No. 1

MINISTRY OF MARINE RESOURCES
ERITREA

BASIC DESIGN STUDY REPORT ON ARTISANAL FISHERIES DEVELOPMENT PROJECT IN THE SOUTHEAST OF ERITREA

FEBRUARY 1996

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BASIC DESIGN STUDY REPORT ON ARTISANAL FISHERIES DEVELOPMENT PROJECT IN THE SOUTHEAST OF ERITREA FEBRUA

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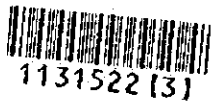
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BASIC DESIGN STUDY REPORT
ON
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IN
THE SOUTHEAST OF ERITREA

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PREFACE

In response to a request from the Government of Eritrea, the Government of Japan decided to conduct a basic design study on the Artisanal Fisheries Development Project in the Southeast of Eritrea and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Eritrea a study team from August 6 to September 19, 1995.

The team held discussions with the officials concerned of the Government of Eritrea, 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 Eritrea 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 of Eritrea for their close cooperation extended to the teams.

February, 1996

Kimio Fujita
President
Japan International Cooperation Agency

February, 1996

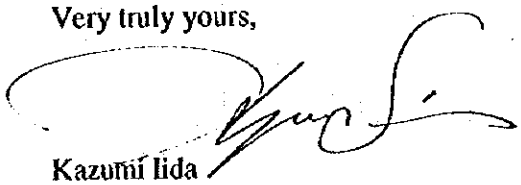
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Artisanal Fisheries Development Project in the Southeast of Eritrea.

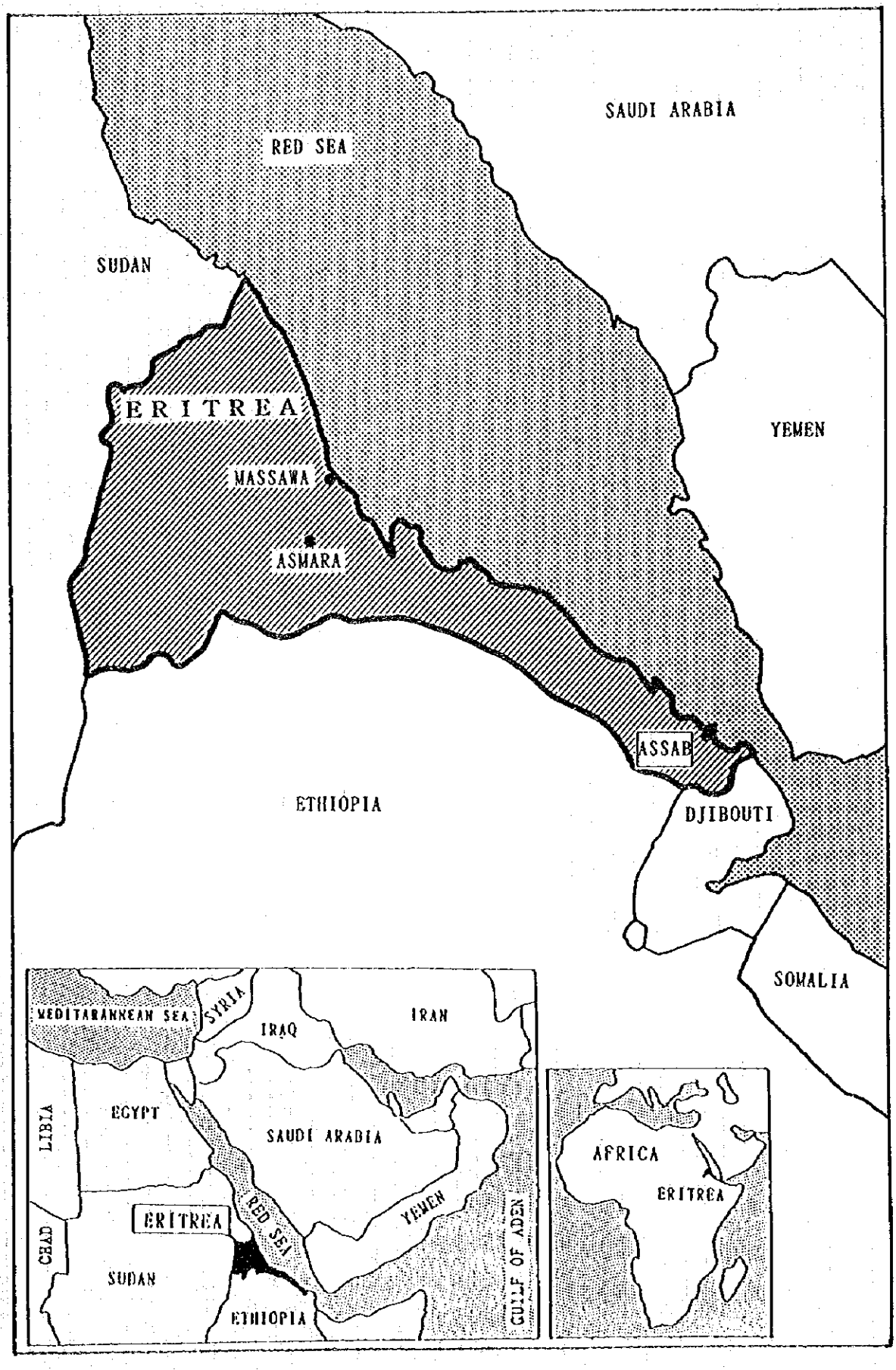
This study was conducted by Overseas Agro-Fisheries Consultants Co., Ltd., under a contract to JICA, during the period from July 31, 1995 to February 5, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Eritrea 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,



Kazumi Iida
Project manager
Basic design study team on
the Artisanal Fisheries Development Project
in the Southeast of Eritrea
Overseas Agro-Fisheries Consultants Co., Ltd.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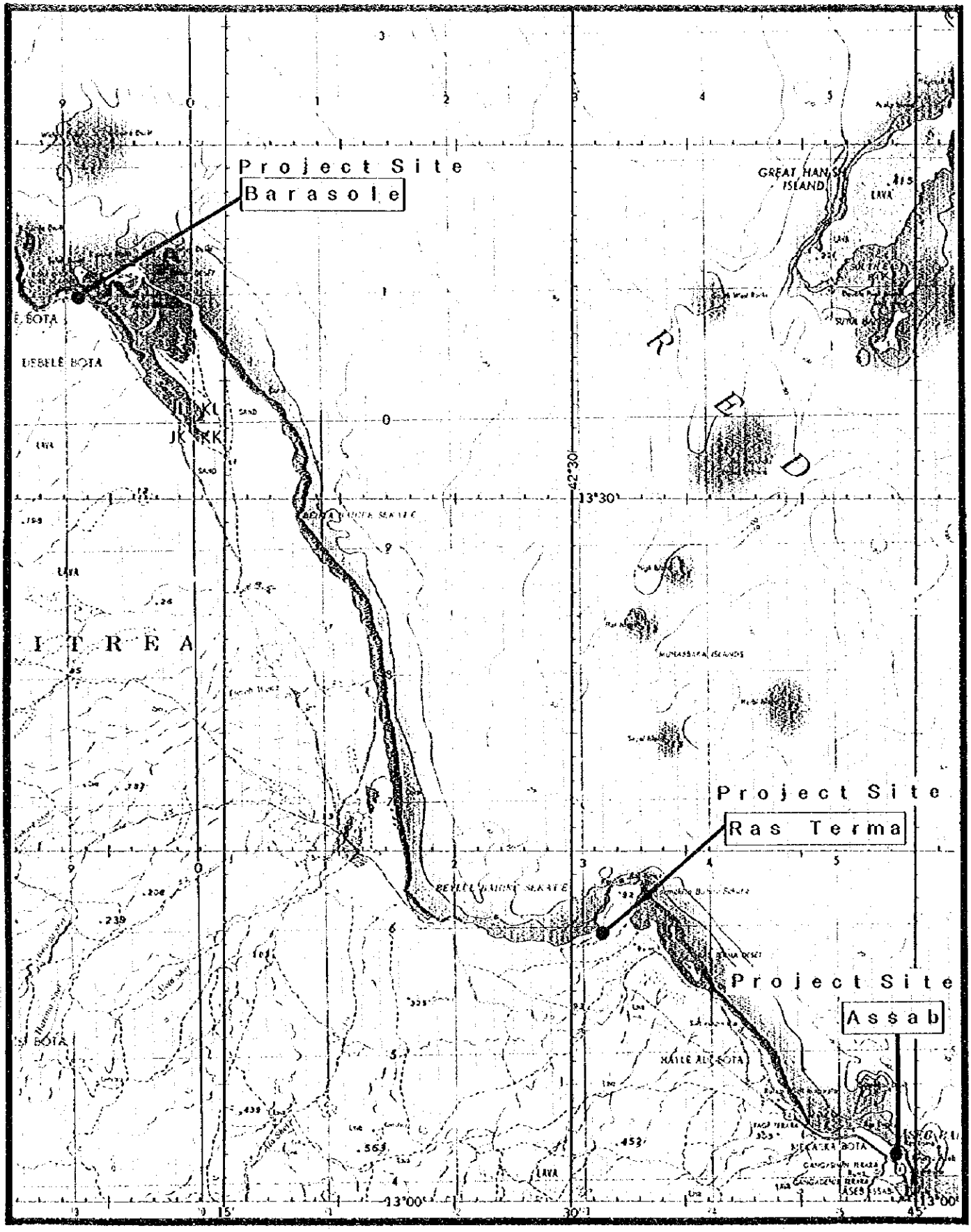
Project Site
Barasole
Project Site
Ras Terma
Project Site
Assab
GREAT HANISH ISLAND
LAVA
DEBELE BOTA
I T R E A
R E D S E A
MUNASSIRA ISLANDS
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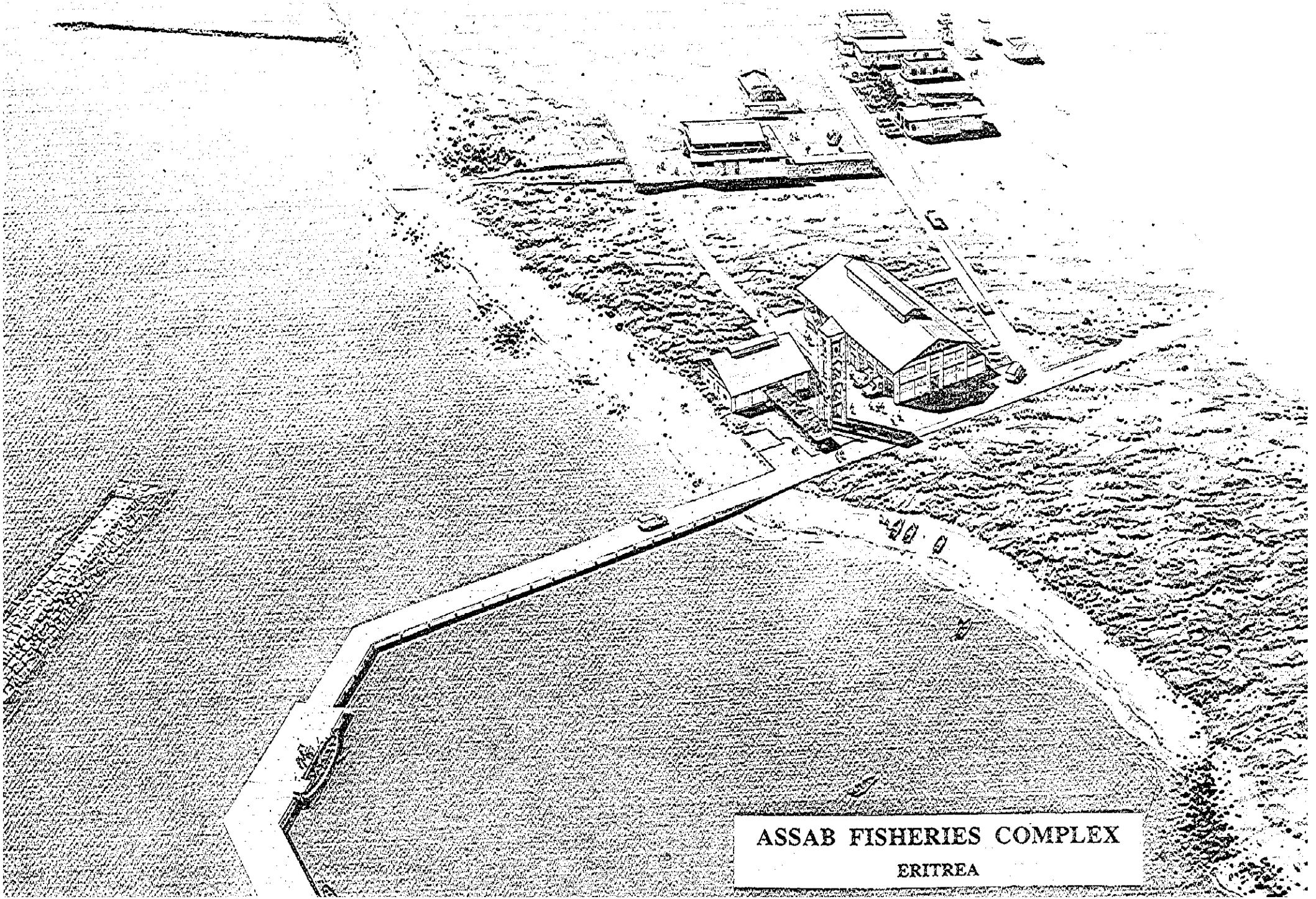

ASSAB FISHERIES COMPLEX
ERITREA

Contents

Appendices

Chapter 1. Background of the Project

Eritrea achieved independence as the 53rd country in Africa in May 1993 after the struggle over 30 years. However, the protracted warfare and natural disasters such as drought have impoverished both the economy and the lives of the country's people.

The Government of Eritrea has planned reconstruction projects in the sectors of transportation, agriculture and industry. Yet, as 70% of the population reportedly depends on food aid to some extent and the demand for food will increase as the approximately 750,000 people who fled due to the civil war return, a serious food shortage is predicted. In response, the government is focusing on emergency self sufficiency projects in the primary industries of agriculture, fisheries and livestock. The export of fishery products is also being considered to earn foreign exchange necessary for reconstruction of the country.

Fisheries of the country flourished before the civil war, with annual catches of 8,400 to 25,000 tons in the 1950's. During this period over 20,000 people were involved in fisheries, however, the fishing population has been greatly reduced as most fishermen were forced to change to other livelihoods or flee the country due to the protracted warfare. This devastated the fishing industry and reduced the production to the current 400 tons/year level. In order to improve this situation and promote the fishing industry, some projects have been implemented in the Massawa and Assab regions with assistance of UNDP/FAO and other organizations. However, the scope and scale of these assistance projects are still insufficient and further cooperation based on regional development plan is deemed necessary.

In September 1994, the Government of Japan sent a project identification survey mission to Eritrea to commence economic assistance for the country. The mission found need of construction of infrastructures, and assistance to increase food production. The fisheries development project in the southern region, which was strongly requested by the Government of Eritrea, was assessed and was found as a prospective project for Japanese grant aid from the point of view of both providing a stable food source and creating an export industry.

The Project described in this report is a result of the request for grant aid to construct facilities for promotion of fisheries in the southern region of Eritrea. The Government of Eritrea submitted the original request in September 1993, and thereafter revised and re-submitted the request in November 1994 after considering the results of the project identification survey mentioned above.

Chapter 2. Contents of the Project

2-1 Objectives of the Project

The coastal waters of Eritrea have a continental shelf with many small islands, making them suitable for artisanal fishing. This is an important resource for Eritrea. The development and promotion of a fisheries industry based on the effective use of this resource is necessary for the recovery of Eritrea and its long term economic development. Such development would lead to the achievement of the following goals: i) Securing a livelihood for the people living in the coastal areas, increasing employment opportunities; ii) supplying the people of Eritrea with food; and iii) acquisition of foreign currency through exports. The objective of this Project is to promote the fisheries industry in the southeastern part of Eritrea, centered on Assab, by strengthening the production and marketing of the catches. To accomplish this in the target area where there currently are no operating fisheries facilities, the Project will construct the fundamental fishery facilities and provide equipment as the first investment to promote local fisheries.

2-2 Basic Concept of the Project

2-2-1 Obstacles to the Promotion of the Fisheries Industry and Measures to be Taken

Eritrea's coastal area is dotted with fishing villages and fishing on a small scale is conducted by the inhabitants. Most of the catch, however, is reportedly landed in neighboring countries.

The reasons for this are:

a) Lack of fishing and marketing facilities. Because of the lack of transportation and storage facilities, it is impossible to market the catches.

b) Undeveloped consumer market for marine products. Even if catches are landed, they cannot be sold at once, and the lack of storage facilities causes them to be spoiled.

c) Lack of fisheries support facilities, such as fuel, ice and water facilities. In local fishing villages, it is difficult to obtain fuel, fishing gear, repair parts, etc.

d) Aged fishing boats and engines.

Conversely, the fishermen in the project area can at least sell their catches and procure various supplies in the neighboring countries, when they land their catches there. The situation in Yemen is:

a) Sales routes for catches have been established. Although the transactions are controlled by agents and Eritrean fishermen are subjected to disadvantageous conditions compared with local fishermen, any catches landed there are certain to be sold.

b) The fishermen can procure food, fuel, ice, water, fishing gear and other supplies necessary for fishing as well as everyday goods. (In general these items are purchased through barter.) Their prices are generally lower than those in Assab.

c) Local agents and buyers provide loans for fishing boats, engines and other supplies.

d) Under conditions in which there is no ice, nor refrigeration facilities, fishing for sharks and sun drying the catch is possible. There is a demand (sales routes) for such products and dried shark in Yemen.

Because of these circumstances, the Eritrean fishermen have no other way but to land their catch to the neighboring countries where they can at least sell their catches and at the same time, purchase fuel, ice, foodand , daily goods. This is a reason why they have landed their catches in the neighboring country. Due to the same circumstances, the fishing and landing of the catches have been stagnated in the Project area, while most of the catch and products have been sold in the neighboring country.

In order to improve these conditions and promote the artisanal fisheries, the following measures must be taken.

Development of marketing:

Construction of landing, collection, storage and transportation facilities for the catch.

Development of markets, and sales channels.

Expansion of consumer demand by promoting the eating of fish.

Support for fishermen:

Supplying of fishing boats, engines, fishing gear and other equipment necessary for a fisheries industry.

Support for fishing activities, such as supply of fuel, ice, water and the like.

The basic planks of this Project are: i) development of marketing of fish; and ii) support for fishing, i.e., making it possible to procure fuel, ice, fishing gear and other supplies. These will create a condition in which fishermen will be able to operate on a continuous basis in the project area.

1) Measures for Marketing

Domestic Distribution: Because of lack of roads, marketing from the Project area to Asmara and other domestic cities is impossible for the time being (except a few products such as lobsters, which can be shipped by air). Therefore, this Project will focus on marketing in the project area centering on Assab.

Enlightening and instructing the inhabitants about eating fish and supplying suitable fish are required to expand consumption of fish and increase demand as we described earlier. Fish markets must be opened in urban areas and places where people gather (or fish should be sold from automobiles or bicycles). It is necessary to periodically supply fresh fish in an area which is easily accessible to the inhabitants. In this Project we shall instruct the fishermen's cooperatives and retailers to promote the expansion of fish sales and consumption in the Assab area by using existing retailers. In order to support these efforts, we shall introduce and construct the facilities and equipment (such as facilities for landing, collecting and transporting the catch) necessary for a stable supply at the wholesale level.

Foreign Distribution: Exportation of marine products is one of the major objectives in developing the fisheries industry in Eritrea. This factor is also included in this Project as a major element.

Being different from Massawa which is relatively close to Asmara, the capital of Eritrea, there are no other cities, which could provide large markets, in the Assab area. Assab, however, has good access to Addis Ababa, the capital of Ethiopia. Therefore, shipment and sales to the Addis Ababa market is an important element for marketing of fishery products, which are indispensable for the promotion of the fisheries industry in the Project area.

The recent production of fisheries products in Ethiopia is shown in the following table.

	1988	1989	1990	1991	1992	1993	1994
Freshwater fish	3.4	2.7	3.8	4.1	4.5	4.2	—
Marine products	0.7	1.5	1.2	0.1	0.1	—	—

(× 1000 tons) (FAO Yearbook)

Until the secession of Eritrea, the annual consumption of marine fish in Ethiopia ranged from between 600 and 1,500 tons per year. Eritrea was the fisheries production center of Ethiopia, and it is estimated that 300 - 500 tons per year of the above production was consumed within Eritrea and 300 - 1,000 tons per year was consumed in Ethiopia, mainly Addis Ababa. In statistical terms, it can be considered that, following the independence of Eritrea, the production of freshwater fish has increased to supplement

the lost marine fish, however, as general tastes towards marine fish have remained unchanged, a consumption level of at least 300 tons per year within Ethiopia can be expected.

One of the basic conditions of this Project is that the Project implementing agency of the Eritrean government will promote and realize the development of markets of fish. This Project is to provide landing, collecting, refrigeration facilities and equipment which are necessary for promotion of marketing the local fisheries.

2) Support Measures for Fishing

One of the main obstacles to the fisheries is undeveloped consumer demand and lack of facilities / measures for merketing the catches. Producers require easy landing of the catches, ability to sell their catches at any time, and, for distant areas, the ability to transport their catches to Assab. This aspect will be handled together with measures for merketing which was described in the preceding section.

In addition to the above, the ability to locally supply fuel, ice, water, fishing gear, spare parts and other materials is important if the fishermen are to operate locally on a continuous basis.

Therefore, this Project will provide facilities necessary for landing, marketing the catches and supplying material for the fishing boats. Currently, fishermen are obtainging the supplies in Yemen in exchange for their catches. In order to cope with this situation, supporting measures from the government of Eritrea are necessary in regard to the providing supplies in this Project. This is especially true for fuel, so that it will have to be supplied at a special discount to the fisheries industry.

With respect to fishing villages and areas of operation which are far from Assab, facilities and equipment to provide the above materials and allow shipment of catches shall be established (local fisheries stations). This will allow support for fisheries operations in local areas, and shipment of catches to Assab.

Concerning antiquated fishing boats, engines, fishing gear and the like, and the lack of same, such equipment shall be supplied.

In regard to shipment of catches from local fishing villages and landing sites, the initial request called for the collection and transportation of the catches by ship. This plan was made because of the lack of roads at the time. Currently, the main fishing villages in the Project area are connected by roads, so that overland transport is possible. Therefore, we have determined that overland transport with refrigerated trucks is best because:

i) Operation expenses for ships is higher than that for land vehicles, and ii) it would take them eight hours for a one way trip between Assab and Barasole.

Based on the considerations above, this Project shall establish Assab as the center of landing, shipment and distribution, and Barasole and Ras Terma as fisheries industry support and collecting sites for shipment of fish to Assab and for support of fisheries activities. Therefore, a fisheries complex will be constructed at Assab, and it will include: catch landing, distribution, frozen storage, ice making, fishing boat supply, catch collecting and distribution, and other functions. Local fisheries stations will be constructed at Barasole and Ras Terma for the collection of catches and supplying of fishing boats. The transportation and distribution equipment and fisheries production equipment necessary for these activities will also be installed and constructed.

2-2-2 Setting the Project Scale

This Project will be centered on Assab, and will include the area with Barasole in the north and Rahyta in the south. The fishermen who live in this area will be targeted by this Project. The number of fishermen and fishing boats in the target Project area, based on the fishermen and fishing boat registration material for March to August, 1995 compiled by the Ministry of Marine Resources (MMR), are as follows.

Number Fishing Boats and Fishermen in the Target Project Area

Fishing villages	Fishing Boats		Fishermen
	Houri	Sambuk	
Barasole	15	2	103
Beylul	3	0	23
Assab	25	7	253
Kiloma	2	0	11
Gahro	1	0	9
Rahaita	9	2	73
Total	55	11	472

(MMR material; licenses issued between March through August, 1995)

(1) Providing of Fishing Boats and the Number of Fishing Boats Targeted by the Project

Fishermen who had fled to avoid the civil war are returning, so that the number of fishermen is increasing rapidly, however, only a small percentage of these fishermen have fishing boats, so that a growing number of fishermen are going unemployed.

In Houri two to four fishermen board one boat, and in Sambuk about five to seven board one boat. Because of the aging fishing boats and engines, and the increase in fishermen, however, there is a lack of fishing boats. This means that many fishermen cannot find boats to board.

In the current fisheries project being implemented with the cooperation of the UNDP, UNCD and FAO, FAO specialists are giving technical instruction in the construction of fishing boats (Sambuk type), and the first boat is being made. The plan calls for a capacity to build eight boats a year in the future. Because it takes a considerable amount of time for workers to become skilled and because of the difficulty in procuring lumber, however, the actual construction capacity will be about two boats a year for the time being. By the time that this project is completed in 1998, it is projected that about seven boats will be completed. In order to support the construction of these boats, the Project will supply engines.

Because the existing fishing boats and engines are aging and because it is believed that fishermen shall continue to return for some time, the construction of the boats above alone cannot make up for the lack, so that it will be necessary to include fishing boats in the production equipment to be provided. In order to cope with this situation, a number of fishing boats that are about the same as the Houri type will be provided, so that local fishermen will have a chance to work and the fisheries production capacity will be increased.

Fishing village	Numbe· of fishermen	Number of existing fishing boats		Boats being constructed by the FAO project (Sambuk)	Number of fishermen who can operate fishing boats	Number of fishermen who cannot board fishing boats
		Houri	Sambuk			
Barasole	103	15	2	---	57	46
Beylul	23	3	0	—	9	14
Assab	253	25	7	7	159	94
Ktoma	11	2	0	—	6	5
Gahro	9	1	0	—	3	6
Rahaita	73	9	2	—	39	34
Total	472 people	55 boats	11 boats	7 boats	273 people	199 people

This Project plans to supply one fishing boat for three fishermen. This will be enough to cope with about half of the fishermen who cannot board fishing boats. Together with the fishing boats being constructed under the UNDP, UNCD and FAO fisheries project, the number of fishing boats in the Project area will be as shown below. This number will be considered the targeted number of fishing boats in the Project.

Fishing village	Existing number of fishing boats		Boats being constructed by the FAO project	Fishing boats to be supplied by this Project	Total
	Houri	Sambuk	(Sambuk)	(Houri)	
Barasole	15	2	—		
Beylul	3	0	—		
Assab	25	7	7		
Kiloma	2	0	—	30 boats	103 boats
Gahro	1	0	—		
Rahaita	9	2	—		
Total	55 boats	11 boats	7 boats		

(2) Landing of Catches

Because it is currently impossible to procure ice, store landed fish, and because of lack of marketing measures, the quantity of the landed catch in the Assab area is much lower than that in the Massawa area. By eliminating these limiting factors, it will be possible to promote fishing and increase the landing of catch in the Assab area.

This Project is to eliminate these limiting factors by providing facilities and equipment, so that fishing activities in the Project area are supported and the catch is increased. It is one of the objectives of this Project to increase the landed catch to the same level as that in the Massawa area in about three years after the implementation of this Project.

The annual landed catch by the fishing boats in the Massawa area is between 360 to 370 tons.

Landed Catch (Unit: tons. According to MMR statistics.)

Year	Assab area	Massawa area
1992	34 (Aug. to Dec.)	364
1993	50	367
1994	53	371

*** The figures above are according to an MMR survey on landed catches. These figures do not indicate the total catch by local fishing boats because some of the catches are landed at other areas.

The fishing methods used in both areas are the same, and their CPU (catch per unit effort of fishing) are also about the same. There are 117 fishing boats operating in the Massawa area, of which 98 are Houri (84 percent) and 19 area Sambuk (16 percent). In comparison, 103 fishing boats are targeted by this Project, of which 85 are Houri (83

percent) and 18 are Sambuk (17 percent). This means that the compositions of fishing boats in both areas are about the same. Therefore, it is possible to estimate the landed catch in proportion to the number of fishing boats. By providing facilities for supply of ice, fuel, etc., and market of fish to promote local landing of the catch, the target quantity of landed catch in this Project will be set as shown below (in a condition that they land their catches as same level as in the Massawa area).

Targeted quantity in this Project
= Planned number of the fishing boats in the project area / Number of fishing boats at Massawa x Landed catch in the Massawa area 360 tons

= 316 tons/year

= 310 tons/year

(3) Number of landing catches at the Project Facilities to Achieve the Target Landed Catch

As was mentioned above, the Project aims to raise the quantity of landed fish at the Project facilities to 310 tons per year by the third year following completion of the facilities construction and the equipment provision. The required number of landings by fishing vessels at the Project facilities in order to achieve this fish landing target are estimated in the manner shown below.

The average fishing trip duration and landed quantity per trip by fishing vessel type are set as shown below.

	Houri	Sambuk	New Fishing Vessel
Days per Trip	2 days/trip	4 days/trip	2 days/trip
Landed Quantity per Vessel per trip (*1)	80 kg/trip	200 kg/trip	80 kg/trip

(*/1): The landed quantities per trip are based on MMR data (catch CPUE in Assab area)

The average number of fishing trips per year shall be 80 for the houri (160 days at sea per year) and 40 for the sambuk (160 days at sea per year). As for the new fishing vessels, because their seaworthiness is better and going out to fish is easier than in the case of houri, a fishing trip frequency 10% in excess of the houri is assumed.

The number of landings required to land 310 tons per year at the Project facilities, based in accordance with the aforementioned operating patterns, are obtained as follows.

	Houri	Sambuk	New fishing boats	Total
Number of fishing boats targeted in this Project	55 boats	18 boats (*/2)	30 boats (*/3)	103 boats
Catch landed per boat per trip	80 kg/outing	200 kg/outing	80 kg/outing	
Average number of landings per boat per year	35 times/boat/year	18 is is times/boat/year	40 times/boat/year	
Quantity landed at the project facilities	153 tons	64 tons	94 tons	310 tons

(*/2) Including the seven fishing boats to be constructed by the UNDP, UNCD, and FAO fisheries project.

(*/3) New fishing boats to be provided by this Project.

(4) Number of Fishing Boats to be Operated, Based on Each Project Site

The number of fishing boats to be operated, based on each Project site are set as follows.

The fishing boats for the Barasole station are those registered at Barasole. The fishing boats for the Assab fisheries complex are those registered at Assab and those fishing boats registered south of Assab (Kiloma, Gahro, Rahita). The fishing boats for the Ras Terma station are those registered at Baylule and those boats that move to Ras Terma during the fishing season.

The 30 new fishing boats of the Project shall be based in Assab and Barasole, where landing facilities are to be prepared under the Project. In accordance with the ratio of fishermen (in Assab, there are 369 fishermen south of Beylule, and 103 fishermen in Barasole), 23 of the fishing boats shall be stationed in Assab and the remaining seven boats shall is be stationed in Barasole.

Consequently, the number of fishing vessels which will use each of the Project facilities will be as follows.

	Houri	Sambuk	New fishing boats	Total
Assab fisheries complex	37	16	23	76
Barasole local station	15	2	7	24
Ras Terma local station	3	0	0	3

During the Ras Terma fishing season (October to May), some of the fishing boats will go to Ras Terma, and use Ras Terma as a base for their fishing operation. During that period the number of fishing boats at each Project site will be as follows.

	Houri	Sambuk	New fishing boats	Total
Assab fisheries complex	29	11	16	56
Barasole local station	15	2	7	24
Ras Terma local station (*/5)	11 (8)	5 (5)	7 (7)	23 (20)

(*/5) During the Ras Terma fishing season, fishing boats registered at Beylule and Assab will operate, based on Ras Terma. About one-third of the fishing boats registered at Assab will operate, based on Ras Terma during this period, so that the number of fishing boats which use Ras Terma local station is calculated by adding the Beylule registry boats to one-third of the Assab registry boats. The figures in the parentheses indicate the number of Assab registry boats.

(5) Number of Fishing Boats Landing Their Catches at each Project Site and Landed Catch Forecasts

The number of catch landings and the landed catch quantity are set for each Project site as follows.

1) Assab fisheries complex

	Houri	Sambuk	New fishing boats	
Number of fishing boats using Assab	37 boats	16 boats	23 boats	
Average number of landings per boat per year	35 times/year	18 times/year	40 times/year	
Total number of landings per year	1,295 times/year	288 times/year	920 times/year	
Average number of landing catches per day (assuming that there is 240 days a year, possible for fishing.)	6 boats	2 boats	4 boats	Total 12 boats/day
Annual landed catch total (*/6)	103.6 tons	57.6 tons	73.6 tons	Total 234.48tons
Average landed catch per day (*/6)	234.8 tons/year / 240 days = 978 kg/day = approx. 1.0 ton/day			

(*/6) Includes fish landed at Ras Terma station during its fishing season.

2) Barasole local station

	Houri	Sambuk	New fishing boats	
Number of fishing boats using Assab	15 boats	2 boats	7 boats	
Average number of landings per boat per year	35 landings/year	18 landings/year	40 landings/year	
Total number of landings per year	525 landings/year	36 landings/year	280 landings/year	
Average number of boats landing catches per day (assuming that there is 240 days a year, possible for fishing.)	3 boats	1 boat	1 boat	Total 5 boats/day
Annual landed catch total	42.0 tons	7.2 tons	22.4 tons	Total 71.6 tons
Average landed catch per day	71.6 tons/year / 240 days = 298 kg/day = approx. 0.3 ton/day			

3) Ras Terma local station

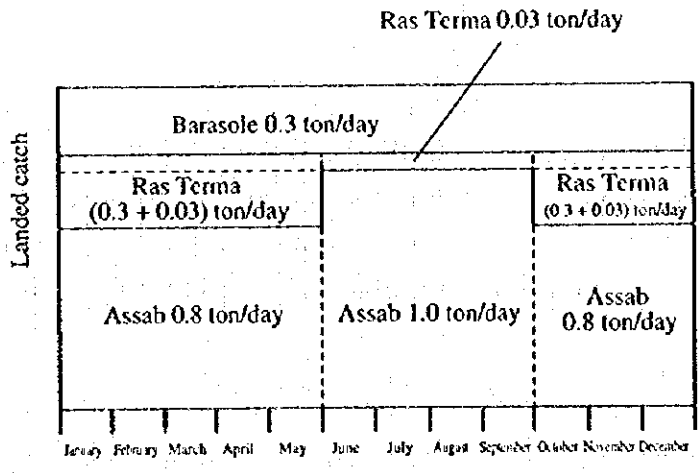
Landed catch by Beylule registry boats.

	Houri	Sambuk	New fishing boats	
Number of fishing boats using Assab	3 boats	—	—	
Average number of landings per boat per year	35 landings/year	—	—	
Total number of landings per year	105 landings/year	—	—	
Average number of boats landing catches per day (assuming that the number of possible fishing days is (240 days × 8/12) in a season.)	1 boat	—	—	Total 1 boat/day
Annual landed catch total	8.4	—	—	Total 8.4 tons
Average landed catch per day	8.4 tons/year / 240 days = 35 kg/day = approx. 0.03 ton/day			

Landed catch by Assab fishing boats from October to May.

	Houri	Sambuk	New fishing boats	
Number of fishing boats using Assab	8 boats	5 boats	7 boats	
Average number of landings per boat per year	35 landings × 8/12	18 landings × 8/12	40 landings × 8/12	
Total number of landings per year	187 landings/year	60 landings/year	187 landings/year	
Average number of boats landing catches per day (assuming that the number of possible fishing days is (240 days × 8/12) in a season)	1 boat	1 boat	1 boat	Total 3 boats/day
Annual landed catch total	15.0 tons	12.0 tons	14.9 tons	Total 41.9 tons
Average landed catch per day	41.9 tons/year / 240 days = 262 kg/day = approx. 0.3 ton/day			

The landed catch (average) at each Project site is shown as a graph below.



2-2-3 Consideration of the Contents and Scale of the Main Facilities and Equipment

(1) Assab Fisheries Complex

As the central site of this Project, facilities and equipment for landing catches, collecting catches, distribution, resupply, repair and other fisheries activities support functions will be constructed and supplied.

Fish landing jetty:	A pier which will allow fishing boats to dock alongside. It will allow landing of catches, and loading of fuel, ice, water, etc., so that preparations are simplified.
Fish market shed:	An area for delivering landed fish, separating and weighing them, selling the fish to buyers and other related work. This area will be connected to the refrigeration complex below.
Refrigeration complex:	This facility will be used for freezing and refrigeration of fish for export to neighboring countries. It will include work space for cutting and other pre-freezing work, a freezer and chilled storage. It will also have a ice plant to make ice for fishing boats and transporting fish.
Administration office:	This office will be used to manage and operate the complex facilities, conduct collecting and sales, etc.
Workshop:	A facility for repairing fishing boat engines, such as outboard motors.

The content and scale of the main facilities are as described below.

1) Fish landing jetty

The current fishermen's beach has a frontage of between 70 to 100 meters. Because it is a shallow reef with a depth of only 0.5 to 1 meter, entrance by boats is limited, and large fishing boats must moor outside the reef. There are no piers, so that landing fish, loading supplies and other work is very labor intensive and time consuming. In order to reduce both labor and time in order to promote Assab as a landing site, it is necessary to simplify the work of landing catches, and supplying fuel, ice, fishing gear and other necessary supplies.

In the future, harbor facilities which will provide a mooring area for fishing boats will be necessary. For the time being, however, we have focused on reducing the work of the fishermen and promoting the landing of catches. Therefore, a pier which will allow fishing boats to moor alongside to land their catches and load supplies will be constructed.

The length of the pier is set as shown below based on the average number of fishing boats which will be landing their catches per day as described in the preceding section.

i) Number of fishing boats landing their catches per day

	Houri	Sambuk	New fishing boats	Total
Average number of boats	6	2	4	12

ii) Landing time

In order to use one pier effectively for both landing and preparing for outings, and to reduce confusion, it will be necessary to set up a time schedule. The fishing boats from Assab usually go out in the afternoon, operate during the evening, night and early morning, then land their catches in the morning. Therefore, in principle, ships will be allowed to land their catches during the morning, and then ships will be allowed to refuel, load ice and make other preparations.

Such a system is also necessary to facilitate sales to distributors and retailers, and to make processing of fish at the complex efficient. In order to ship landed fish as soon as possible, and conduct processing and freezing in the fisheries complex with as little loss as possible, landing will be from 7:00 to 10:00 a.m. in principle, and each fishing boats will be allotted 40 minutes for mooring and landing catches.

iii) Fishing Boat Dimensions for Jetty Specifications

The dimensions of the Project fishing boats were set based on the measurement of boats existing in Assab and data from fishing boat registries in the Massawa region. Fishing boats in Eritoria are of two major types, the Sambak, and the Houri. Their sizes vary and the Sambak is not always larger than the Houri. When scale of boats differs widely, different jetties are to be prepared depending on the length and draft the boats, however, the dimensions of the fishing boats in the Project area are close enough to consider them as one group.

Therefore the boat length, width and draft for jetty specifications are set taking the average size of the largest 1/3 of the boats registered in the Massawa district.

Boat dimensions

Type of boat	Length	Width	Draft
Samabak Houri New boat	14.0 m	3.0 m	1.0 m

iv) Required number of berths

12 boats × 1 / (3 hours / 40 minutes/boat) = 3 berths

v) Required length of the jetty

(Average fish boat length Loa = 13.4 m) × 1.2 × 3 berths = 48.2 m
= 50 m

2) Fish market shed

The fish market shed will be an area for delivering landed fish, separating and weighing them, selling the fish to buyers and other related work. It will be connected to an area near the landing pier. In addition to providing a base for fishermen to delivery the fish which they have landed, and for holding transactions with fish retailers and buyers, the planned facilities management organization will also buy fish and accept fish delivered from other regions. The quantity of fish to be handled per day will be about 1.3 tons, including fish delivered from other regions. Therefore, we are planning on an area of about 6 meters by 12 meters to conduct the work described above. In order to facilitate delivery of fish by fishermen, the shed will be located near the landing pier, and it will be connected to the refrigeration complex. The layout will also be such to facilitate delivery by vehicle and to allow easy access by retailers and other buyers.

3) Refrigeration complex

The Project site does not have any storage or distribution facilities for fish. This is one of the main factors which is limiting the operation of local fishermen, and landing and distribution of catches. In order to cope with this situation, facilities shall be constructed to allow supplying fishing boats with ice, allowing chilled shipment of landed fish, and sales and distribution.

The size must be such that the facility can cope with fluctuations in the actual catch, so that the fluctuations in the catch must be considered.

The monthly catches at Assab and Massawa in recent years are shown below. The average catch for each month varies from 0.2 to 1.8 times the monthly average. The standard deviation for this fluctuation in the catch is 0.377, so we have set a size of 1.377 times the average monthly catch as a size which will cover about 85 percent of fluctuations.

Catch at Assab			Catch at Massawa			
1994			1993		1994	
	Tons	(a)	Tons	(a)	Tons	(a)
January	8.07	1.8	52.12	1.7	48.20	1.6
February	3.68	0.8	19.32	0.6	33.49	1.1
March	2.88	0.7	33.29	1.1	17.48	0.6
April	2.47	0.6	26.44	0.9	33.96	1.1
May	0.96	0.2	32.71	1.1	26.04	0.8
June	1.64	0.4	13.14	0.4	29.96	1.0
July	5.10	1.2	22.81	0.8	25.74	0.8
August	5.94	1.4	18.27	0.6	42.89	1.4
September	3.71	0.8	32.73	1.1	29.38	1.0
October	5.26	1.2	31.95	1.1	27.97	0.9
November	5.98	1.4	36.82	1.2	25.86	0.9
December	6.94	1.6	46.96	1.5	29.84	0.8
Average monthly catch	4.39		30.55		30.90	

(a) = Ratio of catch in each month against the average monthly catch.

a) Ice plant

(A) Ice for fishing boats

Quantity of ice required for fishing boats is estimated with a ratio of ice 1 for catch 1.

i) Assab and Ras Terma

	Houri	Sambuk	New fishing boats	
Number of boats going out per day (average) Assab (*/6)	6 boats	2 boats	4 boats	
Beylule registry boats	1 boat	—	—	
Ice required per boat (per each outing)	80 kg	200 kg	80 kg	
Daily requirements	560 kg	400 kg	320 kg	Total 1.3 tons/day

(*/6) Includes those boats that operate in Ras Terma during its fishing season and land their catches at Ras Terma station.

ii) Barasole

	Houri	Sambuk	New fishing boats	
Number of boats going out per day (average)	3 boats	1 boat	1 boats	
Ice required per boat (per each outing)	80 kg	200 kg	80 kg	
Daily requirements	240 kg	200 kg	80 kg	Total 0.5 ton/day

Demand for ice for fishing boats per day

(i) + (ii) = 1.8 tons/day

(B) Ice for storing and transporting fish

i) Barasole local station

Average daily catch: 298 kg

For storage: (1 to 0.5)

For transport: (1 to 0.5)

Required ice: 298 kg × (0.5 + 0.5) = 298 kg/day = 300 kg/day

ii) Ras Terma local station

Average daily catch: 297 kg

(= Beylule registry fishing boats 62 kg + Fishing boats from Assab 235 kg)

For storage: (1 to 0.5)

For transport: (1 to 0.5)

Required ice: 297 kg × (0.5 + 0.5) = 297/day = 300 kg/day

Therefore, the demand for ice for storing and transporting fish is,

(i) + (ii) = 0.6 ton/day

(C) Ice for use in the Assab fisheries complex

The average daily catch delivered, including that from local stations, is as follows.

1.29 tons/day (= 310 tons/year / 240 days)

The quantity of ice required for processing and storage is 0.2 part ice to 1 part fish, so that

1.29 tons × 0.2 = 0.26 ton/day

(D) Ice for domestic fresh fish sales

Ice used for sales of fish (one part fish to 0.5 part ice) is,

0.3 ton × 0.5 = 0.15 ton/day

Therefore, the total average daily quantity of ice required is as follows.

Total required ice = (A) + (B) + (C) + (D) = 2.8 tons/day

In order to cope with the fluctuation of 1.377 times in the average catch, which discussed in the preceding section, a ice making capacity of about 4 tons/day (= 2.8 tons × 1.377) is required.

In the MMR, UNDP, UNCD and FAO project which is currently being implemented, construction of a block ice making facility is included in the freezing facility addition to the existing refrigerated warehouse. During this survey, a brine tank was being added to the existing building which houses the refrigerated warehouse. When construction is completed and the equipment becomes functional, it is estimated that it will have an ice making capacity of about one ton per day. (The capacity of the brine tank is 102 × 25 kg ice making cans, and about 2.5 tons of water is being prepared for ice making. According to the construction plans, two 7.5 kW compressors will be used for this facility. The compressor capacity is sufficient for production of two tons of ice per day, but because the brine tank insulation construction and coolant piping construction are of low precision, we believe the actual capacity will be closer to one ton per day.)

Therefore, of the four tons of ice required per day, one ton can be provided from this ice making equipment, so that this Project will construct a ice making plant to produce three tons per day.

Ice Storage Refrigerator

In readiness for cases where the design ice consumption level of four tons per day is exceeded, and also to act as a stock during times of surplus, an ice storage

capacity of approximately 14 tons shall be considered. (The number of days where the landed load is ± 0.377 times the average landed load is estimated to be 70% or 14 days of the 20 landing days per month, and in this period, the demand for ice will vary between two and four tons. Assuming a daily ice consumption of three tons, a surplus of one ton per day shall be set).

When the planned refrigerators start functioning, it is considered that they will be able to store approximately 10 tons of ice. This leaves an additional four tons of ice in need of storage, however, the process from ice making to ice storage is integrated and, when one considers the normal ice making work, the ice storage refrigerator should be installed next to the ice-making machine as part of the ice-making facility. Moreover, at least a two-day stock of ice needs to be kept in order to make the ice hauling out work smoother. For these reasons, an ice storage refrigerator with a capacity of roughly six tons shall be installed next to the ice-making brine tank in order to make the ice making and hauling out work proceed sinoothly.

b) Freezer and refrigerated warehouse

(A) Fish sales plans

i) Catch per day (collected quantity)

1.29 tons/day (= 310 tons/year / 240 days)

ii) Sales plans

(a) Fresh fish sales in Assab

In Massawa, of the 360 to 370 tons caught every year, about 50 to 80 tons is consumed in Massawa. This comes to consumption of about two kilograms per person. In Assab, about 45 to 50 tons of the catch is consumed annually. This comes to about one kilogram per person, but the potential demand is greater than the supply. With improved retail sales in Assab and promotion of a periodic supply of fish under the instruction of the implementing MMR, demand is to be developed and consumption increased. In regard to the supply of fresh fish for local consumption, this Project shall provide enough fresh fish to meet the target of about 1.5 kilograms of fresh fish consumption per person.

Assab population 45,000 × Average consumption 1.5 kg/year = 68 tons/year

Daily sales quantity = 68 tons/year / 240 days

= 280 kg/day

(b) Sales to other markets

By lowering the current saltwater fish sales price and providing a stable supply, there is a potential demand of 250 tons a year in Addis Ababa. The Addis Ababa Fisheries Public Corporation which has about an 80 percent share of local fish distribution is a prospective client. This company is involved in collecting, processing and refrigerated storing of fish. Therefore, it has a total of 130 tons refrigeration capacity for ice making, refrigerated fish storage, freezing and the like. In order to increase its purchasing capacity and secure and increase a stable supply for its consumer market, it is also constructing a new refrigerated warehouse within the same plant. It is possible to make a tie-up with this company to use its refrigerated warehouse for shipment and sales. It is estimated that a refrigerated warehouse space of about eight tons will be available. We have planned for one shipment totaling eight tons, with 30 shipments a year for a total of about 240 tons shipped and sold per year.

(B) Freezer and refrigerated warehouse capacity

i) Freezer

Although the average daily quantity to be frozen is 1,000 kilograms (240 tons / 240 days), as we saw in the preceding section, the actual catch fluctuates from day to day and from season to season. In order to cope with this fluctuation and have the capacity to handle good catches, a capacity which is 1.377 times the average or about 1,400 kg/day is required.

The existing refrigerated warehouse which is under construction does not have fresh fish freezing equipment, so that this Project shall construct a freezer of the above capacity. The freezer will be divided into two compartments, so that adjustments can be made for small catches.

Freezing capacity = 1,400 kg/day

= 700 kg/day × 2 compartments

ii) Refrigerated warehouse

This facility will be used to store frozen fish destined for Addis Ababa and other foreign markets until they are shipped.

The plans call for shipments of eight tons to be made 30 times a year, so that 2.5 shipments will be made a month. In the case of an average catch, the average monthly production of 20 tons will be shipped 2.5 times a month, so that every time there is a shipment the warehouse stock will be nil. Therefore, the required refrigerated warehouse capacity in this case is eight tons.

In the case of a month in which production is 1.377 times the average, i.e., 26.7 tons, the end of month stock after two shipments are made will be 10.7 tons. If average production is achieved up to the next shipment, then four tons will be produced, so that the stock in the refrigerated warehouse will be 11.7 tons. In order to cope with this a refrigerated warehouse with a capacity of at least 11.7 tons is necessary.

When the MMR/FAO project's refrigerated warehouse construction is completed and if the freezing function works (although the degree of insulation, especially the insulation under the concrete floor, which was installed during construction of the building is not known, if insulation is sufficient), the compressor capacity (7 kW) indicates that one of the two compartments should be usable as a short term warehouse for frozen fish. (The other compartment will be kept at between 0 to -5 degrees centigrade, so that it will probably be used to store fresh fish and ice. Because fresh fish cannot be stacked, they must be placed in baskets or the like to allow cold air to circulate around them. Therefore, the capacity of this compartment is estimated to be about five tons. In the case of ice storage, the maximum height at which ice can be stored by hand is 1.2 meters, so that the capacity for ice is estimated to be about 10 tons.)

Because most frozen fish have an IQF with a round shape, they must be placed in baskets or the like, or partitions must be used to divide the various types of fish if stacking, inventory control and shipping stock to meet demand is to be conducted efficiently. Therefore, when stacking and shipment work space are considered, the capacity of this refrigerated warehouse is estimated to be about 8.9 tons (= 5.8 m × 4.3 m × 1.8 m × 0.2), but MMR has stated that the capacity is five tons.

Therefore, of the 11.7 tons which is required, five tons can be covered by the above refrigerated warehouse, and this Project will construct a refrigerated warehouse with a capacity of seven tons to cover the deficient capacity.

Refrigerated warehouse capacity = Required refrigerated warehouse capacity 11.7 tons - Capacity of the refrigerated warehouse under construction 5 tons

= 6.7 tons

= 7 tons

4) Administration office

An office and meeting room shall be provided for the operating body of the Project facilities. The number of office users and the room areas are planned as follows:

Office: Approx. 72 m^2

(6 m^2x 9 people + manager 12 m^2 + storage space 6 m^2)

Meeting room: Approx. 72 m^2

5) Workshop

In addition to repairing the boats, there are many cases in which boats cannot be operated because engines cannot be repaired, so that a supply of parts and repair services are required. In order to cope with this need, fishing boat engine and outboard motor repair facilities and equipment shall be constructed and supplied as part of the fisheries activities support facilities. As part of the MMR/FAO project, FAO specialists are giving technical instruction on repairing engines, so that the technicians trained in this project shall mainly be responsible for repair services and instructing fishermen on engine maintenance. We are planning on a work area of about 12 meters by 18 meters, including the parts storage area.

Administration office and locker room: About 36 m^2
(6 m^2× 4 mechanics + Locker room 12 m^2)

Tool and part room: About 36 m^2

Work area: About 140 m^2

6) We considered completing the uncompleted slipway at the fishing boat shipyard in the MMR/FAO project in this Project. In order to launch a fishing boat under construction in the shipyard, a depth of two meters in required when the slip is considered. Also, after the vessel is launched a certain amount of area is required to operate the vessel (At a minimum, approximately 20 m in width, 30 m in width on the sea side and 40 m in length). In order to construct such an area, the 0.3 to 0.7 meter deep reef in front of the slipway would have to be deepened. According to a local boring survey, the reef is made of volcanic rock (basalt) and

has a depth of two meters or more. In the soil bearing capacity test, there is a reaction and the N value is extremely high. This excavation would involve either blasting or using a rock crusher, and this would involve a high works cost. In contrast to this, the slipway would only be used a few times per year, and the economic effect in terms of the works cost would not be so great. Moreover, the accumulation of sand within a short period in the excavated section can be considered, and this would sew the seeds for maintenance problems following the completion of the slipway. In consideration of these points, it was decided to give up on the idea of slipway construction within the Project.

(2) Local Fisheries Stations

Local fishing villages are located at some distance from Assab and they have no means of refrigerating their catches, nor do they have ways to ship them. In addition, it is difficult for them to procure fuel and fishing gear. Because of these conditions, little of the local catch is landed locally, and the fishermen have to depend on Yemen for their fisheries activities, including the sales of their catches. In order to promote local fisheries, local fishermen must be provided with the opportunity to ship fresh fish locally, and it must be possible for them to procure the items they require for fishing and their daily lives. In order to cope with this situation, the facilities and equipment described below will be constructed at Barasole and Ras Terma to support fisheries activities and as collection points for the local fishermen's catches. In addition to supporting the operation of fishing boats by supplying fuel, ice, water and other supplies, these stations will provide temporary refrigerated storage of catches and shipment to the Assab fisheries complex. We are planning for the facilities and equipment required to provide these functions.

1) Barasole

This is the most likely local fishing village in the Project area. The construction of facilities for landing and marketing catches, supplying and other functions will be effective in revitalizing the fisheries activities of residents. The fishing village is on a beach which is surrounded by small islands and a cape, so that the waters are quiet. The following facilities and equipment will be constructed on this beach.

a) Simple jetty for fishing boats: A simple pier which will allow fishing boats to moor to land their catches, and get supply of fuel, ice, water and others.

The jetty will be of a size to allow one fishing boat to moor on either side.

b) Supply and collection facility: This facility will be connected to the pier, and insulated boxes for stowing ice and fish a management booth, and a generator for

lighting will be provided. Ice and fuel for supply to fishing boats will be stored, and catches will be kept in insulated fish boxes with ice for marketing to Assab.

2) Ras Terma

In an area which is surrounded by shallow reefs, Ras Terma has a sand beach which fishing boats can approach and moor. This area has a rich fishing area and provides quiet sea during the prevalent SE-SSE winds season from October to May. Therefore, this is the main season in which fishermen operate and Ras Terma becomes a fisheries camp. If it becomes possible to land and send catches from Ras Terma to Assab, as well as supply fuel, ice, water for the fishing boats, operations will become very vigorous. Therefore, a simple supply and collection station with the following equipment should be established at Ras Terma.

a) Supply and collection facility:
Insulated boxes for stowing ice and fish, and a generator for lighting will be provided. Ice and fuel for fishing boats will be stored in the station and provided to the fishing boats, Storage chilled with ice will be provided for catches, and the catches will be shipped.

(3) Main Equipment

1) Equipment for the Assab Fisheries Complex

It is planned to introduce the following equipment at the Assab fisheries complex for handling, processing and shipment of catches, collection of catches from local stations (Barasole and Ras Terma), and for transporting supplies for the fishing boats.

a) Refrigerated truck: One refrigerated truck (Approx. 8-ton)

A truck for shipments of frozen fish to Addis Ababa market.

b) Insulated truck: One insulated truck (Approx. 2.5-ton)

This truck will be used to transport fresh fish and ice between the Assab fisheries complex and the local stations at Ras Terma and Barasole.

c) Equipment for handling fish: fish boxes, hand carts, balances processing tables and other equipment to be used in the Assab fisheries complex for handling fish.

The main items are as follows.

Fish boxes

Plastic fish boxes of 100 liters (20 kg) capacity: 200 pcs in total

(Breakdown)

Fish boxes for landing fish at piers:
Average landing quantity 1 ton/day × 1.377 / 20 kg = 70 boxes

For collection from local stations:
Average landing quantity 0.6 ton/day × 1.377 / 20 kg = 40 boxes

For use in markets and fish processing center:
Average landing quantity 1.3 ton/day × 1.377 / 20 kg = 90 boxes

Hand carts:
Two pcs. for transporting landed fish, frozen fish and ice.

Two-wheeled barrows:
Ten pcs. for transporting fish and ice to the landing piers and in the work places.

Processing tables:
Eight pcs. for processing fish before freezing, such as gutting.

d) Truck for transporting material: One heavy-duty truck with a hydraulic crane.

This truck will be used to support the local stations and local fishing villages. It will be used to transport fuel, fishing gear, engines, and the like.

In order for local fishermen to be able to work from their home bases, they will require methods for shipping and distributing their catches. They will also require periodic supplies of fuel, fishing supplies and the like. In order for Barasole and Ras Terma to function as bases for local fisheries activities that can supply fuel and fishing supplies, a method to ship such supplies to these local stations from Assab is indispensable. In the Project area which does not have any other methods of transportation, a vehicle to transport supplies is necessary. We are planning the introduction of a truck which is suitable for shipping supplies and equipment.

e) Workshop tools

These are equipment and tools for the workshop which is to be constructed in this Project. These are necessary for repairing fishing boat engines, outboard motors and the like.

One set of repair tools for outboard motors, small diesel engines, etc.

f) Project service vehicle

This vehicle will be used for giving instruction to fishermen, promoting the landing of fish at the Project facilities, promoting collection and shipment work, and to promote the other work in this Project. In the Project area which does not have any other methods of transportation, this vehicle is indispensable.

One double-cab pickup truck

g) Radio equipment

This is a wireless telephone system which will be used for communication between Assab, Ras Terma and Barasole. In the Project area which does not have any means of communication, this equipment is indispensable for the efficient use of collection vehicles, materials handling vehicles, etc.

One set of SSB radio

2) Materials for supporting fisheries work

2-1) Fisheries production materials

n order to reinforce the supply of fisheries materials, we are planning the introduction of the following materials. These materials will be supplied to the local fishermen through the fishermen's cooperative.

a) Fishing boats

Because the existing fishing boats and engines are growing old, and the number of fishermen is increasing, there is a lack of fishing boats, so that many fishermen do not have a chance to board a fishing boat and work. Although fishing boats are being constructed by the MMR/FAO project, it will take many years to train craftsmen who are skilled in making fishing boats. In addition, the number of fishing boats which can be built is also limited by the difficulties in procuring wood to make the boats. As a result, the MMR/FAO project alone will not be enough to make up for the lack of fishing boats. It is believed that fishermen will continue to return to this area, so that the lack of fisheries production equipment, including fishing boats, will be in even greater demand in the future. In addition, because it is becoming more difficult to acquire the wood necessary to build and repair boats, an attempt is being made to introduce fishing boats made from new materials and inboard engines which are durable and have low fuel consumption.

In order to cope with this situation, this Project will introduce new fishing boats with inboard engines of about the same size as the local fishing boat, Houris, so that it can contribute to creation of more jobs and improved production. The reasoning for the number of boats to be introduced was described in section 2-2-2, "Setting the Scale of the Project."

30 units of FRP boat with an inboard engine and insulated fish holds
Approx. 12.5 m in length.

b) Engines (outboard motors, inboard diesel engines) and repair parts

In addition to the aging fishing boats, the wear of the existing engines (outboard motors) is significant and many of them require replacement. These engines are another limiting factor in the operation of local fishing boats. In the future, these engines should be procured locally, but because procuring these engines is impossible in the Project area under the present conditions, it is necessary to supply engines and their parts as part of the support by MMR for fishermen. This Project will cooperate with the MMR's support for fishermen by supplying the outboard motors and parts listed below as a foundation for future local procurement.

For the 55 existing fishing boats (Houri), this Project will supply 55 replacement outboard motors as replacements to be used until the fish catch goals are met. The fish catch goals are to be achieved in three years after implementation of the Project. Because the operational life of outboard motors is three to four years, most of these motors will have become worn out and will require replacement at about the same time as the goals are met. Even if facilities and equipment are available, if the operating rate of fishing boats declines and the catch declines as a result, the desired results will not be achieved. Therefore, fisheries production will be reinforced by supplying engines. At the same time, the MMR will give instruction on implementing a system for replacing engines based on engine distribution funds. Three inboard diesel engines will be supplied for the existing Sambuk type boats, and seven inboard diesel engines will be supplied for the fishing boats being constructed by the MMF/FAO project.

Outboard motors:	55 sets
Inboard diesel engines:	10 sets
Repair parts for each engine:	1 set each

c) Fishing gear

The lack of fishing gear and the difficulties in procuring it are also a major negative factor in fisheries activities. It is necessary to supply fishing gear to make up for the lack. Together with the renewal of the fishing boat engines, this will improve the ability to catch fish. In addition to making it possible to procure and repair engines and parts locally, the ability to locally procure fishing gear will support and promote fisheries activities.

This Project is planning to supply gill nets and fishing gear for line fishing, methods of fishing with which the local fishermen are skilled.

In order to allow the fishing boats to be introduced in this Project to be used as soon as they are available, each boat will be supplied with ten sets of gill nets and 10 sets of fishing lines. All additional supplies necessary for these sets will also be supplied. In order to enhance the supplies which are available for the existing fishing boats, the same number of sets will be provided for 30 boats or about half of the existing boats. Preparation of the fishing gear will be left to the local fishermen.

The main fishing gear to be provided are as follows.

Gill net material: Netting, buoys, sinkers, rope, etc.

(30 boats to be introduced + About one-half of the existing boats (30))
× 10 sets/boat = 600 sets

Line fishing material: Fishing lines, hooks

(30 boats to be introduced + About one-half of the existing boats (30))
× 10 sets/boat = 600 sets

2-2) Barasole local station

As a local station, Barasole will be provided with the following equipment, so that it can supply fishing boats with fuel, ice and water, and so that it can store catches until they can be shipped.

This fishing village does not have a source of water in the village, and the residents have to spend a great amount of labor and time in getting water from a well which is located about four kilometers away. It is also necessary to reduce this labor and stabilize the lives of the residents. Therefore, we are planning to improve the water supply for the residents as well as that for fishing boats.

The following equipment shall be allocated to the Barasole local station and be managed and operated by the Barasole fishermen's cooperative under control of the Project executing agency.

a) Water supply equipment

The water to be provided shall be about 8 tons per day.

For fishing boats = (3 Houris and 1 new boat × 3 persons/boat × 2 days/outing + 1 Sambuk × 6 persons/boat × 4 days/outing) × 5 liters/person/day = 240 liters/day

For residents = 400 persons × 20 liters/person/day = 8,000 liters/day

Water will be supplied with tanks loaded on trailers (the same method which is currently used in Assab). The equipment which is required will be provided.

Two ton capacity water tank with wheels: 4

Tractor for pulling the tank: 1

Water supply pump: 1

b) Ice storage

The quantity of ice per day is estimated at 450 kilograms. Basically, ice will be supplied daily at the time when landed fish are collected by the truck from the Assab Fishery Complex, but depending on the situation concerning the collection truck, this may be every other day.

Also in order to cope with large catches, the ice to be supplied will be 900 kilograms for two days.

(300 kg/day for fishing boats + 150 kg/day for storing caught fish) × 2 days

*** According to section 2-2-3, (1) a) Ice making equipment.

Ice storage is not provided with refrigerating equipment due to i) lack of electric power in this area, ii) difficulty of operation and maintenance of refrigerating equipment, and iii) the necessity to keep ice related costs down.

Insulated storage made of prefabricated insulation panels: 1 unit

c) Insulated fish boxes

Basically, fish will be collected daily, but depending on the situation concerning the collection vehicles, this may be every other day. Also in order to cope with large catches, the capacity of the fish boxes will be that necessary for two days worth of average catches of 300 kg/day.

The boxes will be insulated plastic boxes suitable for holding ice. Each box will be 100 kilograms in capacity.

Capacity 300 liters: 6 boxes

d) Wireless telephone

In order to function as a local station, communications with the Assab fisheries complex are indispensable. Because this area does not have any existing means of communication, a wireless telephone unit will be installed for communications with Assao.

One set of SSB radio

e) Small generator

A small generator will be provided as a power supply for lighting during work at night and charging battery for the wireless telephone.

Generator driven by a diesel engine (Approx. 3 kW): 1 set

2-3) Ras Terma local station

As a local station, Ras Terma will be provided with the following equipment, so that it can supply fishing boats with fuel, water, and supplies.

This station will be managed and operated by the Assab fishermen's cooperative.

a) Insulated fish boxes

Basically, fish will be collected daily, but depending on the situation concerning the collection vehicles, this may be every other day. Also in order to cope with large catches, the capacity of the fish boxes will be that necessary for two days worth of average catches of 300 kg/day.

The boxes will be insulated plastic boxes suitable for holding ice. Each box will be approx. 100 kilograms in capacity.

Capacity 300 liters: 6 boxes

b) Ice storage

The quantity of ice per day is estimated at 450 kilograms. Basically, ice will be supplied daily at the time when landed fish are collected by the truck from the Assab Fishery Complex, but depending on the situation concerning the collection truck, this may be every other day.

Also in order to cope with large catches, the ice to be supplied will be 900 kilograms for two days.

(300 kg/day for fishing boats + 150 kg/day for storing caught fish) × 2 days

*** According to section 2-2-3, (1) a) Ice making equipment.

Ice storage is not provided with refrigerating equipment due to i) lack of electric power in this area, ii) difficulty of operation and maintenance of refrigerating equipment, and iii) the necessity to keep ice related costs down.

Insulated storage made of prefabricated insulation panels: 1 unit

c) Water tank

About 420 liters of water will be supplied per day. Water will be carried by the materials transportation truck which will also carry fuel. Water will be supplied about once a week from Assab.

For fishing boats =
(2 Houris and 2 new boats × 3 persons/boat × 2 days/outing + 1 Sambuk × 6 persons/boat × 4 days/outing) × 5 liters/person/day = 240 liters/day

For use by fishermen on land =
(2 Houris and 2 new boats × 3 persons/boat + 1 Sambuk × 6 persons/boat) × 10 liters/person/day = 180 liters/day

Plastic water tank 0.5 tons: 7 pcs.

d) Wireless telephone

In order to function as a local station, communications with the Assab fisheries complex are indispensable. Because this area does not have any existing means of communication, a wireless telephone unit will be installed for communications with Assab.

One SSB radio

e) Small generator

A small generator will be provided as a power supply for lighting during work at night and charging battery for the wireless telephone.

Generator driven by a diesel engine (Approx. 3 kW): 1

2-3 Basic Design

2-3-1 Design Concept

In forming the basic design of the Project, in accordance with the thinking behind the basic Project idea, a basic concept that matches with the existing fisheries conditions and takes the natural and social conditions and construction and procurement situation in the subject country into account shall be compiled. In specific terms, the basic design shall be formed upon giving consideration to the following points.

(1) Natural Conditions

The Project area is said to be the hottest place on earth and the outside temperature during the summer can reach over 40°C. Moreover, because the prevailing winds blow in a northerly direction in the summer and a south to south-easterly direction during the winter, sea winds will continuously blow onto the Project sites from the coastal side. Consequently, design of the facilities shall ensure durability against high temperatures, high humidity and corrosion, and also give the facilities pleasant environments for the users and make the facilities economical and convenient also in terms of maintenance, while also ensuring that the local modes of living are followed.

(2) Scope for Expansion and General Purpose Usability of the Facilities

The main objective of the Project is the phased restoration of the coastal fisheries sector, which was destroyed and impoverished as a result of the struggle for independence. Before the struggle, the fisheries sector was blessed with abundant labor and equipment resources, provided an important source of protein to ordinary citizens and had established an important niche within society. Around the Project area, there is a great potential in terms of both fish resources and distribution and, in line with future social infrastructure development and increased fish hauls, etc., the qualitative and quantitative growth of the fisheries sector can be expected. It is therefore necessary to plan the facilities layout and give them scope for expansion in order to be able to respond to this growth.

(3) Consideration of Maintenance

The struggle for independence not only resulted in social infrastructure losses, but also created the current situation where, through the death or outflow to overseas countries of engineers capable of performing facility maintenance, there is a national shortage of such engineers. This situation will gradually improve over time, however, for the present period, it will be necessary to design facilities and select equipment and materials that allow maintenance to be performed with existing maintenance capacity levels.

(4) Selection of Structures and Building Methods that Consider the Local Construction Conditions

The only construction materials which can be procured locally are sand and stone, and imports are basically relied upon to provide all other materials. Because the local construction market is dominated by ordinary housing, there is a lack of high quality materials, and cheap imports with low levels of durability are mainly used. Consequently, when one considers the repair work, etc. on the facilities, although it would be desirable to give priority to locally procurable materials, the low levels of durability of the overall facilities would cause maintenance costs to increase. Therefore, high quality materials shall be imported according to necessity and efforts shall be made to reduce the amount of maintenance required by the facilities on the whole.

(5) Implementation Plan that Allows Effects to be Quickly Realized

Within the city of Assab, construction of a fish distribution network and the establishment of retail stores has started to gain pace as a result of the efforts of the Government of Eritrea, and it is now a question of waiting for the arrival of the fish hauls. Moreover, the citizens of Assab are strongly anticipating the quickest possible supply of inexpensive fish onto the distribution network. Therefore, in implementing the Project, the first stage shall involve the provision of fisheries production equipment to aid the catching of fish, and the second stage works shall involve the construction of the jetties and landing facilities, ice plants and refrigerators and workshop, etc. and the development of the distribution and fisheries support setups.

2-3-2 Examination of Conditions

Concerning buildings and general facilities, etc., with the country still in the process of recovery in the wake of the war, neither the Ministry of Construction nor Assab City have a codified set of standards. From the hearings held with the staff in charge of the basic design, it was reported that the design is being advanced based mainly on the British Standard. In the Project, the design conditions and structure calculation conditions shall be set based on this standard.

As for the marine structures, the design conditions were set based on the results of the natural conditions surveys and boring surveys, etc. With respect to the calculation of design wave heights and facilities structures, consideration shall be given to the purposes of use of the facilities and an overall judgment shall be made by utilizing the applicable design conditions that are used in Japan. The specific design conditions were set in the following manner.

Table 2-2 Design Conditions

Items		Design Conditions	Remarks
Weather and Tide			
Maximum wind velocity Prevailing wind velocity Prevailing wind direction Design wave height Significant wave height (max.) Prevailing significant wave height		21m/s (SE) (1) 8.0m/s (11.88%) (2) 6.0m/s(11.77%) (1) SSE (29.19%) (2) SE (22.62%) H= 2.5m H 1/3= 2.5m H 1/3= 0.8m (16.81%)	1990.8.1~1995.7.31 Assab Meteorological Observatory
Tidal levels	H.W.O.S.T M.W.L L.W.O.S.T L.W.L(D.L)	+0.37m +0.28m +0.19m ±0.00m	from analysis of of local observation data in 9 days
Tidal Current	speed direction sand drifting	10.0~15.0cm/s N flow 50.0% (10.2cm/s), SSE flow 26%(6.8cm/s) Ho' = 1.4m hi = 3.5m	
Seismic vibration		0.05	
Rain-fall	Annual rainfall Max. monthly rainfall 10mm/day frequency		
Tem-perature	Annual variation Range Daily variation		
Nature of soil			
Item		Surface layer	Foundation bed
Sea bottom Wet density Water content Particle diameter N value Thickness of layer		Sandy soil Average 0.05mm Surface layer- sandy soil N=5~7 Surface layer 1.0~5.0m	 Lower layer- hard basalt, N≥50 Rock layer >2.0-5.0m

Applied Standards

Fishing Port Structures Standard Design : National Fishing Port Association

Road Paving General Guidelines : Japan Road Association

Concrete Standards Manual : Japan Civil Engineering Association

Japan Industrial Standard : Japan Standards Association

British Standard

Material Design Specifications

Rubble mound and covering stones : Angle of internal friction ø 40°, Specific gravity 2.6

2-3-3 Basic Plan

(1) Site and Layout Plan

Concerning the construction site of the central Project facilities at Assab (Assab Fisheries Complex), other candidate sites did exist at the stage of the basic design study, however, in view of the fact that many subsistence fishermen live around the MMR/FAO project site and with the intent of securing a cooperative link with the existing facilities of the said project (herein referred to as the MMR Complex), it was concluded that carrying out the phased reconstruction of the coastal subsistence fisheries sector would be more effective and economical in view of the present social and economic conditions. Thus, it was decided to utilize the land located on the northern side of the existing MMR Complex.

The existing MMR Complex contains all kinds of facilities, however, because its construction was advanced over a great many years, some of the facilities are deteriorated and, from an overall viewpoint, there are some facilities for which it is hard to consider layout planning was performed, and the general facilities layout gives a sense of poor unification. Moreover, due to the fact that land use restrictions existed at the time of construction, the facilities are distant from the coastline and, in addition to this, because the frontal coastline is a rocky zone, fishing vessels cannot approach, thus making the facilities inconvenient for the local fishermen.

The Project facilities are intended to promote the local landing of fish and they will need to make it possible to dock fishing vessels and easily land fish. It was therefore decided to locate the Project facilities next to the existing MMR Complex on a coastal area that faces onto a small bay, where there is a gap in the rock belt and the entry of fishing vessels is possible.

The land facilities for the handling of landed fish shall be placed near to the landing facilities (fishing port facilities) with a view to making the landing and haulage work by the fishermen easier. However, with regard to the ice-making and refrigeration facilities, scale has been set in consideration of the capacity of the ice-making and refrigeration facilities (currently undergoing preparation work) of the MMR Complex, and complex

roads shall be provided in order to enable the mutually cooperative operation of both sets of facilities.

(2) Fishing Port Facilities Plan

1) Concept of the Facilities

The Project will provide the minimum necessary fishing port facilities to land the catches, and load supplies such as ice, fuel and water to fishing boats, which are the basic functions of the fishing port.

The area near the site of the fishing port is not a reef coast, but a small sandy beach. Therefore, the following design concept will be taken in consideration of preserving the water quality of the area.

a) The facility of the fishing port will be used both for landing the catches from fishing boats and loading supplies to fishing boats before they go out to fish.

b) The facility will create a calm water area for easy operation of boats and not cause the accumulation of sand.

c) To prevent pollution of water in the fishing port, there will be a flow of sea water through the facility to reduce stagnant water.

2) Boat Dimensions Used for Jetty Design

a) The number of boats for the Project is as in section 2-2-2 "Setting the Project Scale." The dimensions of the boats are as follows, based on section 2-2-3, (1).

Table 2-2 Boat dimensions

Type of boat	Length	Width	Draft
Samabak Houri New boat	14.0 m	3.0 m	1.0 m

b) The number of possible active days for each boat is set at 240 days/years as mentioned in section 2-2-2 (5). See section 6) (c) "No. of days jetty is used per year" for reference of this number of days (240 days/year).

c) The number of fishing days per boat, 160 to 180 days/year is taken from section 2-2-2 (3).

3) Number of Boats Using the Jetty

The number of boats using the jetty per day is based on section 2-2-3 (1), 1).

Length of the jetty is calculated with the number of boats using the jetty and their dimensions. It results in a length of 50m for the jetty.

4) Natural Conditions

The natural conditions were briefly reviewed in section 2-3-2 "Examination of Conditions." Detailed descriptions of natural and design conditions for designing the fishing port facilities follows.

a) Wind

Wind direction and velocity data used in planning the fishing port facility was obtained from the Assab meteorological station (located on the northern tip of the Assab Port, 10m above sea level).

In the 5 years of data collected between 1990 August 1 and 1995 July 31 (6 a.m.), the maximum wind velocity of 21.0m/s (SE) was recorded only on one day and the next strongest wind of 18m/s, only on 3 days. The prevailing wind direction is SSE (29.19%), the next frequent directions are SSE ~ SE (22.62%) and N (11.5%).

The prevailing seasonal winds are SSE ~ SE from October to May (average of 54%/month), and N ~ NNE (average of 37%/month) and SSE ~ SE (average of 36%/month) from June to September.

Cyclones and other abnormal meteorological phenomena are rare in the Red Sea and neither were such phenomena mentioned in American Naval wave data.

Wind direction and velocity data are in the attached data IV-1. Monthly wind charts are in the attached data IV-2.

b) Waves

i) Wave data used to calculate possible operation days

Deep-water waves were calculated by wind velocity and fetch in SMB method for significant wave, because only one observation data per day was available. The fetches were set in each direction by the fetch calculation method. The waves made by shore winds of S ~ SW ~ WNW were calculated at 10 km of shore.

Wave direction and height table is in the attached data IV-3.

The "direction of waves over 1 m with winds of under 12 m/s" and "direction of waves below 1 meter with winds over 12m/s" are in the attached data IV-4.

ii) Design wave height

The design waves were calculated, adjusting their off-shore waves (H 1/3) calculated by SMB method, by shoaling deformation with "wave energy distribution by

directions Di", "refraction coefficient Kr in shore with parallel isobath" and "diffraction coefficient Kd."

Design wave is show in tables 2-3 and 2-4

Table 2-3 Probable wave in return period of 30 years

Item	Type	Unit	N	NNE	NE	ENE	E	ESE	SE	SSE	NW	NNW
Wave height (max.)	Ho	m	2.2	1.8	1.6	1.9	2.5	1.9	2.0	1.3	1.8	2.5
30 year probability wave	Ho	m	2.6	2.0	1.8	2.4	3.1	2.1	2.1	1.3	2.0	2.8
Cycle	To	sec.	6.3	5.5	5.2	5.7	6.1	5.1	4.8	3.6	5.5	6.5

Table 2-4 Design wave height

Item	Type	Unit	N	E	SE
30 year probability wave	Ho	m	2.6	2.5	2.0
Converted wave height	Ho'	m	2.3	2.7	1.6
Design wave height	H	m	2.5	2.4	1.5
Cycle	To	sec	6.3	6.1	4.8

c) Tides

The standard sea level was determined by harmonic analysis of tide using data from tidal observations for 9 days (216 hours) between 1995 Aug. 23 and Sept. 1. The tidal constant was obtained from the harmonic constants of the tide by harmonic analysis of the tide.

The standard sea level is used as the datum level for designing the port facilities. The main harmonic constants of tide are as follows.

Table 2-5 Main harmonic constant

Code	Name	H (cm)	k(°)
	Semi-diurnal tide		
M2	main lunar semi-diurnal tide	5.8	312.5
S2	main solar semi-diurnal tide	3.8	286.2
	diurnal tide		
K1	solar / lunar combined diurnal tide	11.6	49.7
O1	main lunar diurnal tide	7.0	20.8

H: half tidal range of component tide

k: phase lag

The tidal levels at the Assab project sight are as in fig. 2-1.

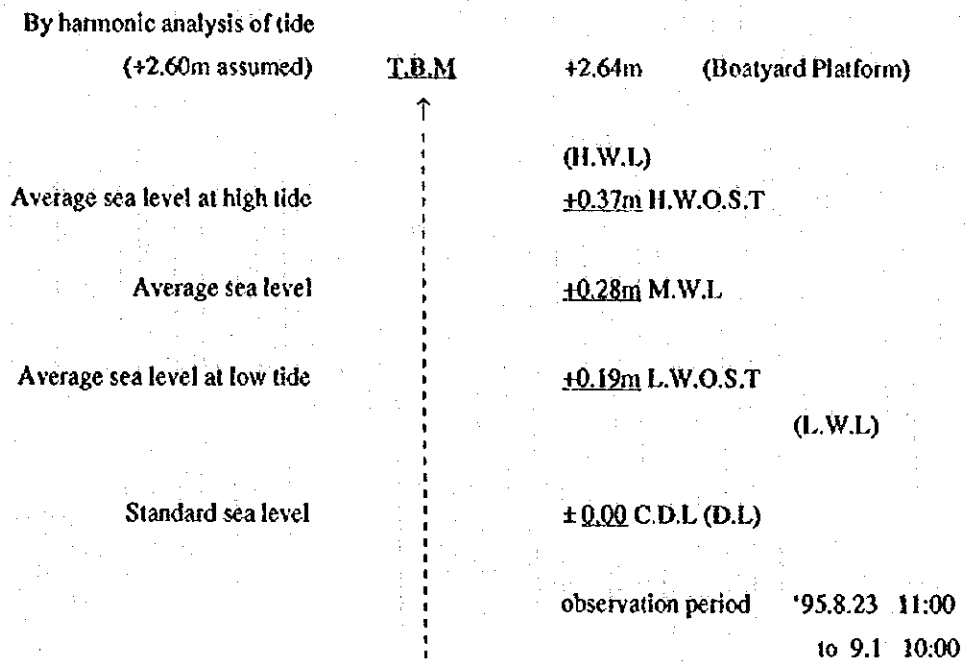


Figure 2-1 Tidal level at the Assab project site

d) Flow Speed and Direction

Tidal flow analysis was conducted for one tidal cycle. The tidal flow in the Assab region was predominantly going and coming from N and SSE, with the N flow being longer.

The average speed was 10.2cm/sec for the N flow, and 6.8cm/sec for the SSE flow. The N flow tends to be stronger than the SSE flow. The N flow was more frequent than the SSE flow with N flows occurring 50.0% of the time, and SSE flows, 26.0%. These two flows account for 76.0% of the measured flows.

e) Drift Sand

The bottom in the port area shallower than 3m is of sand with fine clayey qualities and gray color same as the bottom of the neighboring reef area (0.5 - 0.7m deep) to the south and it is presumed that this sand drifted here from the reef area by E~SE waves.

From the results of the tidal observation, there is no fear of significant accumulation of drift sand due to regular constant flow. However, it is necessary to consider accumulation of drift sand by coastal flow due to wave action.

The sand quality near the shore line is mainly granite with diameter of 0.1 to 1.0mm of brown color. The sand is the same quality as the layer in the port area deeper than 3.5 m and is representative of the bottom of this area.

The results of sounding surveys show that the layer of fine gray soil is about 15.0 cm thick. Therefore the sand which become drift sand found on the bottom are the fine brown granite particles, and the analysis of sand collected from the bottom 3.5 m deep show the same results.

Attached data IV-3 shows that 95.8% of the waves are smaller than 1.4 meters. Because the occurrence of waves over 1.4 m is only 15 days per year, these waves are exempted from consideration of cause drift sand. The critical depth of the sea bottom surface movement is shown in the attached data IV-5. The predominant direction of drift sand is relational to wave direction and is N - NE and SE - SSE.

f) Foundation Conditions

Boring surveys for foundation quality were conducted at 3 points with approximately 100m interval along the base line the land and offshore area. The results show that 1 to 5 m below the surface, there is a fairly hard porous basalt layer (thought to be of volcanic origin), and the surface layer is a soft gray sand with calcareous particles and shells mixed in.

This is generally not a difficult foundation for marine structures. However, care shall be paid, because the surface layer has an N value of 5 to 7 which is relatively soft so.

5) Basic Plan

a) Assab Fishing Port Facilities Plan

According to the concept of the facilities mentioned in section 1), a landing jetty is planned as the main facility of the port. Breakwaters are also planned at the north and the east of the port area to provide a calm area and protect the fishing boats from N waves and SE~SSE waves.

The location of the two breakwaters, from the point of view of protecting against drift sand, will be -3.5m. Considering preventing entrance of waves to preserve calmness inside the bay and entrance of drift sand, the mouth of the fishing port will be between 20 and 30m wide.

b) Breakwater Structure

The structure of the breakwater, considering the bottom conditions, availability of rock material, ease of construction, reduction in wave reflection and prevention of spray, will be mound-type breakwater of rocks.

c) Days of Use of the Landing Jetty

From the shape and size of the existing fishing boats, the maximum wind and wave conditions under which the Project fishing boats can operate are under 12m/s winds and under 1m high waves respectively.

From the meteorological data from August 1990 to July 1995 (see attached data IV-1, IV-3 and IV-4), the average number of days with winds over 12m/s and average number of days with winds under 12m/s but waves over 1m are 97 days/year and 28 days/year respectively for a total of 125 inoperational days per year. Therefore, as 365 - 125 = 240, it is estimated that there are 240 days/year which the boats can be operated.

This number of operational days, 240 days/year, will be used as the number of days which the jetty is used.

d) Allowable Wave Height for Using the Jetty

From the shape and size of existing fishing boats, the maximum wave height in the port under which the unloading of catch can be performed is estimated at 0.3m. It is necessary to dampen wave height of 1m, which is maximum for operation of the fishing boats, to 0.3m in the port.

e) Jetty Height and Width

Considering the maximum tidal and wave height, the height of the jetty will be +1.5m. In order to facilitate the loading / unloading for the fishing boats, which have an average freeboard of 0.8m, the mooring side of the jetty will be provided with a stage +1.0 high, giving the jetty two levels.

The width of the apron for loading and unloading catch and supplies will be 8m to allow the turn around of 2 ton trucks. The width of the bridge to the jetty will be 5m.

f) Jetty Structure

Considering both the preservation of water quality in the port and prevention of drift sand accumulation, the jetty will be constructed on pilings.

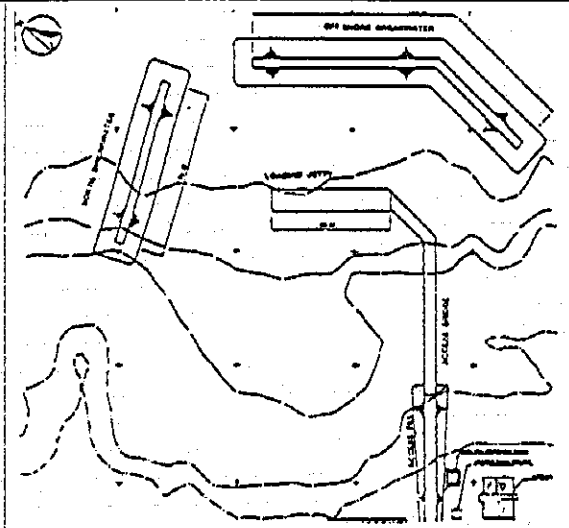
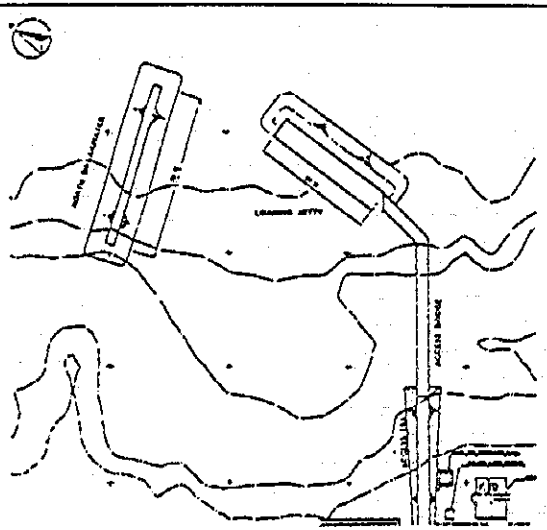
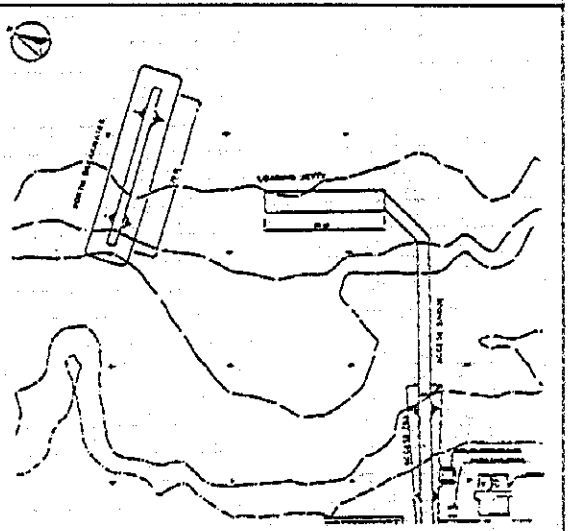
g) Barasole Fishing Port Facility Plan

The Barasole area is protected from the open sea by a peninsula running north from southwest, and can be said to be a natural bay. The area also possesses calm waters protected by rocks, sand formations and sandy beaches.

There are no facilities to assist in the unloading catch or the loading of ice, fuel and fishing material. These operations are currently being carries out on the shore by people entering the water. To assist these operations, a 50.0m long and 3m wide simple jetty will be planed. The jetty will be of piling construction.

Three alternatives which satisfy these conditions were examined and compared. They were A) Breakwater + jetty, B) Breakwater that combines quay wall functions, and C) Breakwater jetty. Upon examining and comparing these alternatives, it was decided to adopt alternative A) Breakwater + jetty. (See Comparison Table 2-6).

Table 2-6 Comparison of Fishing Port Alternatives

Layout Format	A) Breakwater + jetty	B) Breakwater that Combines Quay Wall	C) Breakwater Jetty
Floor Plan			
Work Index	100	110	120
Advantages	Planning Side * A wide tranquil zone can be secured and the mooring of fishing vessels is possible. * Using the breakwater, future expansion of the facilities is possible. Execution Side * Much execution is performed at sea and schedule management is thus easy. * Execution is relatively simple. * Execution is possible even if there is a certain degree of waves breaking.	Planning Side * Winds are weakened on the quay wall side, thus making the landing work easy. * Because the structure is impervious, wave breaking effect is good and docking by vessels is easy. Execution Side	Planning Side * Sea water exchange is good. Execution Side * Little work is performed in the sea and schedule management is thus easy. * Because little work is performed in the sea, the work period will be reduced.
Disadvantages	Planning Side * There is a possibility of tombolos forming behind the breakwater. Execution Side * Much stone will be used, and so the securing of a good supply will be important.	Planning Side * The potential for future expansion is limited. * It will be easy for tombolos to form behind the quay wall. Execution Side * Because much work is performed in the sea, the assurance of work precision levels is difficult. * Large construction machinery such as a crane ship will need to enter the harbor.	Planning Side * Because piles will take on the force of waves, the section will be large. * Docking in the face of south-easterly waves is difficult. Execution Side * It will be necessary to prepare large pile-driving ships and medium excavation augers.
Overall Judgment	◎	○	△

(3) Assab On-shore Facilities Plan

1) Setting of Overall Layout

When planning marine facilities-related projects such as this, settings need to be made upon placing the emphasis on the following points.

a) Short and non-wasteful traffic lines that enable landed fish to be immediately treated.

b) High temperature and solar radiation countermeasures to prevent the degradation of fish freshness prior to treating.

c) General purpose usability of the facilities to respond the landing of concentrated fish hauls.

d) Provision of complex roads and securing of vehicle waiting spaces so as to make the shipping of fish easy.

2) Setting of Access Road

The access road to the existing MMR Complex uses land along the beach to the southern side, however, in the case where the requested facilities layout is followed, large cold storage trucks and other vehicles will travel to and from the facilities and it will be necessary to set an access road that has greater width. Because fisheries-related facilities will be located along the beach line, the access road shall be planned to enter the facilities from the rear of the site.

3) Setting of Physical Distribution Lines

The refrigeration facilities, which form a large part of the land facilities, will be central to the physical distribution of fish landed at the site, and it will be necessary for them to be connected to the landing facilities of the fishing port by smooth and clear traffic lines. Moreover, it will be necessary for the freeze-processed or pre-treated fish to be transported by special vehicles from the facilities to consumers.

(4) Architectural Planning and Design

1) Floor Plan

a) Ice-making and Refrigeration Facilities

These facilities shall possess the following functions.

Fish market	:	Receiving, washing, sorting, weighing and selling of landed fish to fish agents and retailers (private selling and auction selling)
Fish treatment area:	:	Pre-freezing treating such as gutting and panning
Freezer and cold storage	:	Freezing fish and storing frozen fish
Ice plant:	:	Ice-making work

The arrangement of the work areas on the ground floor of the facility shall be designed so as to allow each work process to proceed smoothly. The fish market space, which will accept the incoming fish, shall be located facing the road coming from the landing jetty, and layout of the remaining equipment and work areas shall be planned in accordance with the subsequent flow of work. Fish shall be transferred and carried by buckets and hand carts, etc. and the whole facility shall be on the same level with no gradient. Moreover, as there is other work such as transportation by trucks of fish collected from the regional stations, access to fish merchants and retailers, shipping of fresh fish and frozen fish by freezer truck, and the shipping of ice, etc., access roads and vehicle operating spaces shall be secured around the facilities in consideration of this work and vehicle traffic lines. Within the facility buildings, the composition of space shall be clear and simple with ample consideration given to ventilation.

b) Workshop

The workshop will carry out repairs of the outboard motors of the fishing vessels which support the livelihoods of the coastal subsistence fishermen. Although there are outboard motor repair engineers in and around Assab, there is a shortage of spare parts which makes it impossible for satisfactory repairs to be carried out. Moreover, 30 onboard engine FRP fishing vessels are to be provided under the Project, and the demand for repairs of the engines of the wooden onboard engine fishing vessels, which are being promoted under the guidance of MMR/FAO, is growing. The workshop will handle the repair and maintenance of outboard engines and onboard motors and it will also carry out the daily inspections, etc. of the cold storage trucks and freezer trucks planned for provision under the Project. The work areas required for conducting this maintenance and repair work shall be provided.

As incidental facilities, a staff room for mechanics and a parts warehouse to store spare parts will be necessary. Regarding the required area of the staff room, approximately 40 m^2 shall be secured for four mechanics. As for the warehouse

area, because around 20% to 30% of the yard area will be necessary, approximately 40 m² shall again be secured.

2) Sectional Plan

a) Ice-making and Refrigeration Facilities

With respect to the sectional plan, in order to allow solar radiation heat to escape from the roof and to lower the indoor temperature, ample ventilation shall be ensured by providing a gallery to act as a wind passage along the north-south running axis of the building. Moreover, the central part of the ground floor ice-making and refrigeration facilities and the second floor administration department shall be made an open ceiling construction so as to secure a vertical wind passage, too.

b) Workshop

The building shall be single story for traffic line and facility use reasons. As for the indoor height, as well as the need for space to store outboard motors and onboard engines, because an overhead running crane will be installed and work in high areas will be necessary, the ceiling height will need to be 4.5 m below the beams. Regarding the occupied room sections, a heat proof ceiling shall be provided inside to block solar radiation heat from the roof in order to improve garret ventilation and reduce the cooling load.

3) Structural Plan

a) Ice-making and Refrigeration Facilities

Regarding the foundations, because the land geological survey found the surface layer to consist of silt, rappel concrete shall be placed as far as the rock layer of the foundation bed in order to transmit the load onto the rock bed. The building frame shall use reinforced concrete, and the ground floor shall be planned in such a way to minimize walls, etc. in the central area in order to remove obstructions to work. On the second floor, wooden trusses shall be hung for ventilation and light receiving purposes, and the plan shall be designed to give a broad spatial feeling.

b) Workshop

Because large spans and good height are necessary due to the floor plan and for reasons of use, the structure shall be one of reinforced concrete. As was mentioned previously, because the ground consists of a surface layer of silt,

rappel concrete shall be placed as far down as the rock bed layer. The roof frame shall consist of wooden truss beams in order to secure good ventilation.

4) Equipment Plan

a) Electricity

Power will be received from the existing power line that runs alongside the site and taken in by an electricity room, which will be newly constructed and fitted with a feeder panel and step-down transformer. From the electricity room, power will then be distributed to each of the facilities. It will be necessary to install separate power meters in the electricity room to enable understanding of the power consumption quantities of each of the facilities. Because there is a risk of power cuts occurring, an emergency generator shall be installed to operate the fish freezer. The generator shall be operated manually.

b) Water Supply

Water shall be obtained from the two-inch pipe which is already laid within the site. Because there is a risk of water feed pressure fluctuations, an intake tank and elevated water tank shall be installed, as is the case at the existing MMR Complex. The volume of the intake tank shall be set at 20 m^3, which will be the daily water requirement, and it shall be placed on land for maintenance reasons. The capacity of the elevated water tank shall be set at 6 m^3.

c) Air Conditioning

In view of the sweltering heat in the Project area, the offices and administrative department shall be fitted with a cooling system. As for other areas, the design shall ensure that the natural ventilation of garrets is maximized.

d) Wastewater Treatment

Regarding the wastewater generated within the facilities, it shall all be treated by means of septic tanks and direct discharge into the sea shall not be carried out. Similar treatment shall be performed on fish blood, etc. and efforts shall be made to preserve the environment.

5) Building Materials Plan

Regarding the finishing of each building, consideration shall be given to weather proofing and work contents. Materials for the main spaces have been set as follows.

a) Ice-making and Refrigeration Facilities

External facing	Roof	: slate	Outer walls	: mortar finish + AEP
Ice-making room	Floor	: mortar hardener	Inner walls	: mortar finish + AEP
Sorting room	Floor	: mortar hardener	Inner walls	: mortar finish + AEP
Administration room	Floor	: vinyl tiles	Inner walls	: mortar finish + AEP

b) Workshop

External facing	Roof	: slate	Outer walls	: mortar finish + AEP
Repair room	Floor	: mortar hardener	Inner walls	: mortar finish + AEP
Administration room	Floor	: vinyl tiles	Inner walls	: mortar finish + AEP

(5) Ice-making and Refrigeration Facilities

1) Facility Modes

a) Ice-making Machine

In consideration of the wishes of the Project implementing agency and the following points, block ice was chosen as the ice type and the indirect brine method was chosen as the ice making method.

- Almost all the locally produced ice is block ice and the local fishermen are familiar with and used to using this type of ice.
- The ice is used on the fishing boats for keeping fish fresh. It needs to last for a certain amount of time even in fish holds or boxes with poor insulation. Block ice is more suitable to this requirement than other types of ice.
- The ice needs to be transported to regional areas, stored and then loaded onto fishing vessels, and block ice is convenient in terms of this kind of work.

To enable ease of handling, the ice blocks shall be made small at 25 kg and the plant machinery shall also be made small scale.

b) Freezing Equipment

Fish for export to Addis Ababa and other countries shall be freeze processed with blast freezing. The fish will be laid out on freezing pans and then put onto the shelves installed in the freezer room for freezing.

2) Design Conditions

The atmospheric conditions for the facilities are as follows.

- Atmospheric temperature: 40°C, Humidity: 70%, Water temperature: 28°C
- Compressors shall be of open type to allow easy replacement of parts and repair.
- The defrosting method shall be spraying for the freezer and electric heater for the cold storage.

In the case of the freezer room, it would be difficult to completely defrost condensation on the cooler fins by electric heater alone in the short off-freezing hours during which defrosting has to be accomplished. For this reason, water spraying shall be used to perform this defrosting, and all the other cooling units shall be defrosted by electric heater. Local tap water shall be used as the spraying water, however, filters shall be placed within piping to preserve the quality of the water.

- The power supply shall be 380 VAC, 50 Hz, 3-phase.

3) Ice-making Plant and Ice Storage

a) Main Conditions

Ice-making capacity	:	3 tons/day
Type of ice	:	Block ice, 25 kg/block
Ice-making method	:	Indirect cooling with cooled brine
Refrigerant condensation	:	Air cooling
Ice removal method	:	Can grid

b) Main refrigerating equipment

Ice-making plant

Compressor unit	:	Fitted with open-type multicylinder compressor

Cooling capacity	:	Approx. 27,000 Kcal/hr, ET-17°C/CT 45°C
Compressor motor	:	Approx. 22 kW
Ice-making brine tank	:	Prefabricated, insulated combined type
Ice removal device	:	Can grid and electric hoist

Refrigerating equipment for ice storage

Compression unit	:	Fitted with open-type multicylinder compressor
Compressor motor	:	Approx. 3.7 kW
Cooling unit	:	Ceiling-hung, defrosted by electric heater
Cooling surface area	:	Approx. 35 m^2
Condenser	:	Air-cooled, floor-mounted
Condenser capacity	:	Approx. 55,000 Kcal/hr, CT +45°C

c) Ice storage

Construction	:	Prefabricated construction with insulation panels
External dimensions	:	Approx. 3.6 m (w) × 4.5 m (d) × 2.5 m (h)
Insulation panel construction	:	100 mm-thick urethane, double-sided galvanized steel plate

4) Freezer

a) Main Conditions

Freezing capacity	:	700 kg/time/unit × 2 units
Freezer compartment volume	:	Approx. 110 m^3
Freezing meth	:	Cold blast differential pressure circulation
Freeze temperature	:	Approx. -25°C (final compartment temperature)
Cooling method	:	Direct dry expansion-type unit cooler
Refrigerant condensation	:	Air cooling
Defrosting method	:	Spraying (clean water circulation spraying)

b) Main refrigerating equipment

Compressor unit	:	Fitted with open-type multicylinder compressor
Cooling capacity	:	Approx. 10,000 Kcal/hr, ET -35°C/CT 50°C
Compressor motor	:	Approx. 15 kW
Cooling unit	:	Floor-mounted, defrosted by water spray
Cooler surface area	:	Approx. 100 m^2
Condenser	:	Air-cooled, floor-mounted
Condenser capacity	:	Approx. 26,000 Kcal/hr, CT +45°C

c) Freezer

Construction of freezing compartment	:	Prefabricated construction with insulation panels

External dimensions	:	Approx. 5.4 m (w) × 6.3 m (d) × 3.5 m (h)
Insulation panel construction	:	125 mm-thick urethane, double-sided galvanized steel plate
Compartment arrangement	:	Two freezing compartments with a passage space between the two freezing compartments.

5) Cold Storage

a) Main Equipment

Storage capacity	:	Approx. 7 tons
Inner temperature	:	Approx. -20°C
Cooling method	:	Direct dry expansion-type unit cooler
Refrigerant condensation	:	Air cooling
Defrosting method	:	Electric heater

b) Main refrigerating equipment

Compression unit	:	Fitted with open-type multicylinder compressor
Cooling capacity	:	Approx. 6,700 Kcal/hr, ET -30°C/CT 50°C
Compressor motor	:	Approx. 7.5 kW
Cooling unit	:	Floor-mounted, defrosted by electric heater
Cooler surface area	:	Approx. 100 m^2
Condenser	:	Air-cooled, floor-mounted
Condenser capacity	:	Approx. 16,000 Kcal/hr, CT +45°C

c) Freezing compartment

Construction	:	Prefabricated construction with insulation panels
External dimensions	:	Approx. 4.5 m (w) × 5.4 m (d) × 2.5 m (h)
Insulation panel construction	:	100 mm-thick urethane, double-sided galvanized steel plates

(6) Regional Fisheries Stations

1) Barasole

a) Fishing Vessel Jetty

A jetty shall be provided for use by the local fishing vessels of Barasole and a water depth of 2 m shall be secured for the mooring section. The length of the mooring section shall be enough to cover two berths, with one berth each on either side of the jetty. The length of each berth shall be 20 m (average local fishing vessel of 15 m plus an extra 5 m for mooring work) and the width shall be 3 m in consideration of the passage of hand carts, etc. The total jetty length shall be approx. 30 m to reach the required water depth plus the berth length, giving a total of approx. 50 m. The upper surface height shall be +1.5 m, which is again the same as in the case of the jetty at Assab.

As the construction site is in a relatively tranquil sandy beach section of coast, which is surrounded by small islands and capes, etc. and thus does not directly receive the effects of outer ocean waves, the jetty construction shall be a simple pile type.

b) Supplies and Collection Area

A supplies and collection building shall be built adjacent to the jetty, and this shall be fitted with a insulated ice stowing box, insulated fish boxes, a control booth, a radio telephone set and lighting generator, etc. The building shall be a single block and the required equipment and spaces shall be laid out within this.

The main building area shall be set at 32 m^2 to allow space for the provision of the insulated ice stowing box, fish boxes and control booth. The roof shall be made protruding and beneath it fish sorting and weighing work space and a fuel drum storage section shall be provided.

Building area: 96 m²

(Ice stowing box, fish cold box storeroom, control booth: 4 m × 8 m)

(fish sorting and weighing work space: 4 m × 12 m)

(fuel drum storage space: 4 m × 4 m)

The construction shall be single story concrete block construction.

A small diesel generator shall be installed to provide power for lighting and charging batteries for the radio telephone.

2) Ras Terma

There are no resident fishermen in Ras Terma, however, it is a fisheries camp used by migrant fishermen who come from Assab, and so on. In order to support and promote the activities of the fisheries camp, a regional fisheries station shall be provided for the storage and supply to vessels of ice, fuel and water, etc. and for the temporary ice storage and shipping of fish hauls. The station shall consist of a simple refueling and shipping base and the following equipment shall be provided.

a) Supplies and Collection Area

A supplies and collection building shall be built adjacent to the jetty, and this shall be fitted with a insulated ice stowing box, insulated fish boxes, a control booth, a radio telephone set and lighting generator, etc. The building shall be a single block and the required equipment and spaces shall be laid out within this.

The main building area shall be set at 32 m² to allow space for the provision of the insulated ice stowing box, fish boxes and control booth. The roof shall be made protruding and beneath it fish sorting and weighing work space and a fuel drum storage section shall be provided.

Building area: 96 m²

(Ice stowing box, fish cold box storeroom, control booth: 4 m × 8 m)

(fish sorting and weighing work space: 4 m × 12 m)

(fuel drum storage space: 4 m × 4 m)

The construction shall be single story concrete block construction.

A small diesel generator shall be installed to provide power for lighting and charging batteries for the radio telephone.

b) Equipment: Ice stowing insulated box, insulated fish cold boxes, scale, water tanks, radio telephone, lighting fixtures, small generator

(7) Equipment Plan

1) Fisheries Production Equipment and Materials

1-1) Fishing Boats 30 units

Fitted with inboard diesel engine
Vessel model and size is similar to the local fishing boats, Houri.
Hull material: Fiberglass reinforced plastic (FRP)
Hull dimensions: Approx. 12.5 m (length) × 2.0 m (width) × 1.1 m (depth)
Engine: Marine diesel engine, approx. 23 HP

1-2) Engines (Outboard Motors, Onboard Diesel Engines) and Maintenance Parts

a) Outboard Motors

Gasoline outboard motors (approx. 25 HP): 15 sets
Gasoline outboard motors (approx. 40 HP): 30 sets
Gasoline outboard motors (approx. 75 HP): 10 sets
Maintenance parts: 1 set

b) Onboard Diesel Engines

Onboard diesel engines (approx. 40 HP): 10 sets
Including stern tube, shaft and propeller
Maintenance parts: 1 set

1-3) Fishing Tackle

a) Gill net materials

Nets:	Materials:	Nylon, multi-filament, several varieties 210 d/15-51
	Mesh size:	40 mm - 180 mm, several varieties
	Length:	100 m × 140 MD - 65 MD, several varieties
	Quantity:	Total 600 pcs
Net thread:	Thread for repairing above nets, 500 g/spool:	Total - 300
Rope:	Diameter 8 mm, 10 mm × 200 m/coil:	Total 300 pcs
	Diameter 15 mm × 200 m/coil:	Total 60 pcs
Float:	Plastic, float strength 150 kg, 240 kg:	Total 27,900 pcs

Sinker: Lead sinker, 75 g, 235 g: Total 19,800 pcs

b) Hand Fishing Materials

Thread: Nylon fishing gut, several varieties: Total 2,700 pcs

Hooks: All varieties: Total 8,400 pcs

2) Equipment for Assab Fisheries Complex

The following equipment and materials have been planned as necessary items for the activities of Assab Fisheries Complex

a) Freezer Truck 1 unit

Freezer truck for transporting frozen fish
Diesel engine
Fitted with insulated van and freezer unit
Payload: Approx. 8 tons

b) Truck with insulated van 1 unit

Truck for transporting ice stored fish and ice
Diesel engine, four-wheel-drive
Fitted with insulated van
Payload: Approx. 2.5 tons

c) Fish handling equipment

Fish boxes	:	Plastic fish boxes, approx. 100 liters	200
Hand carts	:	Steel, with caster wheels	2
Two-wheel barrows	:	Steel	10
Processing tables	:	Stainless steel tables	8
Scales	:	100 kg weighing range	1

d) Transportation Truck 1

Heavy duty truck, fitted with a hydraulic crane
Diesel engine, four-wheel-drive
Payload: Approx. 3 tons

e) Workshop tools 1 set

The workshop shall be provided with the tools and machinery required for repairing fishing vessel engines and outboard motors, etc. The main tool items of equipment are as follows:

Hand tools:	1 set	General-purpose drilling machine:	1
Power drill:	1	Bench grinder:	1
Hydraulic press:	1	Air compressor:	1
Electric welder:	1	Gas welder:	1
Work tables:	2	Equipment and parts shelves:	4

f) Project service vehicle 1

Double cabin pickup truck
Diesel engine, four-wheel-drive

g) Radio telephone 1

SSB radio telephone: Approx. 150 W

3) Equipment and Materials for Barasole Regional Station

a) Water Supply Equipment

Water tanks :	Approx. 2 tons, fitted with traction wheels	4
Tractor :	Approx. 50 HP	1
Small water pump :	Approx. 5 HP	1

b) Ice Storage 1

Prefabricated small compartment with insulation panels 1

Dimensions: Approx. 2.7 m (w) × 1.8 m (d) × 2.5 m (h)

c) Insulated fish box

Plastic insulated boxes, approx. 300 liters capacity 6

d) Two-wheel barrows : Steel 5

e) Scales : 100 kg weighing range 1

f) Radio telephone : SSB radio telephone, approx. 150 W 1

g) Small generator : Diesel engine-driven small generator, approx. 3 kW 1

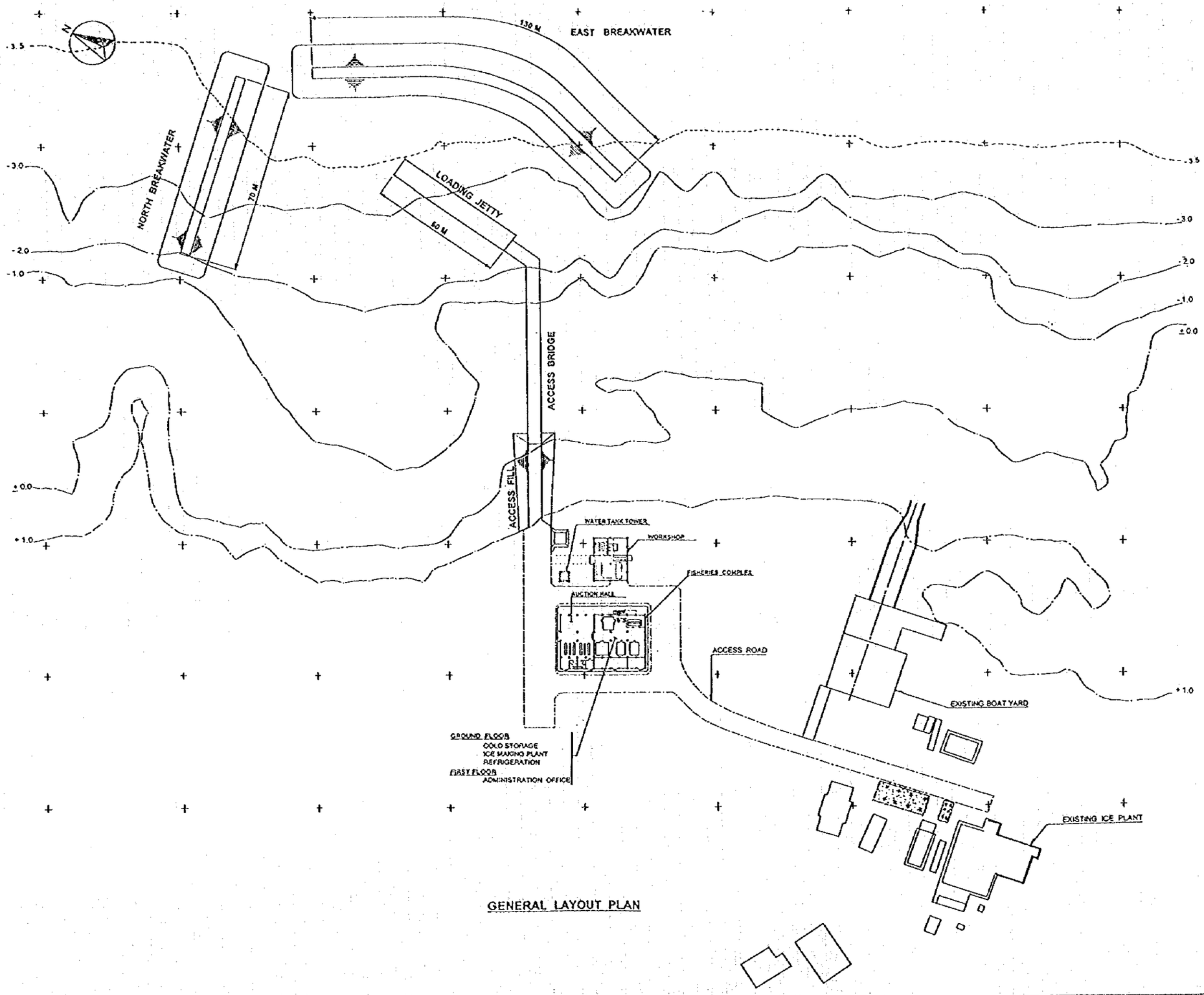
4) Equipment and Materials for Ras Terma Regional Station

a) Ice Storage 1

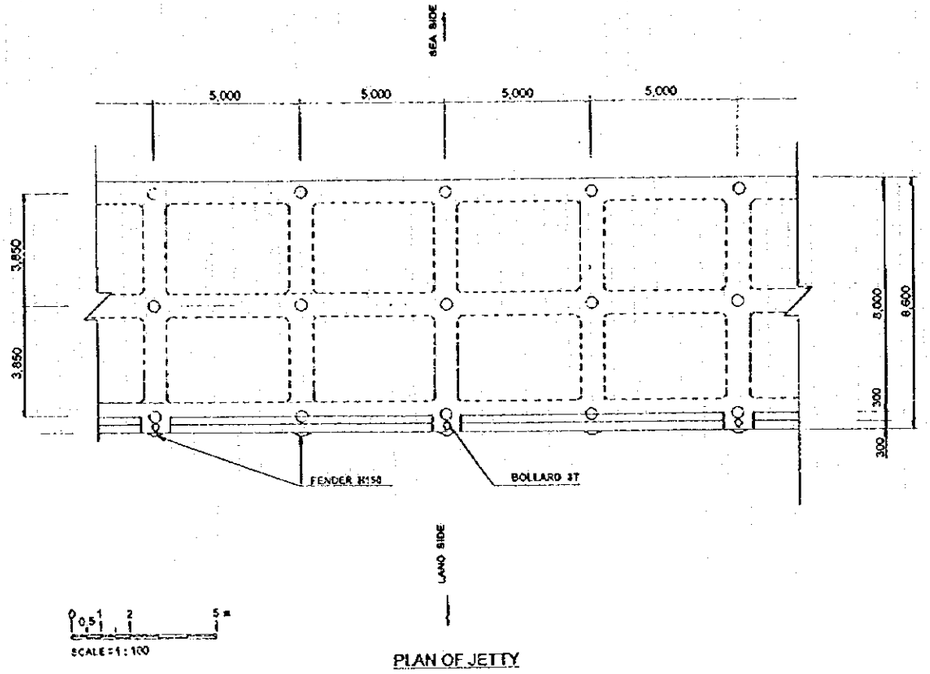
Prefabricated small compartment with insulation panels 1

Dimensions: Approx. 2.7 m (w) × 1.8 m (d) × 2.5 m (h)

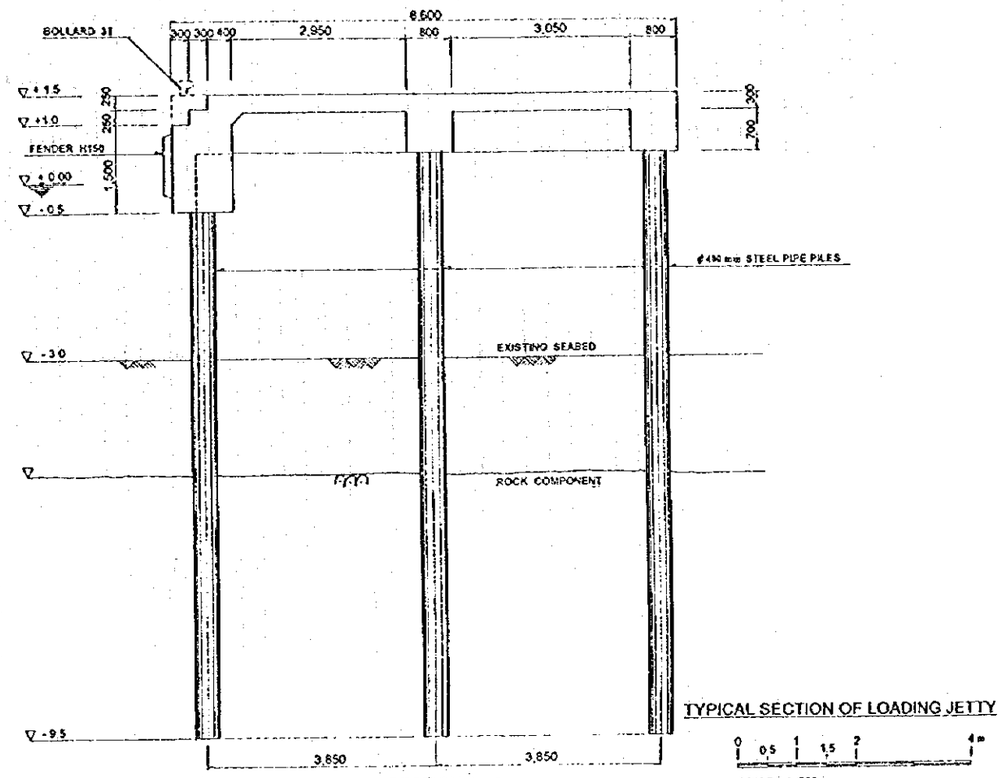
b)	Insulated fish box:		6
	Plastic insulated boxes, approx. 300 liters capacity		
c)	Scales :	100 kg weighing range	1
d)	Water tanks :	Plastic water tanks, approx. 500 liter capacity	7
e)	Radio telephone :	SSB radio telephone, approx. 150 W	1
f)	Small generator :	Diesel engine-driven small generator, approx. 3 kW	1



GENERAL LAYOUT PLAN

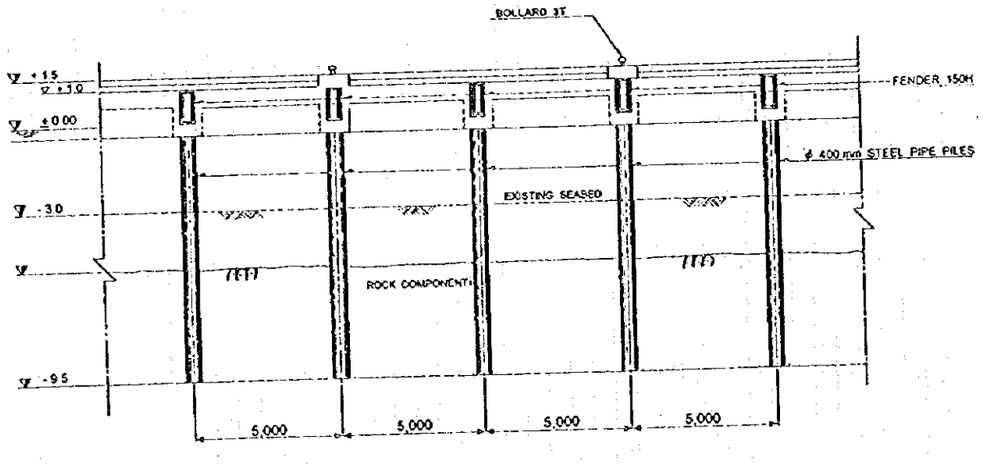


PLAN OF JETTY

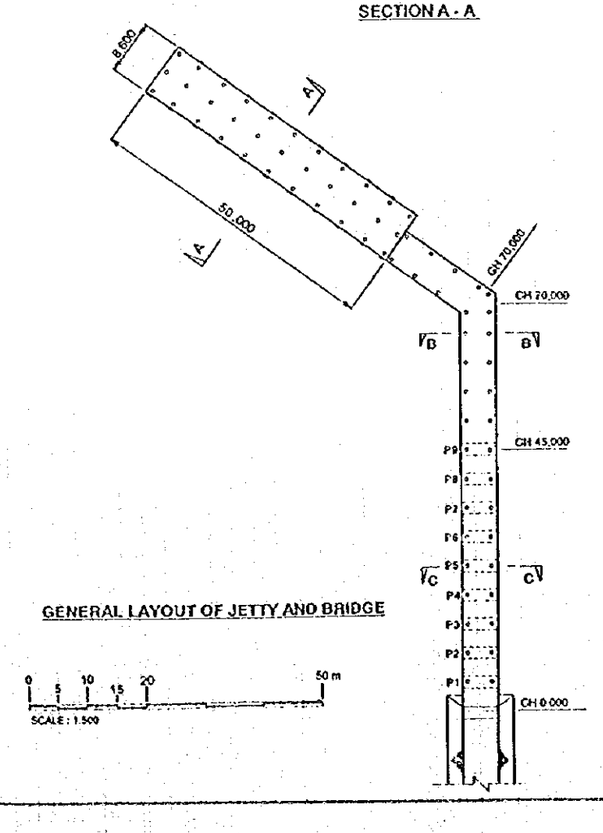


SECTION A - A

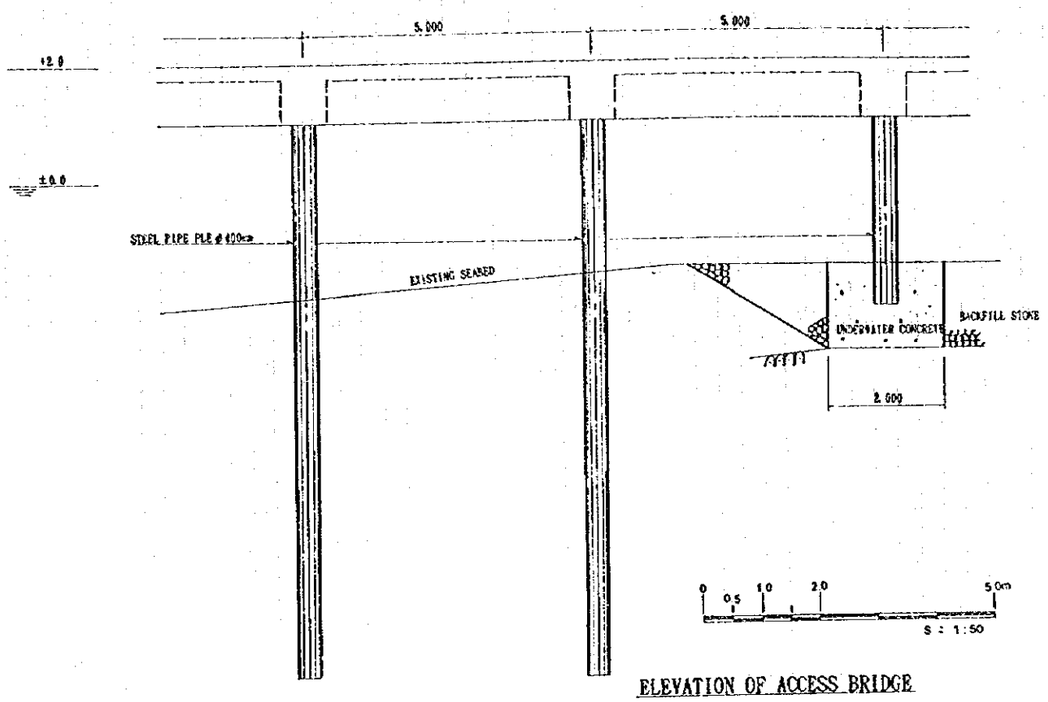
TYPICAL SECTION OF LOADING JETTY



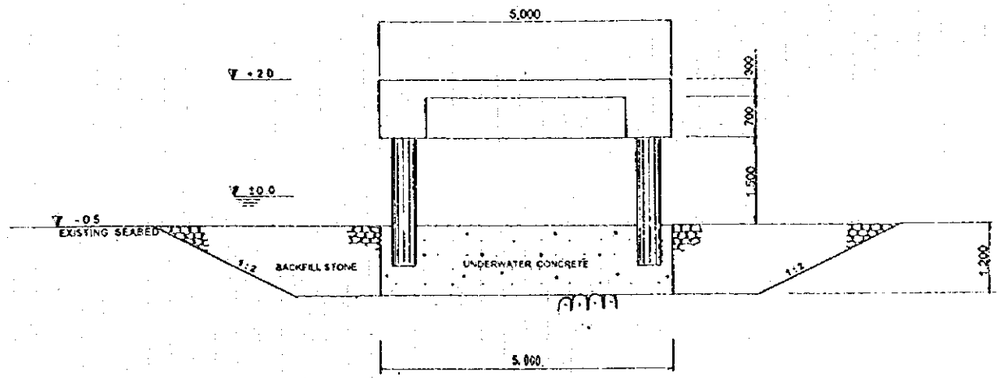
ELEVATION OF LOADING JETTY



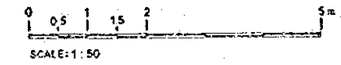
GENERAL LAYOUT OF JETTY AND BRIDGE

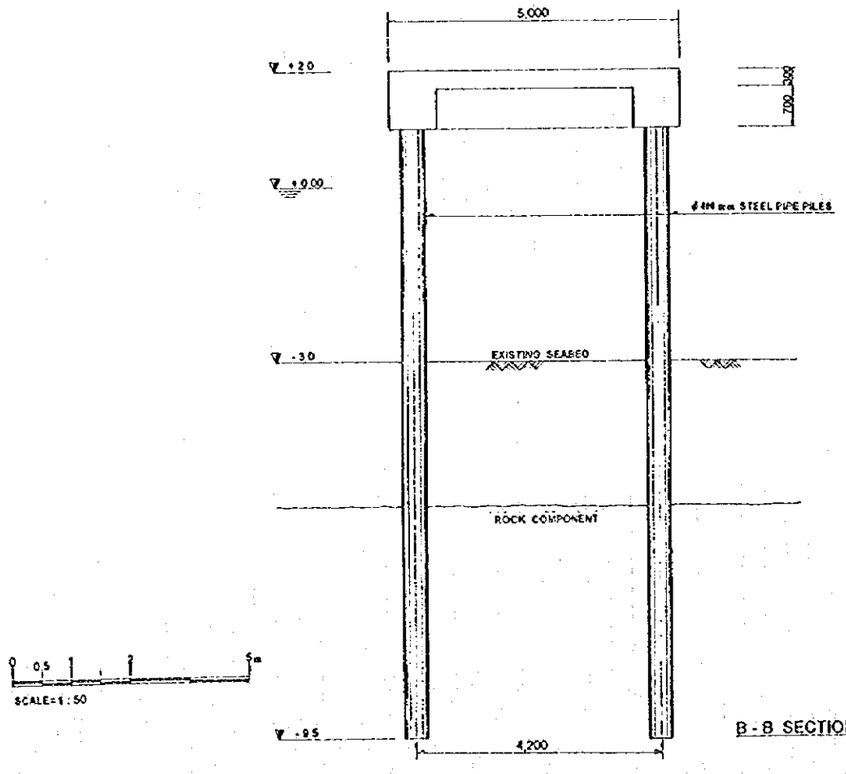


ELEVATION OF ACCESS BRIDGE

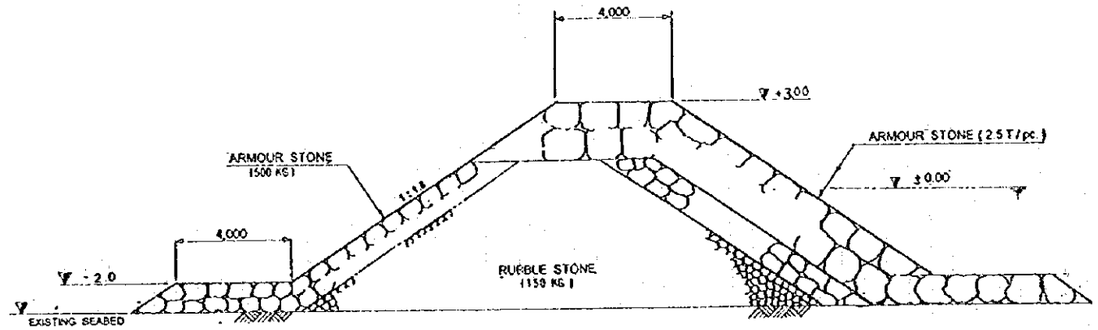


C - C SECTION OF ACCESS BRIDGE

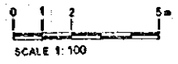




B - B SECTION OF ACCESS BRIDGE

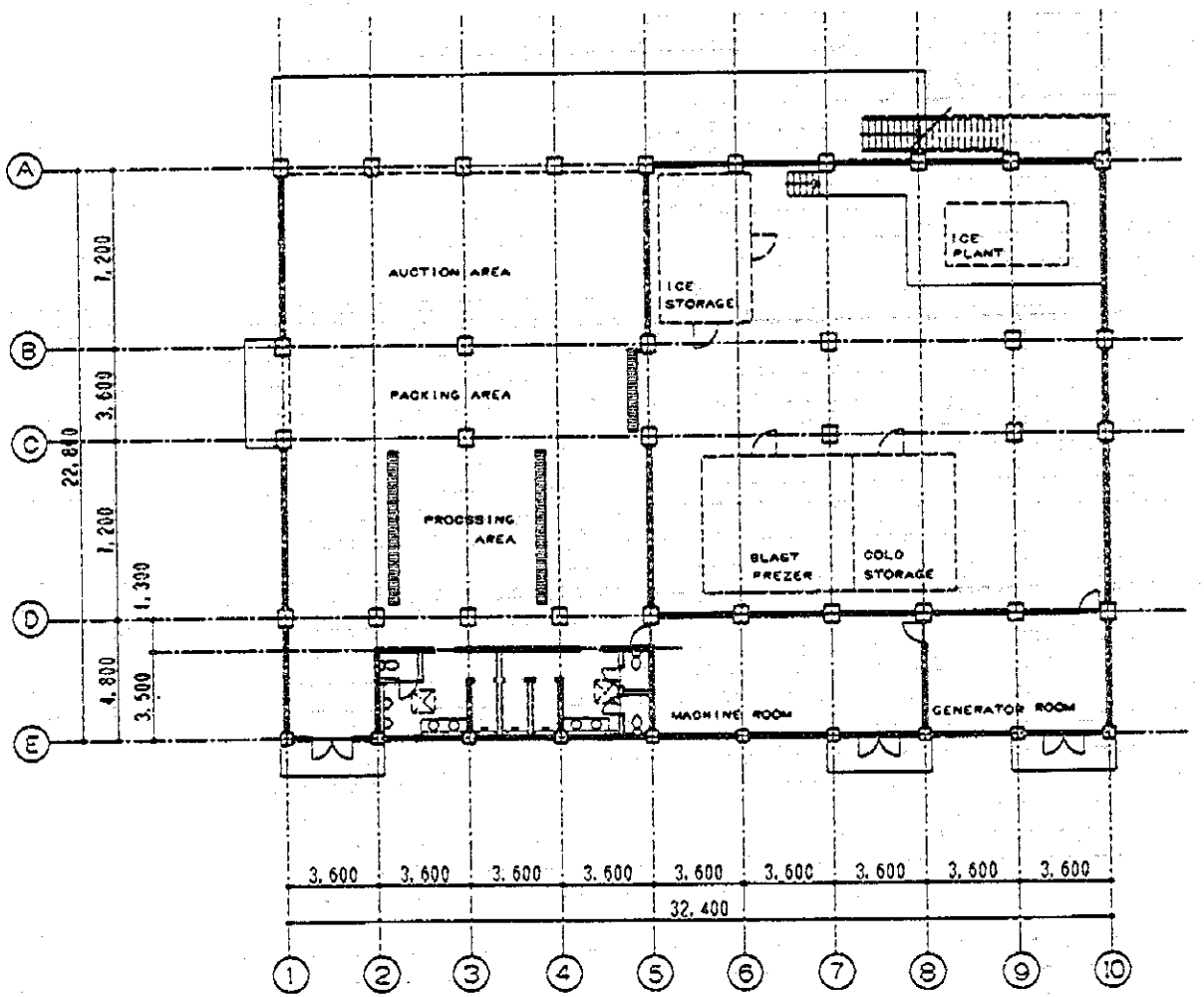


TYPICAL SECTION OF EAST BREAKWATER



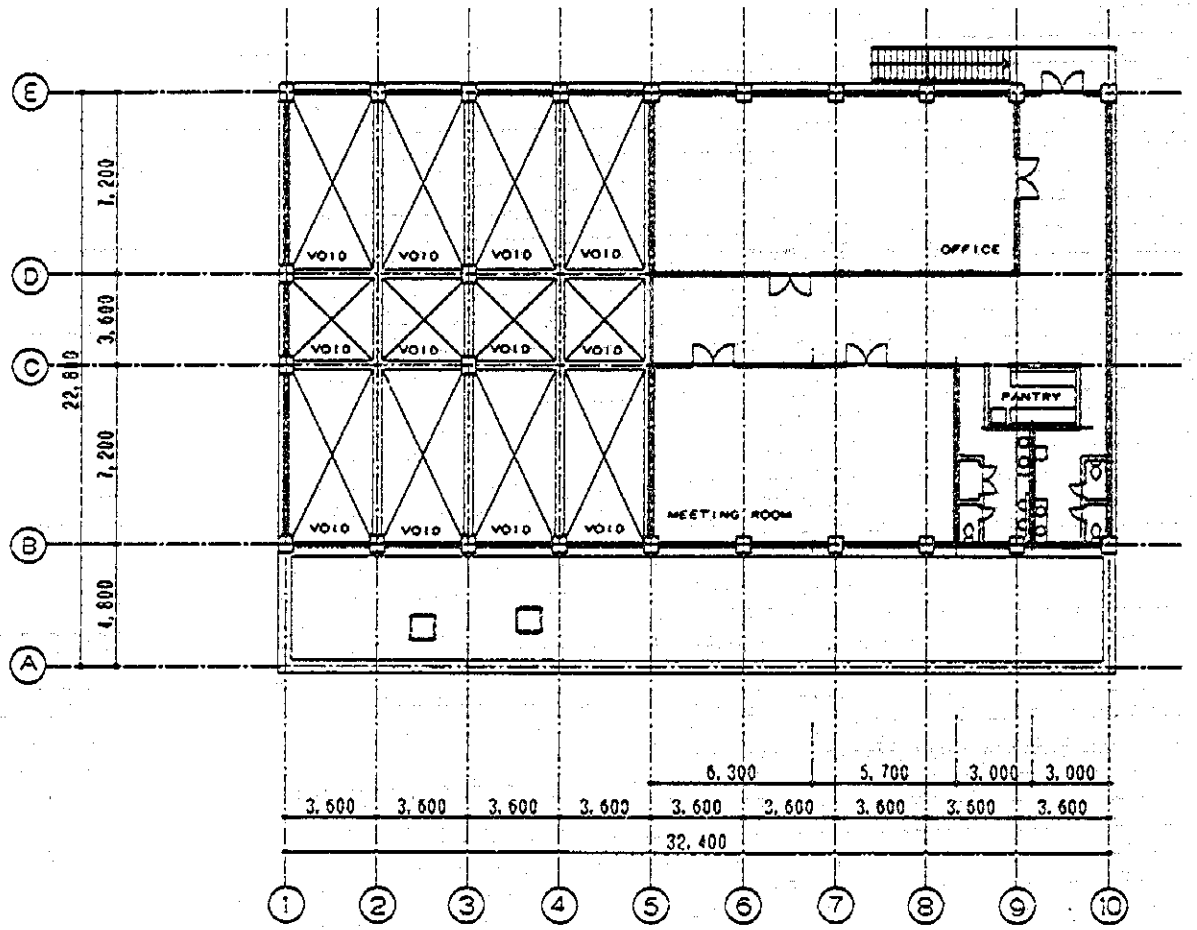
TYPICAL SECTION NORTH BREAKWATER

REFRIGERATION PLANT



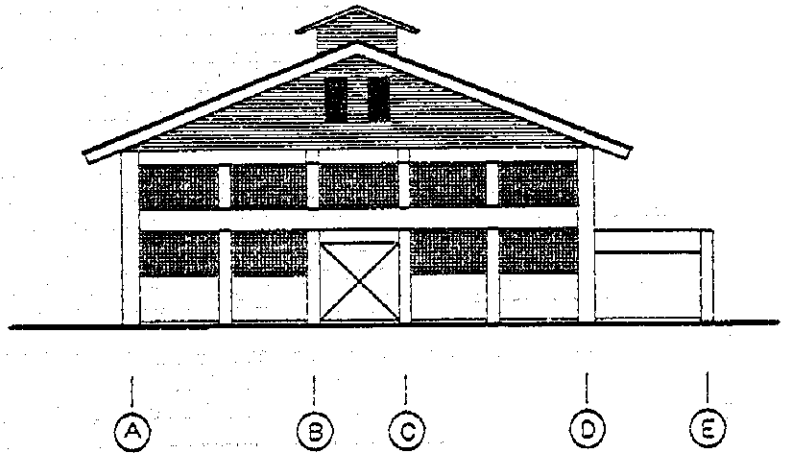
GROUND FLOOR PLAN 1/200

REFRIGERATION PLANT

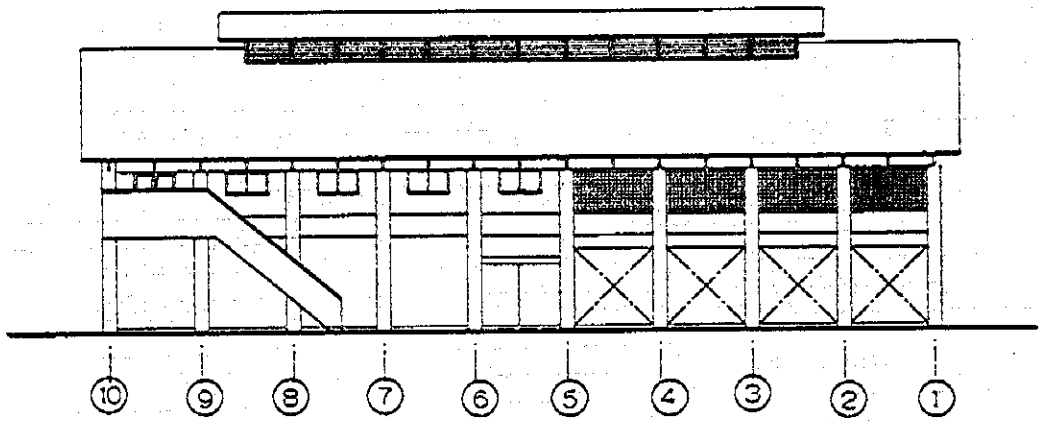


FIRST FLOOR PLAN 1/200

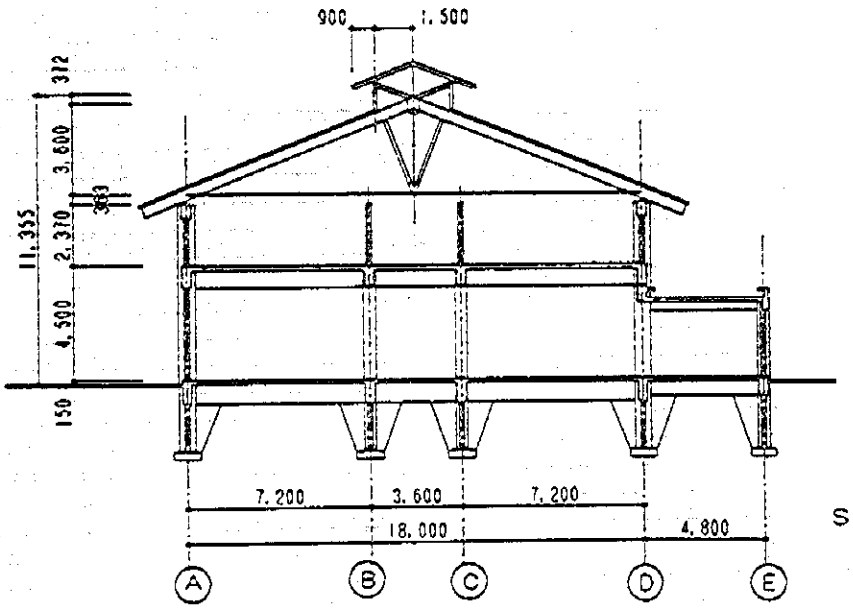
REFRIGERATION PLANT



WEST ELEVATION 1/200

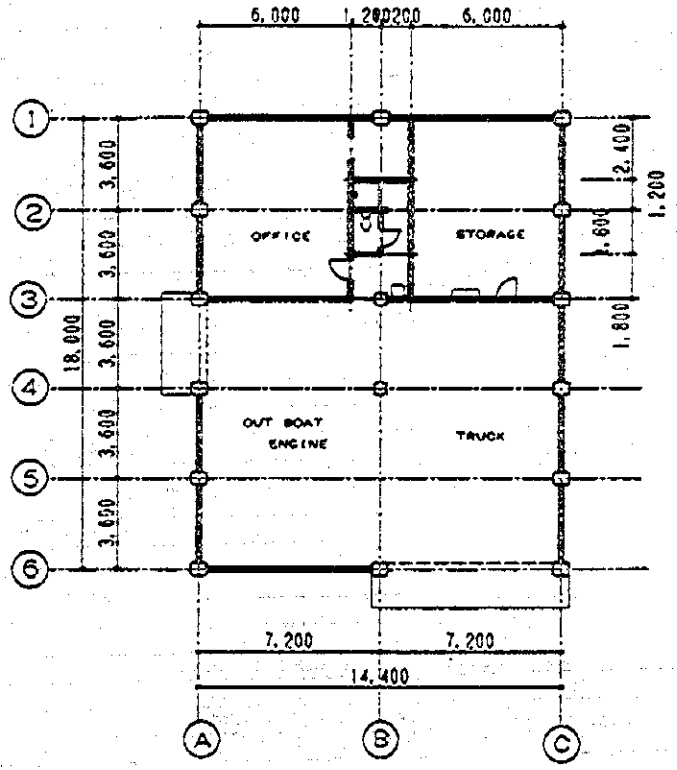


NORTH ELEVATION 1/200

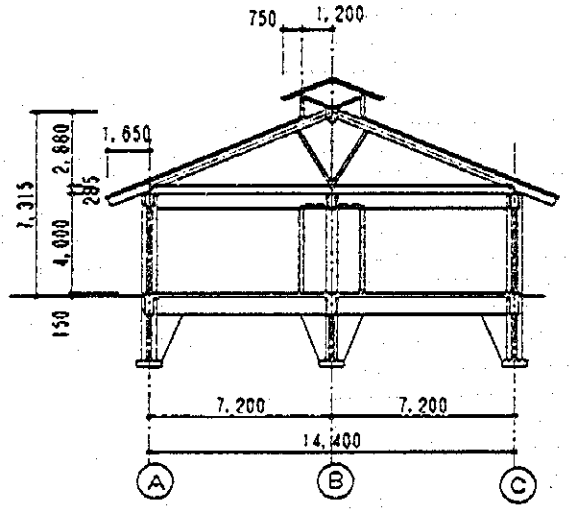


SECTION 1/200

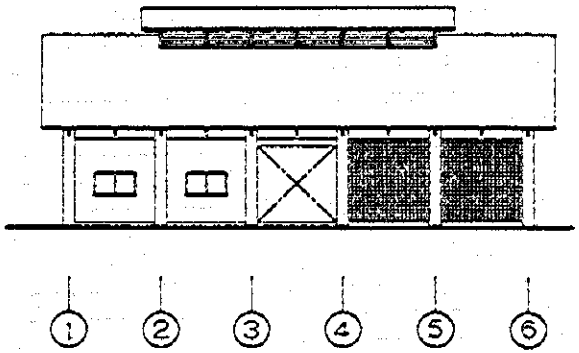
WORK SHOP



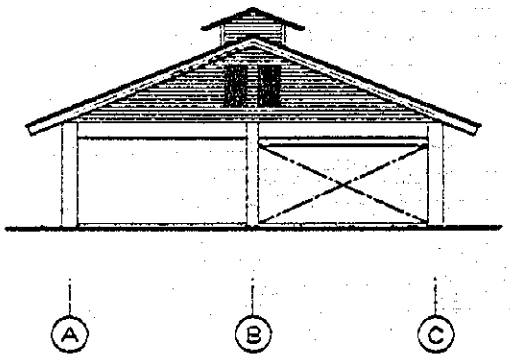
GROUND FLOOR PLAN 1/200



SECTION 1/200

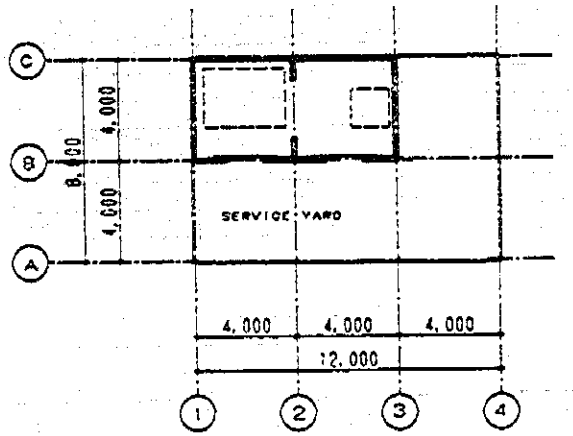


WEST ELEVATION 1/200

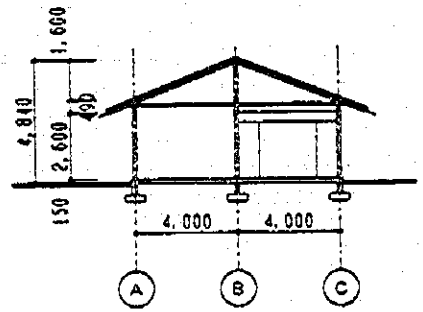


SOUTH ELEVATION 1/200

BARASOLE FISHERIES STATION



GROUND FLOOR PLAN /200



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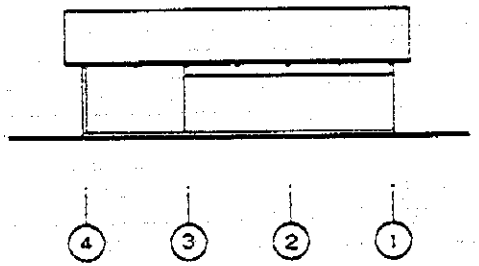
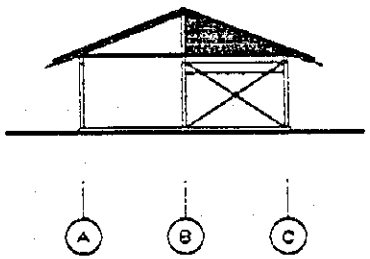
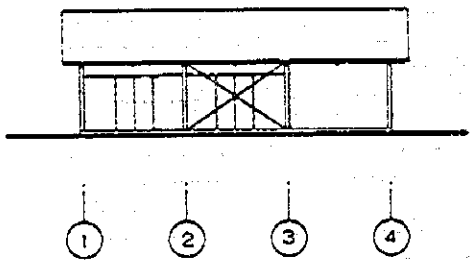


ELEVATION 1/200

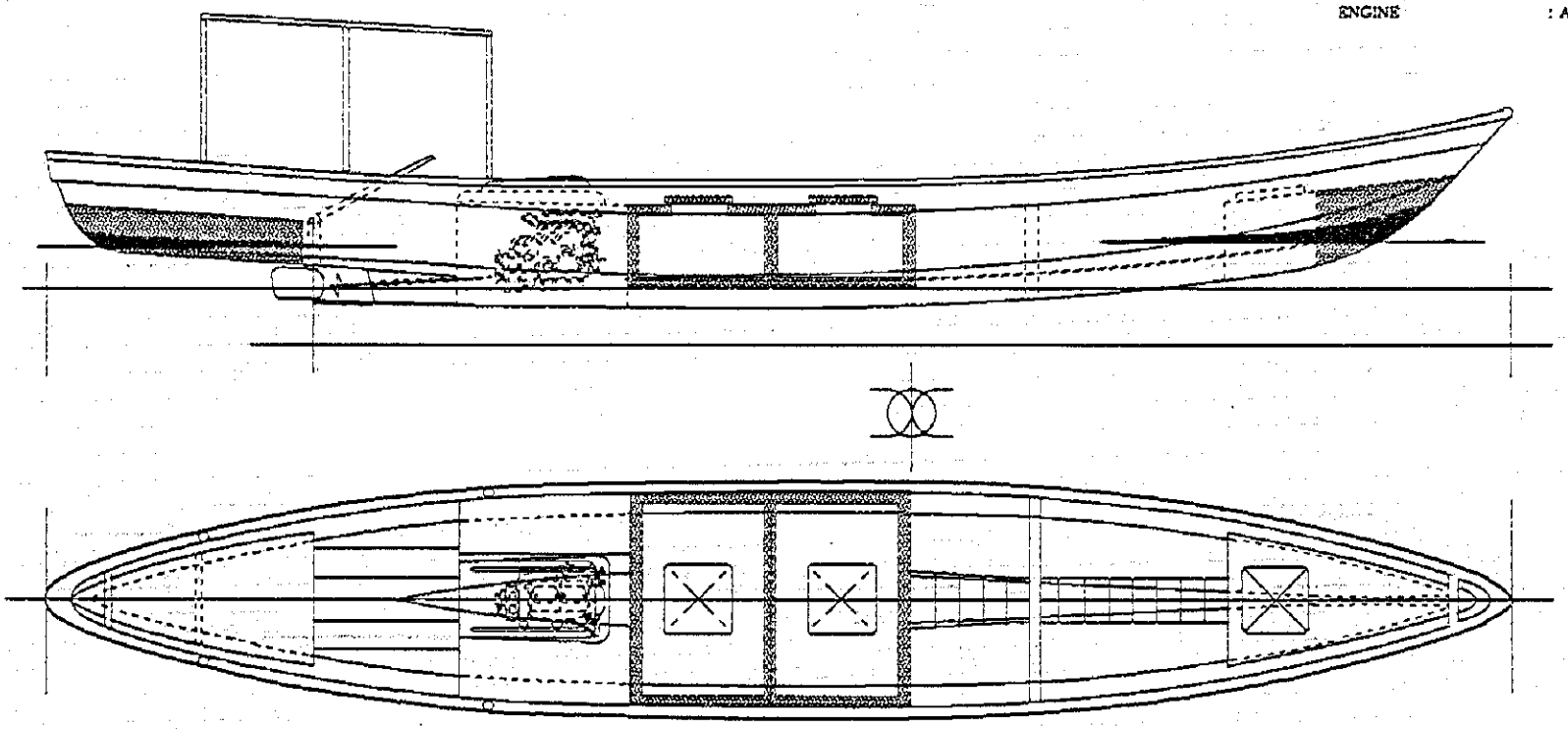


ELEVATION 1/200



ELEVATION 1/200

LENGTH OVERALL	: APPROX. 12.5 m
BREADTH OVERALL	: APPROX. 2.0 m
DEPTH OVERALL	: APPROX. 1.1 m
ENGINE	: APPROX. 23 PS.



FISHING BOAT WITH INBOARD ENGINE