consultant will assist in confirmation and approval of the completion of the delivery of equipment, and examination of the payment documents.

2-2-4-5 Quality control plan

(1) Main points in quality control relating to natural conditions

Sufficient attention will be paid to salt damage prevention and anti-corrosive measures for facilities which are near the sea and susceptible to sea breezes and seawater spray.

Since removal of the salt concentration in the aggregate and mixing water will be difficult, the epoxy-coated steel bars will be used, in casting concrete for structural frame. Heavy duty coating will be applied to the part of the steel sheet pile exposed to seawater.

(2) Concrete works

Concerning the concrete, the ready mixed concrete will be used. The following items will be inspected at the concrete plant. Before casting concrete, the quality of the concrete will be maintained and controlled by conducting the following verification and tests and the concrete strength control tables (including X-R control charts) for the respective mix proportions will be recorded.

Table 2-41 List of items in concrete quality controls

Cement	Verification of type, standard, and characteristic
Admixture	Verification of test results
Mixing water	Content of detrimental materials
Aggregate	Verification of grading, specific gravity and the water absorption. For fine aggregate, verification of chloride content
Trial mix	Verification of slump, strength, mix proportion and quality

2-2-4-6 Procurement Plan

2-2-4-6-1 **Facilities**

(1) Policy on procurement

When procuring materials and equipment, their costs and quality will be thoroughly investigated and the costs of local procurement, procurement from Japan and procurement from third countries of materials and equipment of equivalent quality and availability will be compared. Those with the lowest costs will then be procured. Particularly for the materials and equipment locally available, their quality and availability will be thoroughly investigated.

(2) Procurement of major construction materials and equipment

Domestically produced and imported construction materials available in the Marshall Islands will be procured locally for this plan so long as they satisfy the qualitative and quantitative requirements and are inexpensive. Although domestic products are limited to aggregate/sand, concrete blocks and wood, their quality and availability will meet the demands of this plan. As for the steel sheet pile, the quality control system of it is important in manufacturing, in particular, inspections of actual size, welding, tack-welding and paint during manufacturing, will be closely connected to the quality guarantee, and the period required after ordering the piles will be a critical factor for the construction schedule, it is considered appropriate to procure the pile materials from Japan.

Most of materials for mechanical and electrical work are available in local stocks of imported goods. However, in order to construct a reliable system, some of the electrical materials and equipment such as switchboards and distribution boards, which are not available locally, will be procured from Japan, in consideration of both quality and costs.

The table below shows the procurement sources of major construction materials and equipment to be used in this plan.

Table 2-42 Procurement sources of major construction equipment and materials

	Major construction materials	Japan	RMI *1	Third countries	Remarks
1	Steel sheet pile	○			Locally unavailable. To be procured from Japan in consideration of quality guarantee and period required for procurement.
2	Steel frames /steel plates	○			Ditto
3	Tie rod	○			Ditto
4	Cement		○		
5	Aggregates for concrete (sand)			○	Locally unavailable, import from Nauru or Pohnpei
6	Aggregates for concrete (gravel)			○	Ditto
7	Steel bars (epoxy-coated)	○			Locally unavailable. These shall be procured from Japan considering cost-effective and stable supply
8	Concrete blocks		○		
9	Timber		○		
10	Dock accessories (Bollards/fenders)	○			Locally unavailable. These shall be procured from Japan with an emphasis on price and stable supply
11	Solar power system	○			Locally unavailable. To be procured from Japan considering cost-effective and stable supply.

*1) Items produced locally or imported goods readily available for local procurement

(3) Major construction machinery

The construction machinery required for the work includes machinery for the Dock construction and for the Fish Market Center construction.

The construction machinery required for the plan work includes excavators for the foundation work, cranes for the reinforced concrete work and dump trucks for the transport of materials. As construction companies located in Majuro own and maintain such kinds of machinery, they will be able to be used in the plan. On the other hand, vibration hammers and water jet cutting machines which can not be procured locally and generator which would be used for a long period, they will have to be procured from Japan. Table 2-43 shows the Project procurement schedule

Table 2-43 Procurement sources of major construction equipment

	Major construction machinery	Japan	RMI	Third countries	Remarks
1	Truck crane		○		
2	Crawler crane (50t)		○		
3	Bulldozer (15t)		○		
4	Backhoe ($0.6m^3$)		○		
5	Dump truck (11t)		○		

	Major construction machinery	Japan	RMI	Third countries	Remarks
6	Welding equipment (D300A)		○		
7	Power generator (80kw)		○		
8	Motor Grader (3.1m)		○		
9	Tire roller (8-20t)		○		
10	Road roller (10-20t)		○		
11	Vibrating roller (3-4t)		○		
12	Vibrating hammer (60kw)	○			Locally unavailable
13	Water jet cutter	○			Ditto
14	Power generator (200KVA)	○			Ditto

(4) Transport Plan

The items among the materials and equipment required to be procured from Japan include steel sheet pile, steel bar, several types of construction materials and piling machinery. The liner service from Yokohama to Majuro is being available. Distance from the Majuro Port to the Project site is approximately 5 km and imported goods will be transported by trucks. It takes approximately 10 days to transport goods from Japan to Majuro.

2-2-4-6-2 **Equipment**

(1) Policy on procurement

When procuring the equipment, their costs and quality will be thoroughly investigated and the costs of local procurement and procurement from Japan of materials and equipment of equivalent quality and availability will be compared. Those with the lowest costs will then be procured. Particularly for the materials and equipment locally available, their quality will be thoroughly investigated.

(2) Procurement of Equipment

Among the equipment, only insulated containers are commercially available in RMI. However, as they are often inferior in terms of quality of the thermal insulation and surface materials, they will be procured from Japan, in consideration of both quality and costs. Fish collection boats and other equipment such as fish box, insulated tank, high pressure water washer, radiotelephones will be procured in Japan, since it is difficult to be procured in RMI.

Table 2-44 Procurement sources of the equipment

Fish collection boats

No	Items	Japan	Marshall	Remarks
—	Fish collection boats	○		To be procured from Japan since there is no shipbuilder in RMI and construction of the plan vessel will not be possible locally.

Other equipments

No	Items	Japan	Marshall	Remarks
1	Fish carrying box	○		To be procured from Japan since it is not available locally.
2	Cart	○		Ditto
3	Insulated tank	○		Ditto
4	Fish storage box	○		Ditto
5	Insulated container	○		To be procured from Japan in consideration of quality.
6	Band saw	○		To be procured from Japan due to stainless steel model is unavailable in RMI.
7	High pressure water washer	○		To be procured from Japan since it is not available locally.
8	Scale	○		Ditto
9	SSB Radio telephone	○		Ditto
10	VHF Radio telephone	○		Ditto

(3) Transportation Plan

Calculation of transportation costs for the planned boats is based on total length, width and height measurements. When a boat's wheelhouse and light mast are fixed, then its dimensions are calculated as a rectangular solid up to the mast top. This means that a lot of equipment and materials can be packed in the hold and on the deck of the boat. In our plan, equipment and materials that are not available locally can be procured in Japan, loaded in and on the 2 plan boats, and transported onboard the liner, which would help to reduce transportation costs.

Materials and equipment other than the planned boats can be procured during the boats building.

2-2-4-7 Operational Guidance Plan

Engineers will be sent to give a initial operation and maintenance instruction of the fish collection boats to the crews of MIMRA. Technical guidance for antenna installation and operation of the radiotelephones will also be given.

Table 2-45 Guidance on Initial Operation

Equipment	Outline of Guidance	Period
(1) Fish collection boats	Guidance on boat operation, hull repairing, operation and maintenance of engine, propulsion system and outfitting including radar, sonar, radiotelephones.	5days
(2) Radiotelephones	Installation of antenna and guidance on operation for SSB and VHF radiotelephones at the fish market.	3days

2-2-4-8 Soft Component (Technical Assistance) Plan

(1) The necessity of soft component (Technical Assistance) introduction and issues to address

Fresh fish from MIMRA's fish collecting operations in the Outer Islands is transported from the islands and sold in Majuro in the OIFMC, but the fish left unsold proportion reached to 10% of incoming volume in 2007. Although people in Majuro have a deep-rooted preference for species of fish and fish caught in Majuro, and substantial quantities of unpopular kinds of fish are included among the fish brought in from the Outer Islands, customers' reluctance to buy them are mainly attributed to poor handling of the Outer Islands fish which deteriorate quality of them. In order to increase distribution volume of the Outer Islands' fish in Majuro, it is essential to improve the quality of the fresh fish from the Outer Islands, and to sell fish and fish products which meet the consumers needs and preferences, as well as to improve the convenience of the market for users. In addition, fish and other merchandise which are in line with customers' needs should be sold, and efforts shall be made to improve convenience for users. Thus, the following problems should be addressed.

1) The fish is poorly handled in loading and during transportation from the Outer Islands, which make the quality of fish deteriorate tremendously.
2) The landings of the fish are time-consuming, which are carrying out for a long time on the sundrenched decks of fish collection boats, which reduces freshness of the fish.
3) After fish are sorted out into four categories, they are sold with small effort to meet customers' needs.
4) Deliveries of fresh fish from the Outer Islands are irregular, and there is no information in public when and from what islands the fish are coming, the present market dose not draw many customers.

In order to meet these problems, all people involved in handling fresh fish should learn and accustom to proper handling and techniques for it. Since this will probably require considerable time, it is hoped that medium-to-long term technical support under the schemes which dispatch experts and/or volunteers will be realized. However, to achieve the best results in the current plan, at least the core group of them dealing with fresh fish should have a basic knowledge of proper handling and working technology. To that end, we plan a soft component in the project in which technical assistance by the consultant, in proper fresh fish handling and working technology, will be provided to the Outer Islands' fishers, the fish base managers, crew of the fish collection boats, and staff in the planned fish market.

(2) Outcomes Expecting

The outcomes we are expecting from the soft component are as follows.

1) Fresh fish handling after collected in the Outer Islands, by the managers of the Outer Islands fish bases, and crew of the fish collection boats, will be improved, and the fishers in the Outer Islands

will have a better understanding of maintaining freshness of fish.

2) A series of handling works of fish after landing at Majuro, such as offloading the fish from the boats, transfer to the market building, sorting out, and weighing, will be done more efficiently.
3) The fish to be sold in the planned market will be kept fresh, and the marketing of them will be effective to general consumers in Majuro.
4) Arrivals of the fresh fish by the fish collection boats will be announced publicly, which will make the market convenient and useful for users.

(3) Activity details

Target 1 :	Improvement of quality control of the fish
Activity details:	On-the-job training (OJT) for managers of fish bases in the Outer Islands and the crew of the fish collection boats, and instruction for the fishers in the Outer Islands (on handling the catch, classification of fish, how to use ice, improved methods for packing and preservation during transportation by boat)
Duration	During construction of the facilities (1-4 days/atoll x 4 atolls, conducted during the boats are engaging in fish collection)

Target 2 :	Improvement of fish handling in landing operation
Activity details:	OJT for MIMRA shore staff and the crew of fish collection boat (including instruction on the offloading, transportation, and sorting of fish and other works to be applied in the plan market)
Duration	During construction up to completion of the facilities (conducted at each landing in Majuro)

Target 3 :	Instruction on treatment, marketing know-how of fresh fish, and food hygiene
Activity details:	OJT for MIMRA shore staff and developing an understanding of customer needs (including technical instruction on how to display, cleaning and gutting fish, filleting, arrangement on the tray, packaging and so on; food hygiene training; questionnaires and workshops to develop an understanding of customer needs)
Duration	During construction up to completion of the facilities (at intervals)

Target 4 :	Making the market convenient for user
Activity details:	Supporting public relations activities of MIMRA (including posting information on the schedules of fish collection boats, species and volumes of arriving fish, in public and on the MIMRA website)
Duration	During construction up to completion of the facilities (at intervals)

2-2-4-9 Implementation Schedule

When this project is implemented under the grant aid scheme of Japan, an Exchange of Notes (E/N) will be concluded between the two countries, followed by a design and supervision contract to be signed between the authority in RMI and the Japanese consulting firm. Detailed design, preparation of tender documents, tendering, concluding the contract(s) with the selected contractors, and construction,

procurement and services necessary for the Consultant's support shall subsequently be carried out.

The project under the grant-aid program in Japan shall be strictly adhered to the construction period in compliance with the system of national budget in Japan, considering the various implementation schedule based on the requirements of natural conditions, procurement for equipment and manpower as well as a detailed progress plan.

(1) Detailed design

In the detailed design phase, the consultant shall draw up the detailed design of each facility and equipment based on the Basic Design Study report and prepare a set of tender documents including detailed design drawings, specifications, and tender requirements. The total period of time required is expected as 4 months.

(2) Tendering phase

The contractors (Japanese companies) of the project shall be selected by the means of competitive tendering in construction of facilities and procurement of equipment respectively. The tendering procedure shall be carried out in the order of tender notice, reception of expression of interest, (pre-qualifications,) distribution of tender documents, tender opening, tender evaluation and contracting with the successful tenderers, and will expectedly require approximately 3 months.

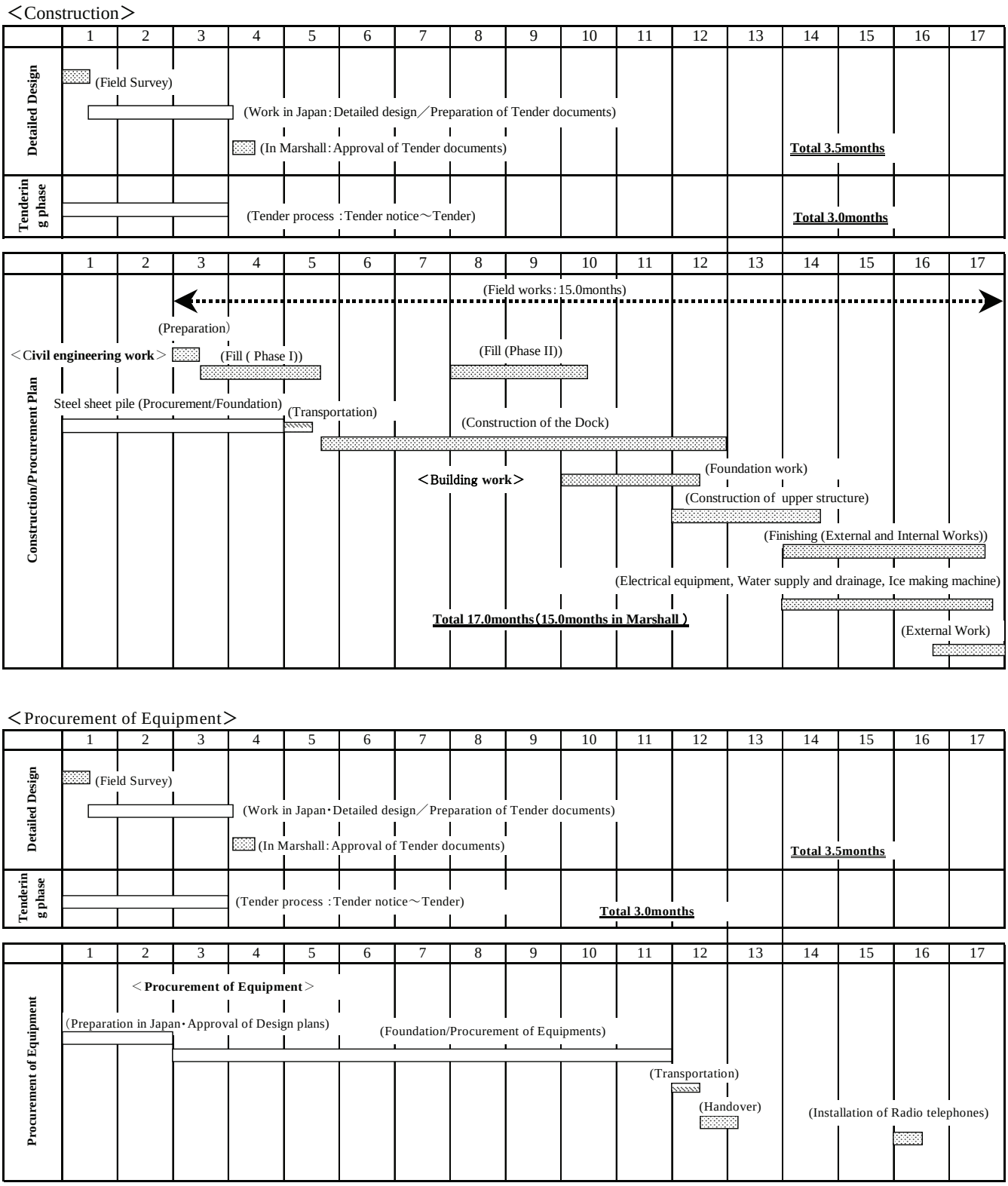
(3) Construction

The contractor shall commence the works immediately after signing of the construction contract. In the meantime, procurement of built-to-order steel sheet pile will require a total of 4.5 months between the order to the arrival in Majuro, including 4.0 months for fabrication and 0.5 months for ocean shipping and customs clearance. The construction works shall start as soon as ready to work in Majuro, and will take 15 months in total including building work and civil engineering work. Above all, 17 months will be required as the whole project implementation period.

(4) Equipment Procurement

The supplier shall commence the works immediately after signing of the procurement contract. In the meantime, procurement of built-to-order fish collection boats will require a total of 13.5 months between the order to the arrival in Majuro, including 12.5 months for fabrication and 0.5 months for ocean shipping and customs clearance. After arrival at Majuro, installation and coordinating of the radiotelephone antenna at the fish market will require a total of 0.5month.

Table 2-46 Implementation schedule



2-3 OBLIGATIONS OF THE RECIPIENT COUNTRY

In implementing the project, the following undertakings shall be carried out by the RMI side until the respective time limit.

(1) Securing of the site

The construction site for the planned facilities has been secured by the Government of RMI. However, existing shrubs, tires and parts of heavy equipment left behind, and the antenna for radiotelephone shall be removed from the site by the Marshall side prior to commencement of the construction works. As for the existing shrubs, transplantation or re-plantation of them is recommendable.

(2) Provision of temporary sites

The RMI side shall secure sites for temporary use during the construction.

(3) Introduction of electricity, telephone line and water supply

The electricity, water and telephone lines have been laid under the access road of the planned construction site and available to connect into the plan facilities without any problem in terms of the capacities.

The RMI side shall branch and introduce electricity, water and seawater supply lines into the plan site in a timely manner at the cost of the RMI side.

(4) Application procedures and acquisition of licenses in connection with the construction (permission for building, use of power, water, and other infrastructure, construction license, etc.)

Prior to commencement of construction, the RMI side shall obtain a permit from the Environmental Protection Authority (EPA) (after carrying out an EIA if necessary), a permit from the Historical Preservation Office (HPO), amendment of lease contracts with the land rights owners, building approval for the construction work associated with this plan including a construction work permit in the port from the Port Authority of the Ministry of Transportation and Communications, electricity sewage and water use permits, etc.

(5) Exemption of any taxes or levies imposed upon any equipment or materials to be imported to Marshall Islands in conjunction with the project and prompt customs clearance thereof.

(6) Exemption of value added taxes, etc.

Any domestic tax such as value added tax on the payment of material, equipment and services to be procured by the contractor(s) under the Project shall be exempted or borne by the RMI side.

(7) Issuance of authorizations to pay, based on Banking Arrangement (B/A) with a Japanese bank with respect to payments provided for in the contract(s) for the Project, and to bear commissions to the Japanese bank.

(8) Exemption of any taxes or duties to be imposed on the Japanese personnel in providing services associated with the project in RMI.

(9) All other items required for the implementation of the Project not specifically included in the undertakings by the Government of Japan.

2-4 PROJECT OPERATION PLAN

The organization responsible in RMI for the implementation of this plan is MIMRA. The Coastal Communities Service Department of MIMRA will be responsible for the outer islands fishing project, such as operation and maintenance of the fish collection boats, and operation and maintenance of the fish market center. Fig. 2-35 shows the organization chart of MIMRA.

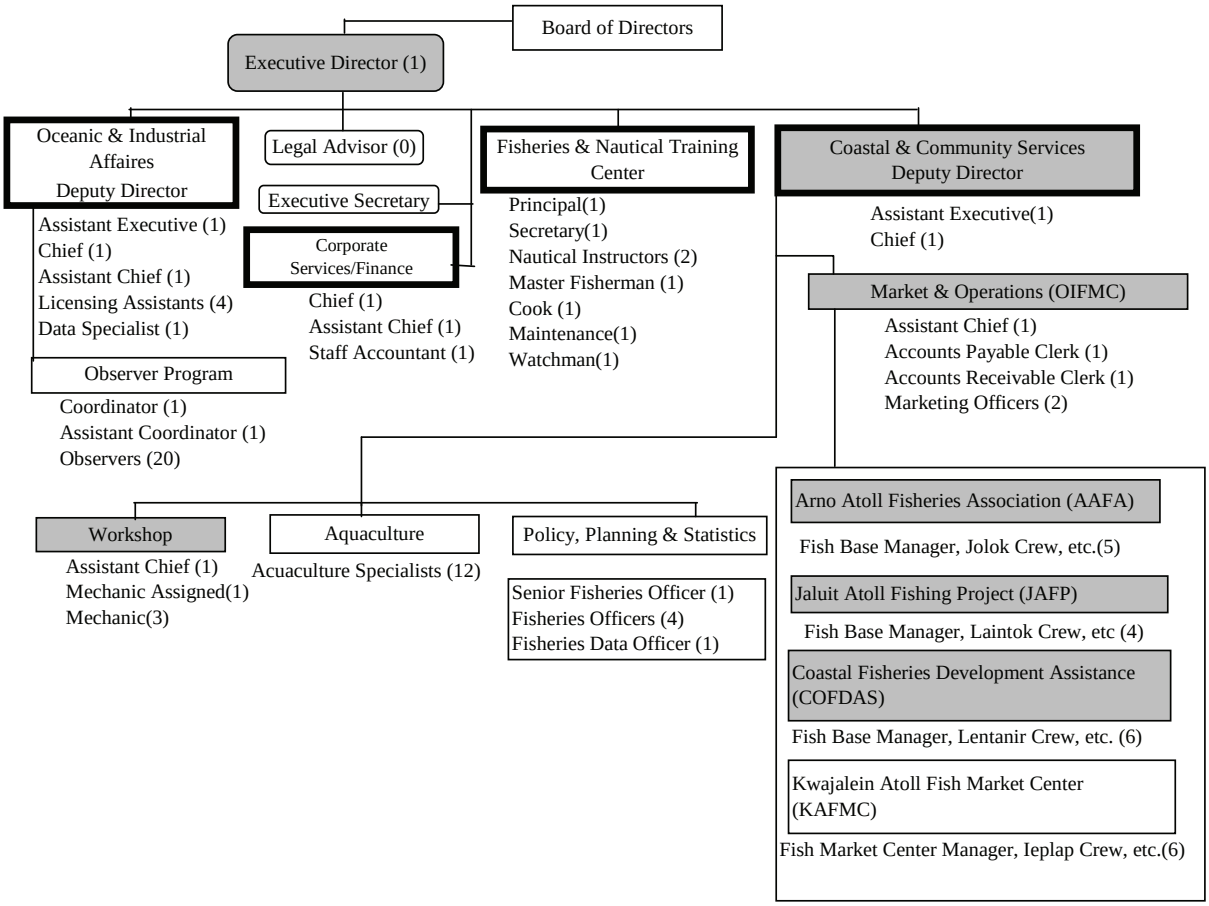


Fig. 2-35 Organization chart of MIMRA

Source) MIMRA

The organization for operation and maintenance of the fish collection boats and operation and maintenance of the planned fish market facilities will be basically kept unchanged from the current Outer Islands Fish Market Center (OIFMC) organization. The budget of MIMRA proper and the outer island fish collection projects of AAFA, JAFP, COFDAS, and KAFMC are independent in accounting terms, but each of these outer island fish collection projects receives financial support from MIMRA. For the time being this situation is unavoidable for MIMRA, and in the future also MIMRA will continue financial support for them. However, the efforts shall be made to increase the turnover of OIFMC and improve its balance of payments, so that it will become independently profitable. Over 80% of MIMRA's budget income comes from the access and license fees. MIMRA's total budget

expenditure is only about 30% or more of its total income, and the surplus is transferred to RMI. Incidentally, in financial year 2007 MIMRA transferred 1.25 million dollars to the General Fund.

Fig. 2-36 shows the organization diagram of the operation system of the planned market facilities. Under a manager who has fresh fish marketing experience in Hawaii, there will be two marketing officers, one sales assistant, and two staff accountants that will carry out the fresh fish marketing business. A mechanic assigned to the workshop will have sole responsibility for maintenance of the equipment of the market.

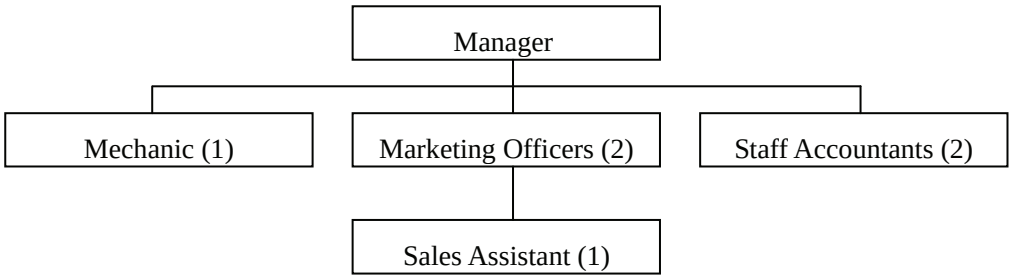


Fig. 2-36 Organization chart of the operation of the planned facilities

The fish collection boats are currently organized as follows: F/V Jolok is assigned to Arno Atoll Fisheries Association (AAFA), F/V Laintok is assigned to the Jaluit Atoll Fisheries Project (JAFP), F/V Lentanir is assigned to Coastal Fisheries Development and Assistance Service (COFDAS), and F/V Ieplap, now not in operation, is assigned to Kwajalein Atoll Fish Marketing Center (KAFMC). The respective boat crews are also assigned to the same organizations, as have been reflected to the situations upon launching each project, though, in practice, management of the operation of these boats is integrated under the control of the Deputy Director of the MIMRA responsible for the Coastal Communities Service Department. However, after implementation of the project either F/V Laintok or F/V Lentanir will be replaced with F/V Ieplap assigned to Kwajalein, and two new fish collection boats will be deployed in this project. Therefore, it is desirable that the fish collection boats be free from their original assigned projects, and will be managed in an integrated manner under the control of the Coastal Communities Service Department. A crew for one fish collection boat shall be recruited. Day to day maintenance of the fish collection boats will be carried out by the captain, the chief engineer, and the deck crew of each boat, and periodic inspections, maintenance and repairs will be under the responsibility of the workshop.

2-5 PROJECT COST ESTIMATION

2-5-1 Initial Cost Estimation

The cost required to implement this project of which RMI shall be borne is calculated as about 16,000 dollars. The breakdown of the costs according to the demarcation of the works between the two countries as described before is estimated as follows, based on the calculation parameters given in (2) later.

(1) Costs to be borne by RMI

Mains and seawater supply work	$2,000
Electrical power supply work	$5,000
Bank commissions and charge	$9,000

(2) Estimate conditions

1) Time of estimate August 2008

2) Exchange rate 1.00 US$ ＝ 105.81 yen

3) Construction period The time schedule for carrying out the detailed design, construction, procurement of equipment, and soft components is as shown on the Project Implementation Schedule.

4) Others The plan will be implemented in accordance with the grant aid cooperation scheme of the Japanese Government.

2-5-2 Operation and Maintenance Cost

(1) Basic Settings

1) No. days / hours of market operation

The fish market center will not open on Saturdays, Sundays, or public holidays (10 days per year), so the number of days of operation per year is 251 days. Also, the market will operate from 8:30am until 4:30pm, or 8 hours in a day.

2) Number of trips to the outer islands, fish collection volume

The number of fish collection trips to Maloelap, Aur, and Jaluit is assumed to be 36 times per island per year. The number of fish collection trips to Arno / Ine is assumed to be 70 times per year. From each island the volume of fish collection is assumed to be the 5-year actual average volume collected. Therefore, the annual volume of fish from the outer islands is,

Maloelap	:	36 times ×556kg	＝20,016kg/per annum
Aur	:	36 times ×570kg	＝20,520kg/per annum

Jaluit	:	36 times ×1,078kg ＝38,808kg/per annum
Arno / Ine	:	70 times ×324kg ＝22,680kg/per annum
		The annual total fish is 102,024kg.

3) Volume to be sold in Majuro

The volume of the fish left unsold at OIFMC in 2007 was 10.1% of the volume collected. It is expected that as a result of implementation of this plan the marketing of fish will be improved and the percentage of fish left unsold will be reduced by 50% or more. Therefore, assuming that the percentage of fish left unsold is 5%, the volume of fish to be sold will be 95% of the collected volume, or 96,922kg.

(2) Revenue

1) Amount of sales of fresh fish in Majuro

The average unit sales price of $2.615/kg ($1.186/lb) at OIFMC in 2007 was adopted as the unit market sales price of fresh fish collected and transported from the outer islands. The annual amount of fish sales is then 96,922kg×$2.615/kg＝$253,451.

2) Boat passenger & freight income

On both the outward and return trips of the fish collection boats to the outer islands, crops, handcrafts, and passengers, etc., are taken on board, and boat passenger fees and freight are taken. The income per trip to each of the outer islands in 2007 was Arno/Ine $32, Maloelap $712, Aur $427, and Jaluit $819.

Taking the 2007 boat passenger fees and freight income per trip as the income per trip in the present plan, the boat passenger and freight income is as follows.

Arno/Ine	70 times ×$32 ＝$2,240
Maloelap	36 times ×$712＝$25,632
Aur	36 times ×$427＝$15,372
Jaluit	36 times ×$819＝$29,484
Total annual boat passenger and freight	$72,728

3) Charter fee income

The charter fee income in 2007 for chartering fish collection boats for transferring emergency patients from the outer islands or for outer island surveys by the Government agencies, etc., was $36,680. It was assumed that the annual charter income after implementation of the plan will be $36,680, the same as the actual for 2007.

(3) Expenditure

1) Cost of purchasing fresh fish on the outer islands

The average unit price for all the islands for purchase of fresh fish in the outer islands was taken to be the same as the actual result in 2007, or $1.849/kg ($0.839/lb). Therefore, the annual cost of purchasing fish is 102,024kg×$1.849/kg＝$188,642.

2) Personnel costs

As a result of implementation of this plan, it will be necessary to recruit one new captain, one chief engineer, and one deck hand as a crew of a fish collection boat. Therefore, the number of fish collection boat crew will total 11 persons, with a total annual salaries of $99,000.

Table 2-47 Personnel costs of the crew of the fish collection boats

Fish Collection Boats Crew	Annual Salary (US$)	Q'ty	Amount (US$)
Captain	16,000	3	48,000
Chief engineer	6,500	3	19,500
Deckhand	6,000	3	18,000
Fisheries Extension specialist (Arno)	8,500	1	8,500
Assistant Fisheries Extension specialist (Arno)	5,000	1	5,000
計			99,000

The personnel costs of one manager, two marketing officers, two accountants, one marketing assistant, and one mechanic for operating the market will be borne by MIMRA headquarters.

3) Fuel and lubricant costs

The engine power of the fish collection boats is 245kW. If it is assumed that the fuel consumption is 0.208928571 lit/kW/hr as commonly cited, the fuel cost per trip to each island and the annual fuel cost are as shown in the table below.

Table 2-48 Fuel costs of the fish collection boats

Outer island	Engine power (kW)	Fuel consumption rate (lit/kW/hr)	Round trip distance (nautical miles)	Boat speed (knots)	Travel time	Fuel consumption per trip	No. trips	Annual fuel consumption (lit)
Maloelap	245	0.208928571	200	12	16.7	855	36	30,780
Aur	245	0.208928571	160	12	13.3	681	36	24,570
Jaluit	245	0.208928571	260	12	21.7	1,111	36	29,926
							Annual fuel consumption	95,276

The price of diesel fuel oil at the time of the survey was $2.92/gal ($0.77/lit), so the annual fuel cost for fish collection trips is 95,276 lit×$0.77/lit＝$73,363.

The consumption volume of lubricating oil is 0.5% of the consumption volume of fuel oil as a standard. The unit cost of lubricating oil is $10.11/gal ($2.88/lit), so the annual lubricant cost for the fish collection trips is 95,276 lit×0.005×$2.88/lit ＝$1,372.

The fish collection boat to Arno/Ine is an outboard motor boat. The return trip between Majuro and Arno/Ine is about 45.3 nautical miles, and the trip time of the outboard motor boat is about 2.3 hours. The gasoline consumption per hour of the outboard motor is 34 lit/hr, so the annual gasoline consumption is 34 lit/hr× 2.3 hrs×70 trips ＝5,474 lit.

The unit cost of gasoline is $5.25/gal ($1.39/lit), so the annual fuel cost of the outboard motor boat is 5,474 lit×$1.39/lit＝$7,609.

The lubricating oil consumption of the outboard motor is 4% of the gasoline consumption. The unit cost of lubricating oil is $10.91/gal ($2.88/lit), so the annual lubricant cost of the outboard motor boat is 5,474 lit×0.04×$2.88/lit ＝$631.

Table 2-49 Annual fuel and lubricant costs of the fish collection boats

Annual fuel cost	Fish collection boat	$73,363
	Outboard motor boat	$7,609
Total annual fuel cost		**$80,972**
Annual lubricant cost	Fish collection boat	$1,372
	Outboard motor boat	$631
Total annual lubricant cost		**$2,003**

4) Electricity costs

The electrical equipment at the planned facility includes a large capacity ice making machine and air conditioning equipment. The operating time of this equipment varies greatly depending on the quantity of fresh fish stored and whether it is on or off the operating hours. Therefore, the required amount of electrical power are calculated after estimating the demand ratios for each item of equipment with cases of large and small quantities of fish stored, and on and off the operating hours.

Table 2-50 Electrical power used on the operating hours of the planned facility (08:00 to 16:30)

Type of installation/ equipment	Power consumption (kW)	Large Quantity stored		Small quantity stored		Holiday	
		Demand ratios	Electricity consumed (kWh)	Demand ratios	Electricity consumed (kWh)	Demand ratios	Electricity consumed (kWh)
Lighting	3.5	0.5	1.75	0.5	1.75	0.1	0.35
Power outlets	4.0	0.3	1.20	0.3	1.20	0	0
Water supply and drainage	2.5	0.3	0.75	0.3	0.75	0.1	0.25
Ventilation	0.3	0.5	0.15	0.5	0.15	0.1	0.03
Air conditioning	11.0	0.6	6.60	0.5	5.50	0.3	3.30
Ice making machine	12.0	0.6	7.20	0.3	3.60	0.3	3.60
Other	3.0	0.3	0.90	0.3	0.90	0	0
Total	36.3		18.55		13.85		7.53

Table 2-51 Electrical power used off the operating hours of the planned facility (16:30 to 08:00)

Type of installation/ equipment	Power consumption (kW)	Large Quantity stored		Small quantity stored		Holiday	
		Demand ratios	Electricity consumed (kWh)	Demand ratios	Electricity consumed (kWh)	Demand ratios	Electricity consumed (kWh)
Lighting	3.5	0.2	0.70	0.2	0.70	0.2	0.70
Power outlets	4.0	0	0	0	0	0	0
Water supply and drainage	2.5	0.3	0.75	0.1	0.25	0	0
Ventilation	0.3	0.1	0.03	0.1	0.03	0	0.03
Air conditioning	11.0	0.6	6.60	0.2	2.20	0.2	2.20
Ice making machine	12.0	0.5	6.00	0.3	3.60	0.1	1.20
Other	3.0	0	0	0	0	0	0
Total	36.3		14.08		6.78		4.13

Regarding the quantity of fresh fish stored, it was assumed that in one year the number of days with a large quantity stored was 125 days, the number of days with a small quantity stored was 126 days, and the number of days the market does not operate is 114 days. Based on these, the annual amount of electricity consumed was calculated to be 88,740 kWh.

Table 2-52 Annual electrical power used in the planned facility

	Unit electrical power used on the operating hours (kWh)	Hours (h)	Unit electrical power used off the operating hours (kWh)	Hours (h)	Electrical power used per day (kWh)	No. days	Electrical power used per year (kWh)
Large quantity stored	18.55	8	14.08	16	373.68	125	46,710
Small quantity stored	13.85	8	6.78	16	219.28	126	27,629
Holiday	7.53	8	4.13	16	126.32	114	14,400
							88,739

The cost of electricity is $0.37/kWh, so the annual electricity cost is $32,833. However, it is estimated that the amount of electricity supplied by solar power system will be 8,078kWh, so the quantity of electricity purchased is 80,661 kWh, so a saving of $2,988 is expected. Therefore the estimated annual electricity cost of the planned facility is $29,845.

Table 2-53 Electricity charges at the planned facility

	Electricity consumed (kWh)	Unit cost ($/kWh)	Electricity cost ($)
Electrical power used per year	88,739	0.37	32,833
Solar power generation	(8,078)		(2,988)
Electricity purchasing	80,661		29,845

5) Annual water cost

The planned facility will mainly use rainwater as the source of water, and the city water will only be used for the sink in the staff room and for boiling water, etc. Therefore, the city water usage except the abnormal dry years will be,

80 lit/person day ×7 persons ×251 days ＝ 140,560 lit.

Also, city mains water will be used for the fresh water for the fish collection boats, and the water usage by the fish collection boats is,

150 lit/boat × 3 boats × 36 trips/year ＝16,200 lit, so the total becomes 156,760 lit.

The unit cost of city water is $0.03/gal ($0.00793/lit), so the annual water charge is

156,760 lit × $0.00793/lit ＝ $1,243.

6) Repair and maintenance cost

The repair and maintenance cost is calculated as the actual cost for repair and maintenance cost in 2007 plus that of the increased portion for the fish collection boats of the plan. The annual repair and maintenance cost is estimated at,

$756 (AAFP)＋($67 (COFDAS+JAFP） ＋$23,000 (MIMRA/HQ))×3/2＝$35,357.

7) Social security expenses, etc.

The social security expenses are calculated as the actual expenses for social security expenses in 2007 plus that of the crew for one fish collection boat. Therefore the annual social security expenses is estimated at $4,974 (AAFP)＋ $19,127（COFDAS+JAFP）×3/2 ＝ $33,664.

(4) Balance of income and expenditure

Summarizing the above income and expenditure, we obtain Table 2-54 as the annual operating income and expenditure, as it has been calculated for OIFMC, for the planned facility.

Table 2-54 Annual operating income and expenditure for the planned facility

Revenue (US$)		Expenditure (US$)		Balance (US$)	Loss/Revenue Rate (%)
Fish sales	253,451	Fish purchase	188,642		
Boat passenger & Freight	72,728	Personnel cost	99,000		
Charter fee	36,680	Fuel cost	80,972		
		Lubricant cost	2,003		
		Electricity cost	29,845		
		Water cost	1,243		
		Repair & Maintenance	35,357		
		Social security expenses	33,664		
Total Revenue	362,859	Total Cost	470,726	-107,867	-29.7%

The outer islands fish collection project is estimated to have an annual income of $362,859 and an annual expenditure of $470,726, which make an annual loss of $107,867. These losses can be written-off with the financial support of MIMRA, same as has been the case to date.

Table 2-55 MIMRA operating income and expenditure for the outer islands fishing project (2007)

Revenue (US$)		Expenditure (US$)		Balance (US$)	Loss/Revenue Rate (%)
Fish sales	53,739	Fish purchase	42,487		
Boat passenger & Freight	17,654	Personnel cost	69,060		
Charter fee	36,800	Fuel cost	30,134		
		Lubricant cost	7,874		
		Electricity & Water cost	60,000		
		Repair & Maintenance	23,823		
		Social security expenses	24,100		
Total Revenue	108,193	Total Cost	257,478	-149,285	-138.0%

The actual annual income (in 2007) for the outer islands fishing project was $108,193, with an annual expenditure of $257,478, which resulted in an annual loss of $149,285. The ratio of loss/income was -138%. Although the estimated annual loss for the plan will decrease by $41,418, the ratio of loss/income of the plan is to improve to -29.7%

(5) Total Balance

1) Depreciation costs

Though the project will be implemented under the grant aid program, it will be necessary to replace the equipment after the life of them. The annual depreciation cost of the fish collection boats, radiotelephones, band saw, weighing scales, ice making machine, chilled storage, and solar power system shall be appropriated. The depreciation cost for the building and the dock will not be taken into consideration. The annual depreciation rates for each equipment, in the case of the Japanese tax laws, are applied on a straight-line basis. Table 2-56 shows the number of years' depreciation for each item, and the annual depreciation rate.

Table 2-56 Depreciation years, annual depreciation rate

Items	No. years' depreciation	Annual depreciation rate (Straight-line basis)
Fish collection boats	7 years	0.143
Radiotelephones (SSB, VHF)	10 years	0.1
Band saw	5 years	0.2
Weighing Scales	5 years	0.2
Ice making machine	13 years	0.077
Chilled storage	13 years	0.077
Solar power system	17 years	0.059

Based on the above annual depreciation rates, the annual depreciation amount is estimated at $251,621.

2) Personnel cost for management and operation of OIFMC

The annual personnel cost for management and operation for OIFMC, a Manager, two marketing officers, two accountants, one mechanic and one market assistant, which is now borne by MIMRA/HQ, is $66,000.

Table 2-57 Personnel Cost for Management & Operation of OIFMC

Management & Operation staff	Annual Salary (US$)	Q'ty	Amount (US$)
Manager	16,000	1	16,000
Market Officer	8,000	2	16,000
Accountant	8,000	2	16,000
Market Assistant	5,000	1	5,000
Mechanic	13,000	1	13,000
Total			66,000

3) Social security expenses for Management & Operation Staff of OIFMC

The annual social security expenses for management and operation staffs of OIFMC is estimated at $11,027.

4) Electricity, water, repair and maintenance costs for facilities at Delap

Even after the planned facility is completed and the function of OIFMC is moved to Uliga, the freezer and ice making machine at Delap will operate at their current location. The costs required to operate them will include electricity and water charges, and repair and maintenance costs for the machineries. In the MIMRA 2007 budget, the annual utilities cost for the Coastal and Community Services Department which covers freezer, ice making machines and the market area was $60,000, and the repair and maintenance cost including the fish collection boats was $23,823.

5) Total Balance for the OIFMC operations

Including the personnel costs for management and operation, which has been borne by the MIMRA/HQ, and the electricity, water, repair and maintenance costs for facilities at Delap, which will be needed after OIFMC will be moved to Uliga, the total balance of the OIFMC operations will make a loss of $268,717 and on top of that, if including the annual depreciation cost, the annual loss will rise to $520,337.

Table 2-58 Total Balance of Operations of OIFMC

Revenue (US$)		Expenditure (US$)		Balance (US$)	Loss/Revenue Rate (%)
Fish sales	253,451	Fish purchase	188,642		
Boat passenger & Freight	72,728	Personnel cost	165,000		
Charter fee	36,680	Fuel cost	80,972		
		Lubricant cost	2,003		
		Electricity cost	89,845		
		Water cost	1,243		
		Repair & Maintenance	59,180		
		Social security expenses	44,691		
Sub-total Revenue	362,859	Sub-total Cost	631,576	-268,717	-74.1%
		Depreciation cost	251,621		
Total Revenue	**362,859**	**Total Cost**	**883,196**	**-520,337**	**-143.4%**

2-6 Other relevant issues

(1) Acquiring the site

After concluding the E/N for this project, it is necessary for the RMI Government to quickly explain the details of the plan to the landowners around the planned site, and conclude revised lease contracts with the rights holders, in preparation for starting.

(2) EIA

It is necessary for MIMRA to confirm whether or not it is necessary to submit an EIA to the EPA based on RMI domestic law, and if necessary, to complete the EIA before starting the construction included in this plan.

(3) Early establishment of the boat operation system

Before implementing the soft components of this plan, MIMRA must establish the new operating system for the fish collection boats, including crew members, and the operating system for the new fish market by the beginning of 2011, so they can be ready to start at any time.

CHAPTER 3　PROJECT EVALUATION AND RECOMMENDATIONS

CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATIONS

3-1 Project effect

As a result of the implementation of this project, the following effects are expected.

Problems	Measure taken in the Japanese assistance	Direct effects, extent of improvement	Indirect effects, extent of improvement
The supply of fresh fish from the remote atolls is unstable because the facilities of MIMRA, which is responsible for transport of fresh fish from the Outer Islands to Majuro, are small and the equipment including the fresh fish collection boats are of the wear and tear and insufficient. Also, in its distribution the quality of the fish is degraded. There is insufficient fresh fish supply to Majuro, and the fishing activities in the Outer Islands is stagnating.	・Construction of a fish market facility, and a dock ・ Procurement of equipment ・Implementation of soft components for improvements in handling fresh fish	(1) The number of trips of the fish collection boats will increase, so the volume of fresh fish shipped from Arno, Aur, Maloelap, and Jaluit Atolls to Majuro will increase from the 23 tons/year in 2007 to about 100 tons/year. (2) By increasing the volume of fresh fish purchased in the Outer Islands, the income of the fishers of Arno, Aur, Maloelap, and Jaluit will increase from the US$42,487/year in 2007 to approximately US$180,000/year. (3) By installing a solar power system, about 8,000kWh of commercial electricity consumption will be saved. (4) The following effects are expected by implementing the soft components. 1) Handling of the fresh fish after collection from the Outer Islands will be improved, and developed the greater understanding of freshness management by those engaged in fish handling in the Outer Islands. 2) Efficiency of the series of handling operations such as landing of fresh fish from the fish collection boat, transport, sorting, weighing, etc., will be increased. 3) The freshness of the fish sold will be improved, and the fish will be sold in a manner to be acceptable by general consumers of Majuro. 4) The operation of the fish collection boats will become widely known, to make users more convenient. 5) The percentage of fish left unsold will be reduced as a result of the improvement of freshness of the fish and convenience for the consumers of Majuro.	(1) Opportunities for earning cash in the Outer Islands will be increased, which will contribute to support the Outer Island communities, and reduce the migration of population to the urban areas. (2) Increasing the volume of fresh fish transportation will contribute to change the Majuro residents' dietary habits away from imported food to domestically produced sea food.

3-2 recommendations

In order to more efficiently and effectively implement this project, it is recommended that careful consideration should be paid to the following points.

1) **Establishment of the fish collection boats operation system as early as possible and maintaining regular trips to the Outer Islands**

The fish collection operation will play an important role in vitalizing the fisheries in the Outer Islands and matching demand for fresh fish in Majuro with supply by the fish collection boats. Fishers in the Outer Islands strongly desire more frequent fish collection trips, and the consumers of Majuro are demanding an increase in the deliveries of fresh fish. To respond to this situation it is necessary that MIMRA establishes a sustainable operation plan, and maintain regular fish collection trips. Achieving a regular operation of the boats will also add convenience for passengers and users for cargo shipping, and is important for bringing consumers to the fish market.

2) **Maintenance of the facilities and equipment and ensuring the budget for operation**

MIMRA has kept remarkably running the fish collection operations over more than 20 years, but in the past few years activities have stagnated as a result of frequent breakdowns of the boats due to the wear and tear and the rapidly rising cost of fuels. The fish collection operations would be kept running at a loss even after the project had been implemented, but in order to continuously develop these operations in response to the strong wishes of the fishers in the Outer Islands, it is necessary to maintain appropriately the fish collection boats and facilities in good condition. In addition, it is important to add value to the products sold at the market in order to increase income as much as possible, and to ensure the budget to subsidize for the loss on operation activities.

3) **Recognizing the needs of consumers**

In order to sell fresh fish from the Outer Islands to the consumers of Majuro, who have a strong preference for fish caught in Majuro, it is necessary not only to ensure quality of fish and arrange the retail prices but also to present the fish in assortment forms that the consumers can accept. It is necessary to recognize the needs of consumers, and to provide products reflecting the consumers' wishes for promoting the sale of the Outer Island fresh fish.

4) **Effective resource management**

It is believed that the fishing pressure for reef fish in the Majuro Atoll has already reached its limit, and in the Arno Atoll also the stage where it is necessary to implement appropriate resource management is approaching. Although it is considered that there is still some margin of the fishing resources in the Outer Islands, it is necessary to assess the resources allowable catch to develop the fish collection operations sustainably and to ensure the food security, and in the future to carry out effective resource management as necessary.

5) **Prevention and Mitigation of Environmental and Social Impacts**

In order to prevent and mitigate environmental and social impacts by the implementation of the project, it is necessary that MIMRA take the following measures;

- To hold meetings regularly with the owners of retail shops and gas stations and to solve the problems in case that were found in the meetings
- When a cyclone approaches, to pay attention to the weather conditions and to take refuge fish collection boats timely so that to avoid risks.
- To take precautions not to dump fish remnants and garbage directly to the sea, as well as to treat wastewater appropriately, in order to maintain the environment properly in the surrounding sea area.
- To prohibit vehicles from idling engines during parking so that to reduce emission of stench and noise.
- To continue monitoring the water quality regularly at the water area in front of the planned site, one of the water quality monitoring points of the EPA.
- To instruct the boat crews to observe safe navigation strictly.