NO

BASIC DESIGN STUDY REPORT

ON

THE PROJECT

FOR

EXTENSION OF FISHING PORT INFRASTRUCTURE

IN PRAIA

IN

THE REPUBLIC OF CAPE VERDE

NOVEMBER 2001

JAPAN INTERNATIONAL COOPERATION AGENCY

ECOH CORPORATION

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PREFACE

In response to a request from the Government of the Republic of Cape Verde, the Government of Japan decided to conduct a basic design study on the Project for Extension of Fishing Port Infrastructure in Praia and entrusted the study to the Japan International Cooperation Agency (JICA).

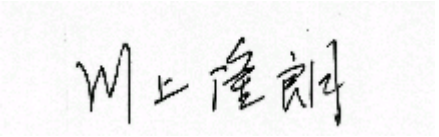
JICA sent to Cape Verde a study team from April 14 to May 23, 2001.

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

November 2001



Takao Kawakami
President
Japan International Cooperation Agency

November, 2001

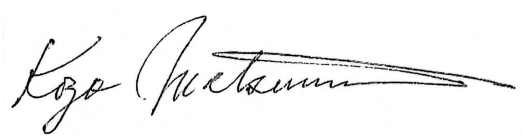
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Extension of Fishing Port Infrastructure in Praia in the Republic of Cape Verde.

This study was conducted by ECOH Corporation, under a contract to JICA, during the period from April, 2001 to November, 2001. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Cape Verde 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,



Kozo Matsumura
Project Manager,
Basic design study team on
the Project for Extension of
Fishing Port Infrastructure in Praia
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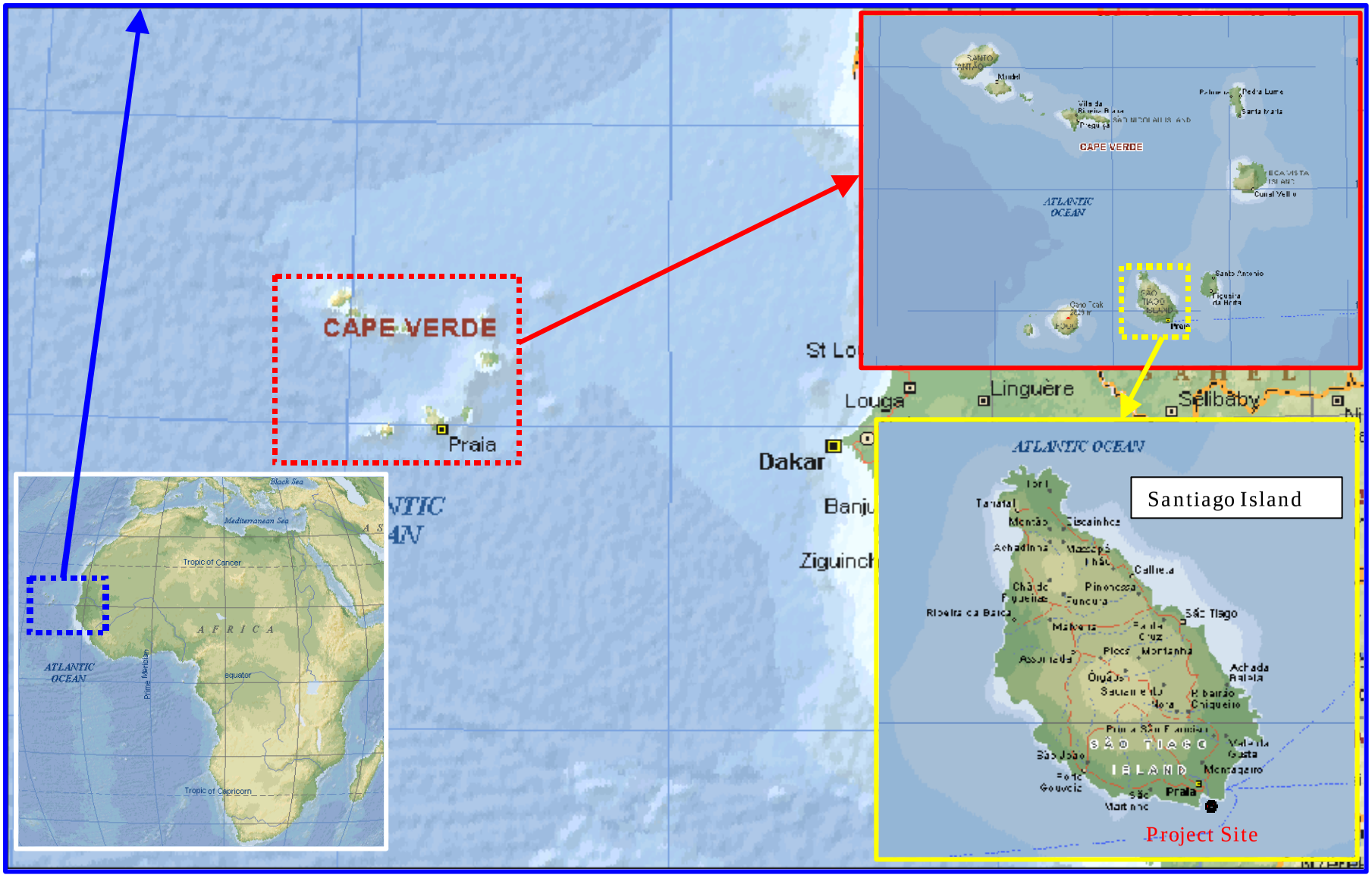
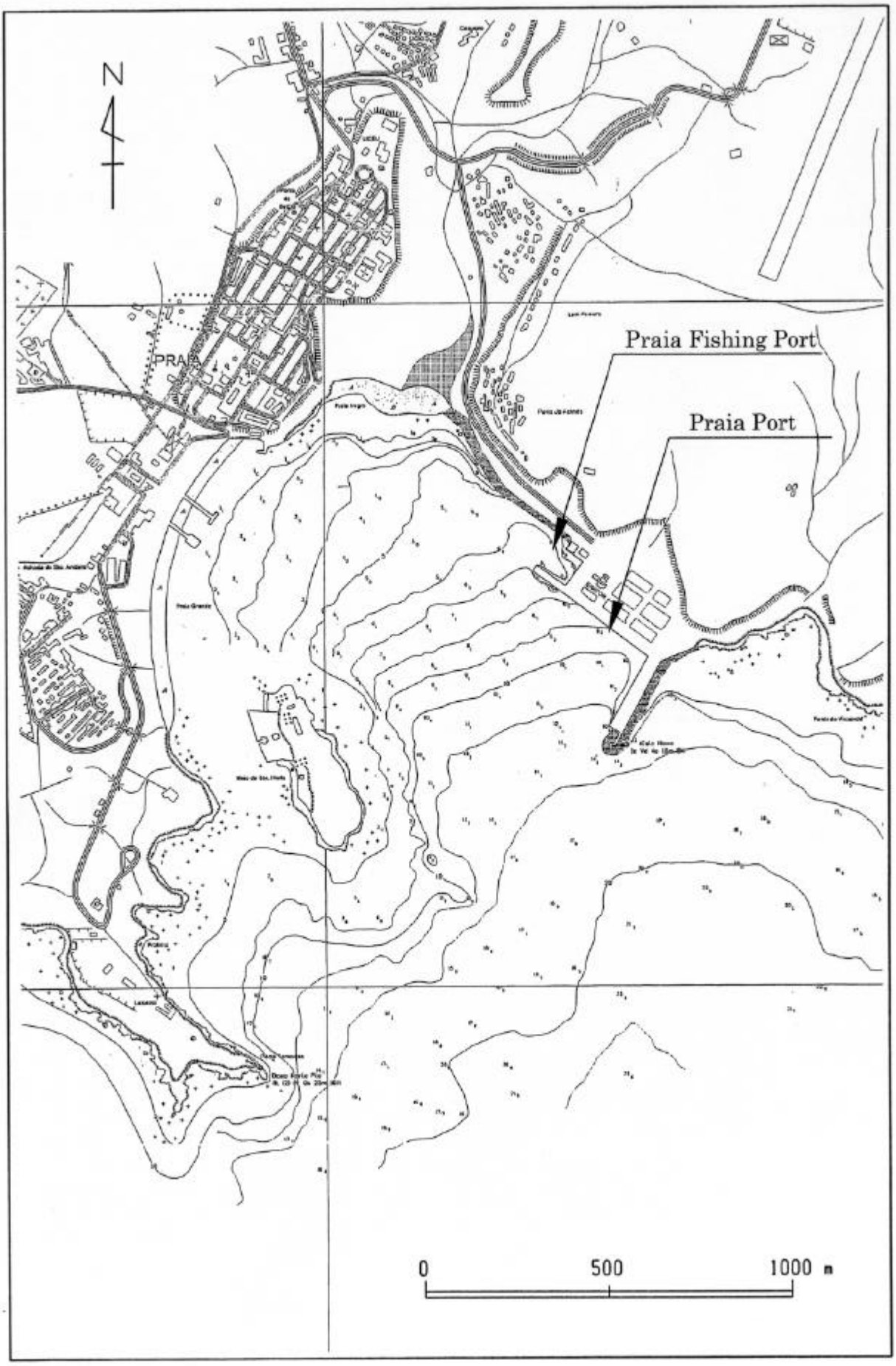


The Republic of Cape Verde and Location of Project Site



Project Site

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Abbreviations

AfDB	African Development Bank
AfDF	African Development Fund
BOD	Biochemical Oxygen Demand
CDL	Chart Datum Level
CEC	Commission of European Communities
COD	Chemical Oxygen Demand
DAC	Development Assistance Committee
DO	Dissolved Oxygen
E/N	Exchange of Notes
EEZ	Exclusive Economic Zone
ELECTRA	Empresa de Elecricidade e Aguas
ENAPOR	Empresa Nacional de Administracao dos Portos
Ecv	Cape Verde Escude
FAO	Food and Agricultural Organization of United Nations
FDP	Fisheries Development Fund
GDP	Gross Domestic Product
GL	Ground Level
GT	Gross Tonnage
HACCP	Hazard Analysis and Critical Control Point
HP	Horse Power
HWL	Mean Monthly-Highest Water Level
IDA	International Development Association
IFAD	International Fund for Agricultural Development
INDP	National Institute for Fisheries Development
JICA	Japan International Corporation Agency
LOA	Length overall
LWL	Mean Monthly-Lowest Water Level
MSL	Mean Sea Level for Observed Period
NHHWL	Nearly Highest High Water Level
NT	Net Tonnage
ODA	Official Development Assistance
Ph	Hydrogenion Concentration
SEFI	Sociedade de Electricidade e Frio Industrial
UNDP	United Nations Development Programme
UNTA	United Nations Regular Program for Technical Assistance
WFP	World Food Programme

Summary

Summary

The Republic of Cape Verde locates about 650km off the coast of Senegal in the Atlantic Ocean, she has nine main inhabited islands and fourteen islets with a total area of 4,033km^2. These islands are volcanic origin and mounted landscape, and its climate is dry and hot exposed to the northeasterly trade wind including harmattan wind from the Sahara Desert, therefore arable land area is very small.

The total population of the country is 435,000 estimated in 2000 with the growth rate of around 2% a year. It is, however, believed that as many Cape Verdians as those living in the country are now working abroad mainly in the U.S.A. and Europe. As for religion, a Catholic occupies most. An official language is Portuguese.

A capital city is Praia (population is around 100,000 in 2000), and is located in a Santiago island.

Cape Verde's main industries are agriculture and fisheries. But since the national territory has a dry Sahel climate and its soil is mostly volcanic with a great deal of undulation, agricultural productivity is low, and the situation regarding expansion of agricultural production is extremely difficult. Because of that, the country's food self-sufficiency is low, which means that it has to rely on food aid from other countries.

GDP of Cape Verde is 580 million US$ (1997) and per capita GDP is 1,371 US$ with the average growth rate of around 4 % (after 1990). Industries of agricultures and fisheries represent 19.5% of GDP (2000).

The main exports of Cape Verde are frozen fish, a banana, the canned food of a fish, etc., and imports are food, consumer goods, an industrial product, an oil product, a car, etc. Trading value of export and import are 43.2 million US$ and 215.1 million US$ in 2000, respectively, such as unfavorable balance of trade. Portugal, Spain, Britain are the main importing countries and main exporting countries are Portugal, France, and the Netherlands.

Cape Verde has a large exclusive economic waters zone (EEZ) which according to fishery resource surveys is endowed with an estimated 40,000 tons of fishery resources. In the other hand, the volume of fish catches has been increasing by

several percent each year, attaining approximately 10,000 tons in 2000. Although the maximum sustainable volume of catches is not clear, it is clear that there is still leeway for further development of such resources.

Although Cape Verde's fisheries industry represents only about 7-8% of GDP, it accounts for approximately 30% of the animal protein consumption of its people and is a major source of foreign exchange earnings, accounting for 27% of total export volume, and from that standpoint is growing in relative importance.

The fishing of CapeVerde is classified into artisanal fisheries (fishing by small fishing boat with outboard engine) and industrial fisheries (fishing by on-board engine with more than 11m boat length). The fish catch of both types in 2000 are almost of the same grade. Although a fish catch in the whole country is increasing, this has the large place mainly depended on the increase of industrial fisheries.

In the case of a small fishing boat, operation in the good fishing spot that spreads out around Cape Verde islands cannot be performed, and fishing activities are restricted to the coast area, so that increase of a fish catch over the present condition is not expectable.

On the other hand, in order to perform efficiently landing and process of fishes, the fishery infrastructures are required.

Specifically, wharfs (a landing wharf, a preparation wharf, wharf for rest) and functional constructions (a fish market, a refrigerator, ice-making plant, and other service equipments) are required.

In Cape Verde, there are few fishing ports where the above wharfs and ice-making machines etc. were improved.

Praia Fishing Port was constructed in 1991 on the basis of Japanese grant aid as an extension of the commercial port of Praia, with construction of a catch landing wharf and breakwater as civil facilities and a fish sorting and handling facility, a storage facility for fishermen's fishing gear, etc. as land facilities. Since its construction the volume of catches landed at it has been increasing year by year as it has come to be used not only by fishing boats based in the vicinity of Praia and elsewhere on Santiago island but also those registered at neighboring islands, reaching about 1,300 tons in 2000. Having the large consumption area of Praia, the capital, in its hinterland, the fishing port is also a hub of distribution

of fishery products, which are brought to it for sale not only by fishing boats registered at it but also from elsewhere on the island.

That being the case, the fishing port is very congested, with not only fishing boats landing catches, doing preparatory work or resting between sorties but also inter-island ferries coming in, all of which lowers the work efficiency of landing of catches and other work there. The wharf is also used at the same time as a place for sale of fish landed at it, for supplying ice and for scaling and other primary processing of fish as well as other activities, and that gives rise to sanitary problems and that of difficulty in keeping the freshness of fish.

The existing ice-making machine has become run-down, its production capacity has decreased, and it is difficult to get spare parts when it breaks down, and that situation has led to insufficient supply of ice for loading on fishing boats in preparation for sorties and consequently decline in freshness of catches and lower prices fetched for them.

For a background of such situation, the Government of Cape Verde requested the grant -aid concerning of fishing port basic facilities, such as breakwater and wharf, and fishery distribution facilities, such as ice-making machine, a fish market, a fishing gear lockers, etc. required for freshness maintenance and distribution of fishes, in the Praia fishing port.

In response to the request, the Government of Japan decided to conduct a basic design study, and sent to Cape Verde a study team as follows.

Basic design study : April 14, 2001 to May 23
Explanation of Draft Basic design Report: August 1, 2001 to August 12

Through an above-mentioned study and above-mentioned domestic analysis, this study team investigated background of the project, contents, natural conditions, and maintenance management organization, and the construction situation, and planned suitable scale and contents as a grant-aid project as follows.

Facilities

Designation of facility	Planned scale	Planned content
Breakwater (with one light beacon)	70 m	Block-type vertical structure
Wharf (water depth of －3.0 m)	80 m	Cellular block type
Parking Area	6 vehicles	210 m^2
Access Road	Longitude 58m	
Incidental Facilities		Light Beacon, Bollard, Fender, etc.
Ice-making facility building	315.0 m^2	7.5 m × 14.0m (3-storey building)
Fish market	341.6m^2	8m × 42.7 m
Fishing gear Locker	22 booths, 82.28 m^2	

Equipment

Designation of facility	Planned scale	Planned content
Ice-making machine		5 t/day × 2 units
Ice storage facility		30 t × 1 unit
Emergency generator		50 KVA × 1 unit
Fish container	Capacity: approx. 40 liters	72
Fish case	Capacity: 0.5 m^3	19
Cold-insulation fish case	Capacity: 1.0 m^3	5
2-wheel cart	Load capacity: 100 kg	7
Push hand cart	Load capacity: 500 kg	2
Pallets for sale of large fish	Dimensions:1m×1m×14cm (height)	20
Scales	Weighing capacity: 100 kg	4
Laver hose	25mmΦ×20m	2

Soft Component

The soft component which performs management of the line of movement, and instruction and the education of the efficient and sanitary handling method of a fish catch is carried out to the fishermen and fish venders.

The whole project period including detail design works is expected 2 years and 2 months.

Costs and benefits of Praia Fishing Port including fish marketing facilities (cold storage and ice making facilities) can be estimated 20.75 million Ecv and 20.77 million Ecv every year, respectively. There will be a surplus of 20,000 Ecv. Therefore, the Fishing Port Facilities will be able to operate on a self-paying basis. It is to be desired that the amount of surplus will be kept and spend for maintenance of facilities.

The present state and problems of Praia Fishing Port as identified at the time of the basic design study can be summarized as follows:

1. There is a great deal of congestion within Praia Fishing Port as a result of increase in the number of fishing boats making use of it as the volume of catches has increased as well as use of it by inter-island ferries and tugboats.
2. Because of insufficient wharf length there is congestion of those fishing boats that are landing their catches, those that are engaged in preparatory work for going out to sea and those resting between sorties, which makes for deterioration of work efficiency in catch landing, loading of ice on board and other work.
3. Not only behind wharf but also on the apron and in the corridors buying and selling of fish, scaling and other primary processing of catches, repairing of fishing nets and sale of ice take place at the same time and same place.
4. Buying and selling of fish takes place in an unsanitary environment in which the fish are laid out directly on the wharf apron in the direct rays of the sun, giving rise to problems of sanitation and keeping the fish fresh.
5. The existing ice-making machine has become run-down, its production capacity has decreased, and it is difficult to get spare parts when it breaks down, and that situation has led to insufficient supply of ice for loading on fishing boats in preparation for sorties and consequently decline in freshness of catches and lower prices fetched for them.

The project to be implemented against the background described above is expected to have the following effects:

Direct Effects:

① With extension of the length of the wharf, it will become possible to separate the different use functions of landing of catches, doing preparatory work and rest between sorties. That should result in higher work efficiency, less waiting time and mitigation of congestion at the fishing port.

② With extension of the breakwater, it will be possible to have calmness waters in front of the new wharf.

③ With more spacious anchorage in the fishing port, there will be improvement regarding the state of congestion of fishing boats and commercial vessels, improvement of vessel maneuverability and reduction of accident risk.

④ With creation of the fish market, it will become possible to buy and sell the fish in a more efficient and sanitary manner, which will make it possible to keep the catches fresher, and that in turn will stabilize the prices they fetch at a higher level.

⑤ Ice shortages will be eliminated by provision of the new ice-making machines, making it possible to keep the catches fresh and thus improve their quality when sold and stabilize their prices.

⑥ Improvement of the fishing gear lockers facility will improve both the efficiency of preparatory work and fishermen's working conditions.

Indirect Effects:

① Thanks to creation and provision of facilities in this project it will become possible to supply not just the population of the city of Praia and other areas of the island of Santiago but the country's entire population of 400,000 with quality fishery products.

② Thanks to the facilities created and provided in this project the total value of catches of the whole country will increase, creating employment in the fisheries industry and in connection with it.

③ With increase in volume of catches, it will become possible to export a part of it and thereby earn foreign exchange.

The following is a summary of the effects of implementation of the project and the extent to which the present situation will be improved by it.

Table 1 Effects of Implementation of the Project and Extent of Improvement of the Present Situation by It

Present situation and problems	Measures taken in the project (undertakings covered by the grant aid)	Effects of the project and expected extent of improvement
The waters within the fishing port are congested with fishing boats and inter-island ferries, creating vessel maneuverability problems and accident risk.	• Extension of the length of the breakwater (70m)	Separation of movement of fishing boats and commercial vessels through increase of anchorage in the port, use of the No. 3 wharf exclusively by fishing boats and use of the area behind the extended part for commercial port purposes
With increase in the volume of catches, the number of fishing boats making use of the fishing port has increased, resulting in overlapping of berthing by fishing boats engaged in the different functions of landing catches, preparatory work before sorties and rest between sorties and consequently in lowering of work efficiency in those different kinds of work.	• Extension of the length of the wharf (80m). Division of the wharf into separate parts: catch landing wharf, preparatory work wharf and rest wharf.	With separate use of the wharf for the different functions, it will become possible to accomplish the different kinds of work in an efficient manner, reducing work waiting time and mitigating fishing port congestion.
Buying and selling of fish laid out directly on the wharf in the direct rays of the sun and scaling and other primary processing work going on at the same time and at the same place, causing problems regarding sanitation and keeping the fish fresh.	• Construction of fish market (341.6 m^2) • Installation of sinks and drainboards in the fish market for fish processing purposes • Furnishing of cold boxes and other fish boxes • Construction of septic tank for disposing of wastewater from fish processing	Buying and selling fish at a roofed fish market using fish boxes will enhance sanitation (keeping the fish out of the sun and clean in the boxes), as will primary processing of the fish at the sinks and drainboards provided there.
The worn-down existing ice-making machine no longer has its initial production capacity, making it impossible to secure the necessary quantity of ice for keeping the fish fresh, and it is also difficult to get spare parts for it when it breaks down.	• Provision of ice-making machines (5 tons/day × 2) • Provision of ice storage facility (30 tons)	For the present situation regarding fishing sorties there will be practically no shortage of supply of ice, and having two 5-ton ice-making machines will make it much easier to cope with breakdowns and accomplish maintenance.
Presently there are only 25 fishing gear storage lockers, i.e. enough for only 32.5% of the 77 fishing boats registered at Praia Fishing Port.	• Construction of additional fishing gear storage capacity (22 additional lockers)	The rate of coverage of the fishing boats registered at Praia Fishing Port will be raised to 61%.

Problems to Be Solved and Proposals

It is proposed that the following points be given full consideration in management and operation after completion of construction of the project facilities in order to be able to resolve the problems of Praia Fishing Port through effective use of the catch landing and fishery product physical distribution facilities.

① Guidance and Restrictions for Fishermen
The facilities will be managed by the Praia Fishing Port operating organization under the guidance of the Ministry of Agriculture and Fisheries' General Directorate. For the sake of appropriate and smooth accomplishment of such facility management and operation it is necessary that the fishermen be provided with appropriate guidance, restrictions, etc.

② Improvement of Work Efficiency
Providing the fishermen with guidance for improvement of work efficiency through separate use of the different parts of the wharf according to the different kinds of work of the fishing boats making use of the fishing port (catch landing, preparatory work, rest between sorties).

③ Establishment of Rules
Establishment of rules concerning buying and selling of the catches at the fishing port (fish market) and thorough orientation of the fishermen and fish merchants concerning those rules as well as making sure that they are observed by implementing guidance and surveillance.

④ Maintenance of Water Quality in Fishing Port
Since the fishing port anchorage waters will be more closed in by the extension of breakwater than now, it will be necessary to strictly enforce prohibition of acts that would have an adverse effect on water quality such as dumping of waste oil and discarding of used fishing gear from fishing boats and processing of catches at the anchorage.
Provision of instruction and guidance, including explanation of the wastewater disposal system at the fishing port, to ensure that primary processing of catches is done only at the fish market sinks and drainboards and carrying out of regular septic tank maintenance and inspection.

⑤ Use the Ice
With provision of the ice-making machines and ice storage facility, it will become possible to keep the catches fresher for a longer amount of time, and that will make it possible to supply better quality fish. The fishermen should therefore be encouraged to use the ice that will become available to ensure fresher supply of fish.

⑥ Safety Navigation
Since not only fishing boats but also commercial vessels navigate the waters of Praia Fishing Port, it will be necessary to give guidance

concerning keeping in close communication with ENAPOR, CAPITANIA and other organizations concerned for the sake of ensuring safe navigation of such boats.

⑦ Fishery Statistics

In order to be able to clarify the trends in the different fished fish species resources and a fishery market it is important to publish annual statistical reports giving statistics concerning fishery productivity based on catch volume per day of fishing operations or day out at sea of industrial fishing boats.

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Chapter 1

Background of the Project

Chapter 1 Background of the Project

1.1 Background of the Project

Santiago, the island on which the project site, Praia Fishing Port, is located, is the island of Cape Verde with the greatest volume of fishery catches, accounting for more than 30% of the country's total volume.

There is a total of 33 catch landing base on coastal area surrounding the island. The island has more than 1700 fishermen and a number of fishing boats in excess of 470 in 1999. Those figures represent about 60% and 45%, respectively, of the national totals. The percentage of those fishing boats that are motor-powered is 58%, which is lower than the national average, and the average volume of catch per fishing trip of the artisanal fishing boats is also below the national average.

Since construction of Praia Fishing Port in 1991 on the basis of Japanese grant aid many of the artisanal fishing boats that had hitherto landed their catches at neighboring Gamboa Beach have come to use the new fishing port instead for that purpose as well as for fishing activity rest and recuperation, preparatory and other functions, the total number of that category of fishing boats using the port now being more than 70.

Furthermore, besides the industrial fishing boats that are registered at Praia Fishing Port, it is the de facto home port of others, too, a total of some 20 to 30 boats of that category now making use of it. In addition to that, according to fishing port plans another 10 larger industrial-type boats are scheduled to start operations with Praia Fishing Port as their base within the next year or so. Of the steel boat or FRP boat type, they are presently under construction in Portugal on the basis of funds furnished by the African Development Bank and the Arab Development Bank.

The city of Praia, situated near the fishing port of the same name, is a large consumption area with the country's largest population. That being the case, Praia Fishing Port is also a hub of distribution of fishery products on the island of Santiago, the fish coming from many different sources, including the catches landed at Praia Fishing Port, catches landed at fishing villages elsewhere on the island and transported overland to Praia and catches landed on other islands where fishing boats are registered and transported to Praia by inter-island ferry.

Thus, Praia Fishing Port has come to be used considerably more than originally planned when it was constructed, resulting in extreme congestion on

the catch landing wharf, in the corridors behind it and elsewhere, and that congestion has in turn given rise to low efficiency of landing work, low efficiency of distribution and sanitary problems like decline in the quality of the fish in distribution.

Furthermore, the ice-making machine provided with funding by the African Development Bank after Praia Fishing Port was constructed is still in operation, but as the fishing port came to be used more than originally planned, shortages have developed in supply of ice to fishing boats and to fish venders for use in distribution, and the situation has deteriorated to such an extent that fishing boats sometimes postpone putting out to sea in order to wait for supply of the ice that they need. At the same time shortage of supply of ice to fish venders for distribution purposes has resulted in decline in the freshness of the fish and consequently lower prices fetched for them.

In view of such a situation the Government of Cape Verde has formulated the “Plan for Extension of Praia Fishing Port” for the sake of making its operations more efficient and is requesting Japanese grant aid for breakwater and wharf construction and other elements of that plan.

1.2 Current Fishery Situation of Santiago Island

The volume of fishery catches of 1998 and 1999 in the island of Santiago was 2930tons and 3324tons, respectively and they are 31% and 32% of the volume for the whole country. Praia fishing port has a large consumption area as hinterland having about 32% share of the catches landed on the island (1007tons in 1998 and 1049tons in 1999). This is the largest production area of fishery catches in the country.

The fishery catches landed in Praia fishing port are sold to fish vendors and they sell to general consumers at public market in Praia and or by peddling. The fish vendors distribute and sell fish to consumers in inland area and also they buy fish distributed from other landing points at Praia fishing port and sell to Praia city area.

(1) Number of fishermen and fishing boat

There are 33 fish-landing bases in Santiago Island. Table 1.1.1-1 shows number of fishermen and fishing boats at the each landing base. Over 3000 fishermen and 600 fishing boats are counted in Santiago Island. Fishermen are 40% and fishing boats are 38% of the number for the whole country in 1999. Motorization of fishing boat is 62.5% less than the whole country's average (73%) and the catch volume of one trip is also less than the whole country's average.

Industrial fishing boats registered in Praia fishing port are 10 and they are operated from the fishing port as a base.

Landing volume of catch at Praia fishing port is 8 tons to 12 tons in one day.

Table1.1.1-1 Number of fishermen and fishing boat in Santiago Island

Name of Fishing Port	Number of fishing boats			Number of fishermen		
	With Engine	Without Engine	Total	Full-Time	Part-Time	Total
Rib da Barca	20	9	29	105	6	111
Pedra Badejo	10	26	36	87	36	123
Gamboa	**46**		**46**	**276**	**27**	**303**
Rincao	34	31	65	136		136
Port Mosquito	26	1	27	83		83
Chao Bom	28	6	34	180		180
Achada Ponta	3	21	24	48	21	69
Praia Baixo	3	25	28	74		74
Cidade Velha	16	3	19	63	23	86
Quebra Canera	4	3	7	18	5	23
Covao Figueira	4	7	11	29	4	33
Calh. S.Miguel	15	3	18	52	1	53
Ra das Pratas	2	2	4	19	2	21
Sao Tome	5	1	6	19		19
Gouveia	1	1	2	9		9
Calh. S. Martinho	2	2	4	15	4	19
Achada Laja		4	4	8	4	12
Port Formoso	14	6	20	73		73
Cancelo	1	7	8	25	8	33
Biscainha	5		5	10		10
Cula	1	1	2	10		10
Baia-Tarrafal	39	2	41	144		144
Tarrafal-Fazenda	1		1	7		7
Portinho	3	4	7	20		20
S. Francisco	4		4	11		11
Porto Fundo	2	6	8	12	8	20
Mangue Negra		2	2	4		4
Tarrafal-T Montes		2	2	4		4
Praia Negra	3	4	7	19	6	25
Binbirim	3		3	6		6
Furna	2		2	4		4
Rubon Porco	2		2	3		3
Total	299	179	478	1,573	155	1,728

Source : INDP's Report (2000)

(2) Fishing gear, method and main species

Industrial fishing boats use mainly long line, pole and line, vertical long line and purse seine. Their target is pelagic fish small pelagic fish and demersal fish.

Artisanal fishing use small size of purse seine and gill net. their main target is demersal fish and small pelagic fish.

Table.1.1.1-2 Fishing method and main target species

Fishing Method	Long line/pole and line	Purse seine	Vertical long line	Hand line	Gill net
Species	Tuna、Skip-jack, Spanish mackerel	Horse mackerel, Spanish mackerel, sadine	Snapper, Groopa、Sea bass	Snapper, Groopa、Sea bass	Snapper, Groopa、
Industrial fishing boat	○	○	○	—	—
Semi-industrial	○	○	○	○	
Artisanal fishing boat	—	○	—	○	○

(3) Fish season

The fishing season is different by type of fishing boats. In case of industrial fishing boat, peak of the season is July to September. During this season, catch volume is over 45% of the whole volume of a year. In case of artisanal fishing boat, they are operated through the year. The fluctuation of their catch volume is small through the year.

(4) Fishing ground and operation pattern

There is a good fishing ground near Maio Island area and Brava where is good fishing ground for demersal fish. Industrial fishing boats and artisanal fishing boats gather to Maio area to catch the fish in the season.

Operation days of industrial fishing boats and semi-industrial boats are 4 days and 4 to 2days respectively. Artisanal fishing boats are almost one-day operation.

(5) Fishing activity in Praia fishing port

Praia fishing port has been constructed in 1991 by the Japanese grant aid. The landing and preparation wharf of 55m long, breakwater/quay of 80m long, fish-market area with administration office and fishing gear lockers have been provided adjoining Praia commercial port.

1) Number of fishing boats using at Praia fishing port

According to the fish landing record at Praia fishing port, 28 number of industrial fishing boats and 48 number of artisanal fishing boats, total 77 number of fishing boats used at Praia fishing port in 2000.

Table1.1.1-3 Number of fishing port used at Praia fishing port

	Industrial	Artisanal	Total
1999	30	41	72 boats
2000	29	48	77 boats

Source：landing record of INDP

2) Landing volume of catch at Praia fishing port

Table 1.1.1-4 shows the landing volume of catch at Praia fishing port. The landing volume increased year on year from 1996. Landing volume of 2000 is 1.4 times of 1997. The annual number of landing also increased.

Table1.1.1-4 Landing volume of catch at Praia fishing port

	1996	1997	1998	1999	2000
Tuna, Skipjack	372	284	285	266	514
Small pelagic fish	705	566	633	706	714
Demersal fish	179	100	90	76	125
Total landing volume(t)	1,256	950	1,008	1048	1,353
Number of landing/year	—	—	1,318	1,294	1,630

Source：INDP

1.3 Natural Condition

1.3.1 Climatic Condition

The climatic data over 1990-1999 was obtained from the Praia Air Port weather station (temperature, rain fall, humidity, atmospheric pressure, wind direction and velocity). The data is being analyzed. In general, Cape Verde belongs to the Sahelian area where it rains little and the northeast wind prevails. There is no reporting of natural disaster like cyclone.

(1) Temperature

Table 1.3.1-1 shows monthly average, monthly average of maximum and minimum temperature during 1990 to 1999. Table shows that the maximum and minimum temperature is 30.9℃ in September, 18.6℃ in March, respectively. Annual average temperature is 24.8℃. Seasonal change of temperature is rather small through the year.

Table 1.3.1-1(1) Monthly Average of Temperature (1990～1999)

Temp	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(℃)	22.5	23.0	23.0	23.5	24.7	25.4	25.7	26.7	27.1	26.8	25.8	23.7

Table 1.3.1-1(2) Monthly Average of Maximum Temperature (1990～1999)

Temp	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(℃)	26.4	27.3	27.4	28.1	29.1	29.7	29.5	30.3	30.9	30.8	29.6	27.4

Table 1.3.1-1(3) Monthly Average of Minimum Temperature (1990～1999)

Temp	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(℃)	18.7	18.8	18.6	18.9	20.0	21.0	22.0	23.1	23.4	22.8	21.8	20.1

(2) Rainfall

Table 1.3.1-2 shows the monthly average rainfall of past ten years. Annual total average rainfall is 118.9mm. There is much precipitation in August and September in a year.

Table 1.3.1-2 Monthly Average of Rainfall (1990～1999)

Rainfall	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
(mm)	3.6	0.1	0.2	0.1	0.0	0.0	9.2	36.4	48.7	17.8	0.2	13.7	118.7

(3) Wind

Tables 1.3.1-3 show the monthly average wind speed and Figure1.3.1-1 show the occurrence of wind speed by each direction. The tables show that strong wind season is from December to May. Predominant wind direction is North-east, its occurrence ratio is more than 70%. In Summer (July to September), occurrence ratio of North-east wind has decreased, on the other hand, occurrence ratio of South wind direction has increased.

Table 1.3.1-3 Monthly Average Wind Speed (1990～1999)

wind speed	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(m/s)	6.7	7.3	6.9	6.7	6.8	6.0	4.6	4.1	4.7	5.6	6.0	6.8

Note: Annual average wind speed is 6.0m/sec

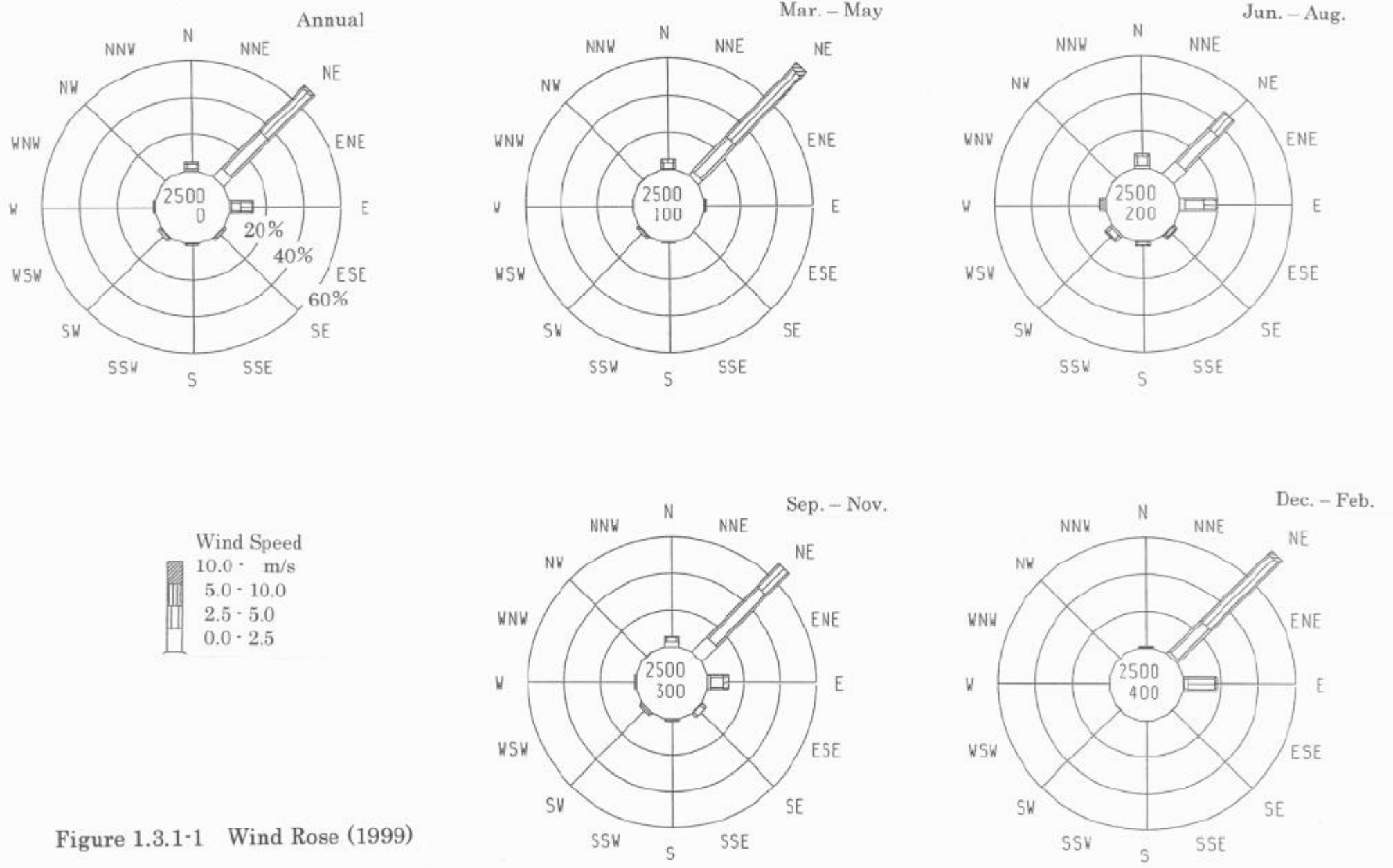


Figure 1.3.1-1 Wind Rose (1999)

1.3.2 Sea Condition

(1) Tide

Tide observation was conducted for 23 consecutive days, from April 26 to May 17 by installing a pressure type tide gauge at the shore-off the coast of Praia Fishing Port. The results of analysis are almost same results obtained in the past Praia Fishing Port Project.

The total of main four component of tide (M2, S2, O1 and K1) is 63.1cm.

(2) Waves

1) Offshore Wave Characteristics

Since there is no wave observation station near Praia Bay, no wave observation data are available. We therefore obtained the data for Santiago hindcast offshore waves by taking from U.S. Navy's Global Spectral Ocean Wave Model database. The frequency of occurrence of offshore waves by height and direction, wave rose of offshore waves are shown in Appendix-6.1.

According to these data, N to NE waves predominate at about 86 %; the occurrence ratio of waves 1m, 2m,3m in height account for 96.0%, 62.7% and 17.8% respectively.

2) Near Shore Wave Characteristics

Wave height, period and direction were observed for same period of tide observation by installing electromagnetic wave-current meter at one location (shown in Figure1.3.2-1) in near the project site. Figure1.3.2-2 shows the time series of the wave characteristics. The significant wave heights were distributed over the range of 0.3m to 1m. Wave periods of significant wave were distributed over the range of 10s to 15s. And dominant wave direction was SE direction.

The project site in Praia Bay is relatively calm, because the mouth direction of Praia bay is SE. The offshore waves generated by the NE trade wind are shielded, but the waves from S to SE are not shielded and enter to the Bay directly.

The waves from each direction deformed by refraction and diffraction are reaching to the site as shown in Figure1.3.2-3.

(3) Currents

Current direction and speed were observed for same period of tide and waves. The maximum current speed observed 0.1m/sec as shown in Figure

1.3.2-4.

The surface currents were observed by the float at four location near the fishing port. The results are as follows.

Current direction is SSW duration of fall and rise. The average speed of the current is 0.15 m/sec.

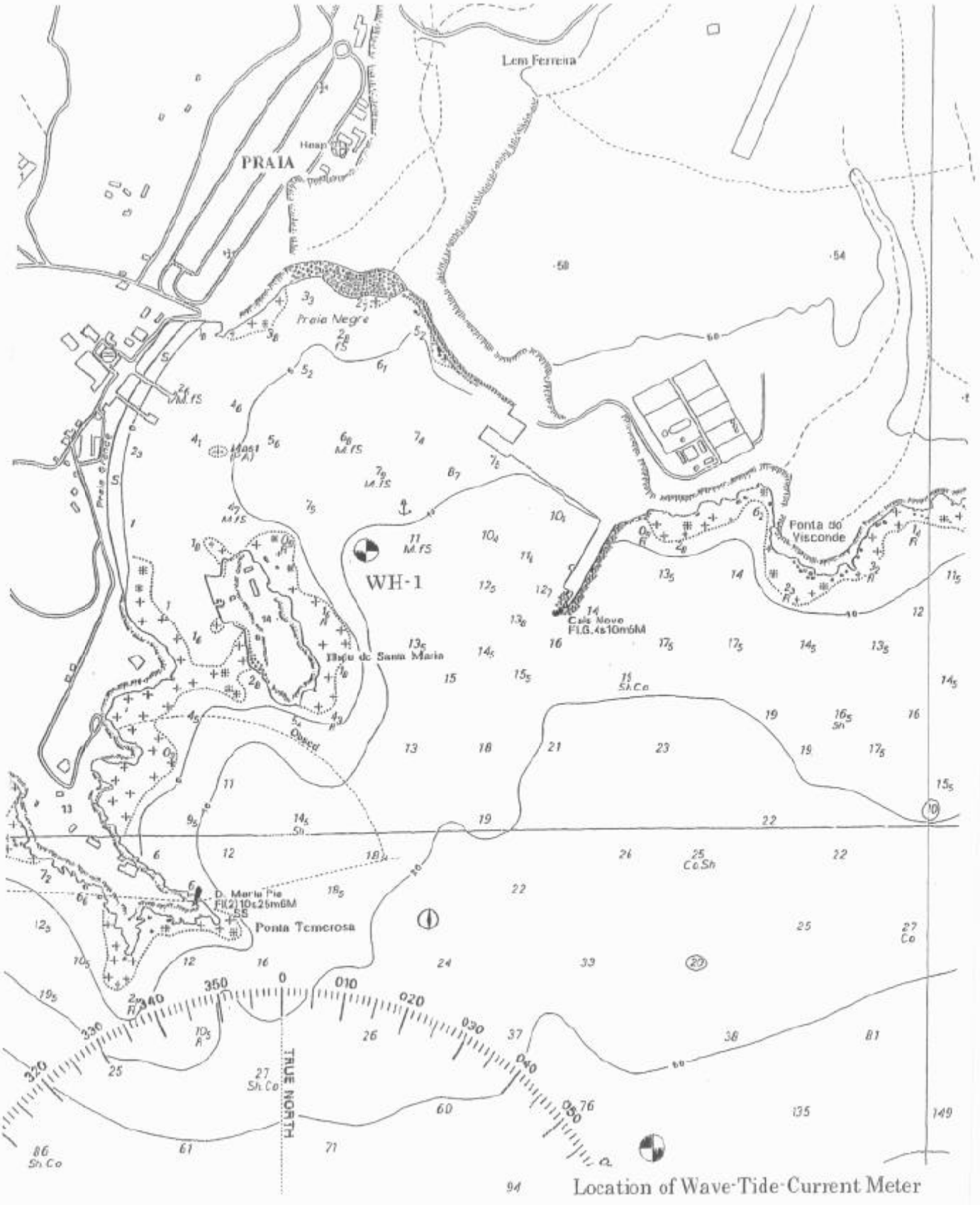


Figure 1.3.2-1 Location of Wave-Tide-Current Meter

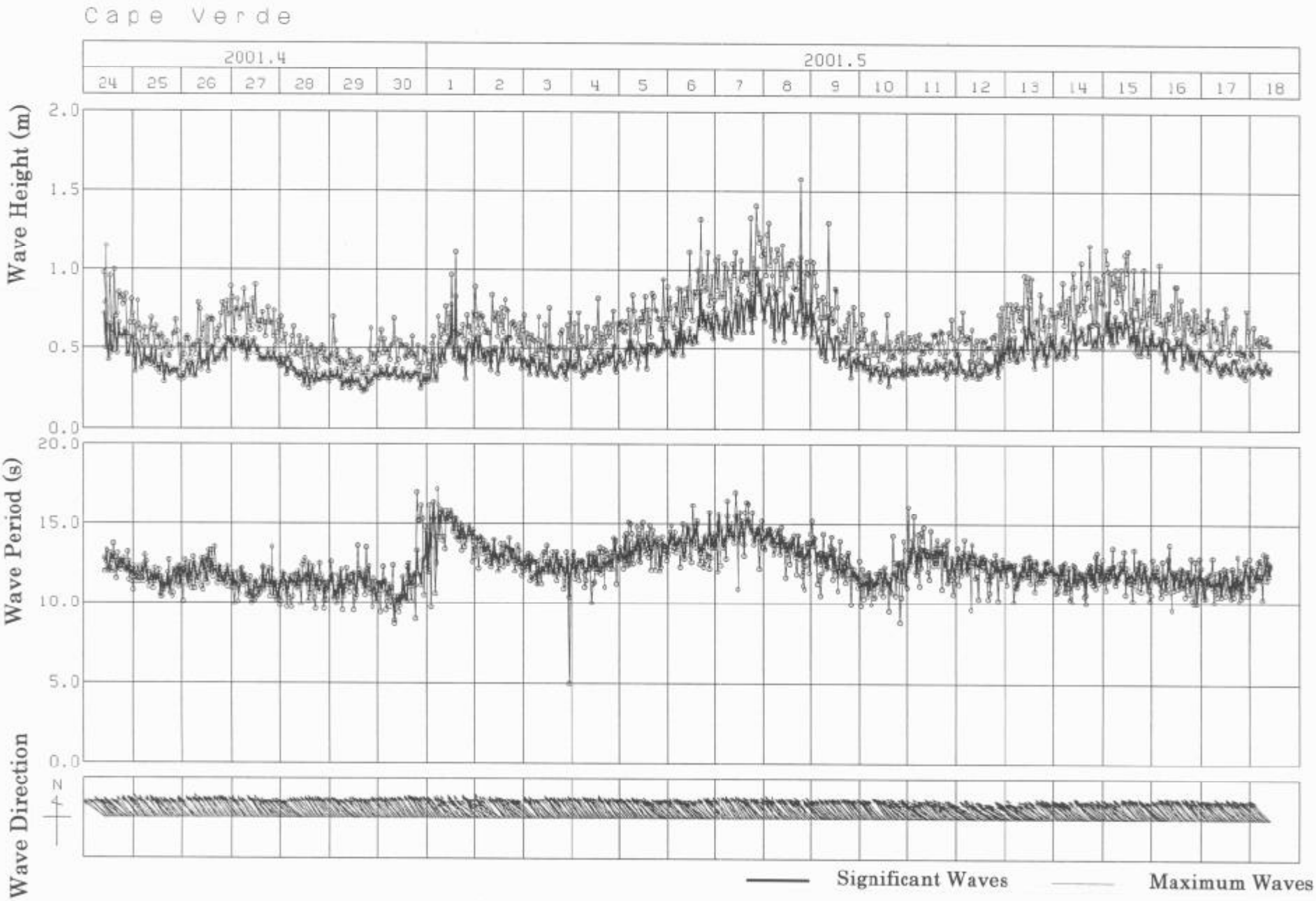


Figure 1.3.2-2 Time Series of Waves

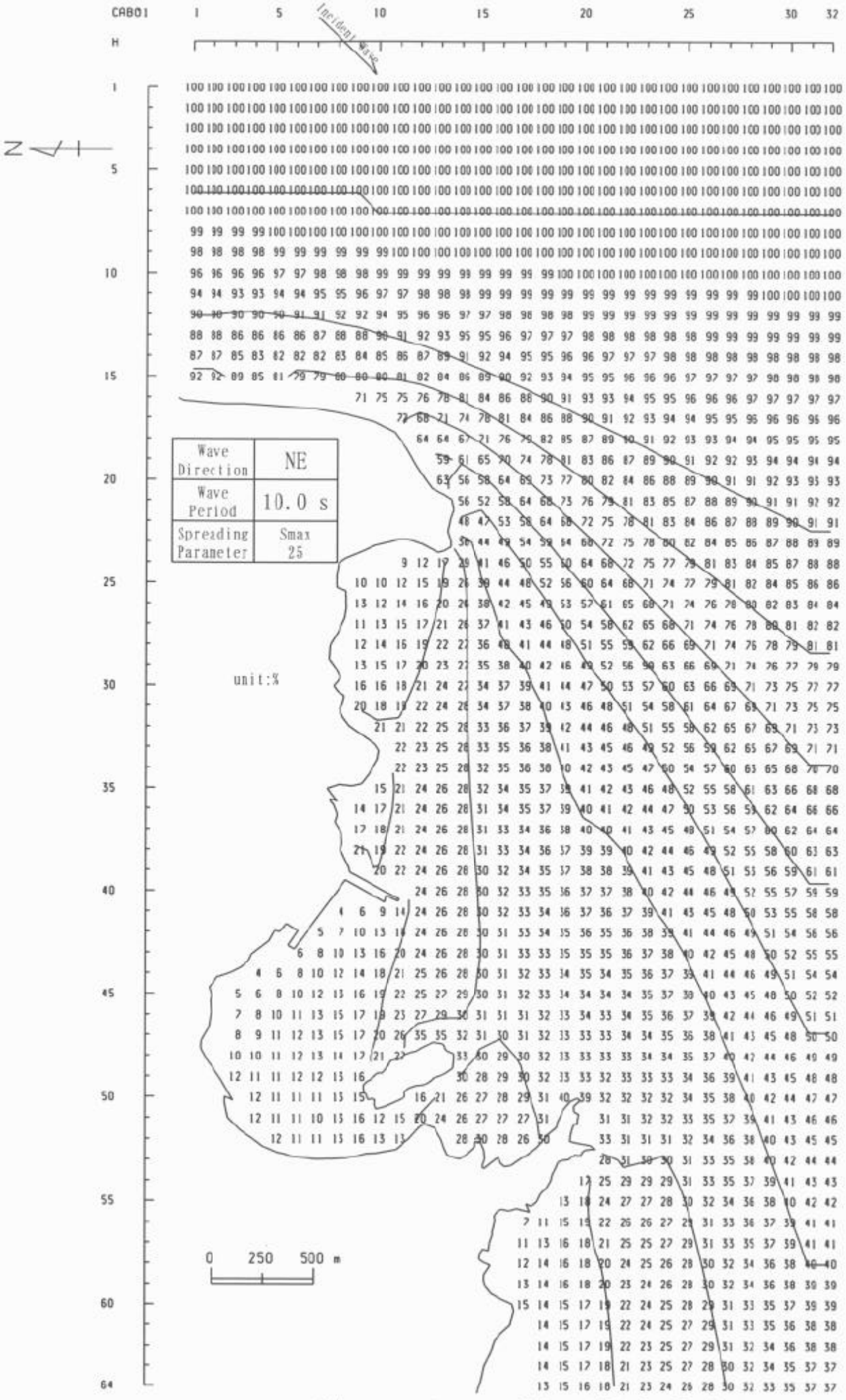


Figure 1.3.2-3(1) Distribution of Wave Height Ratio

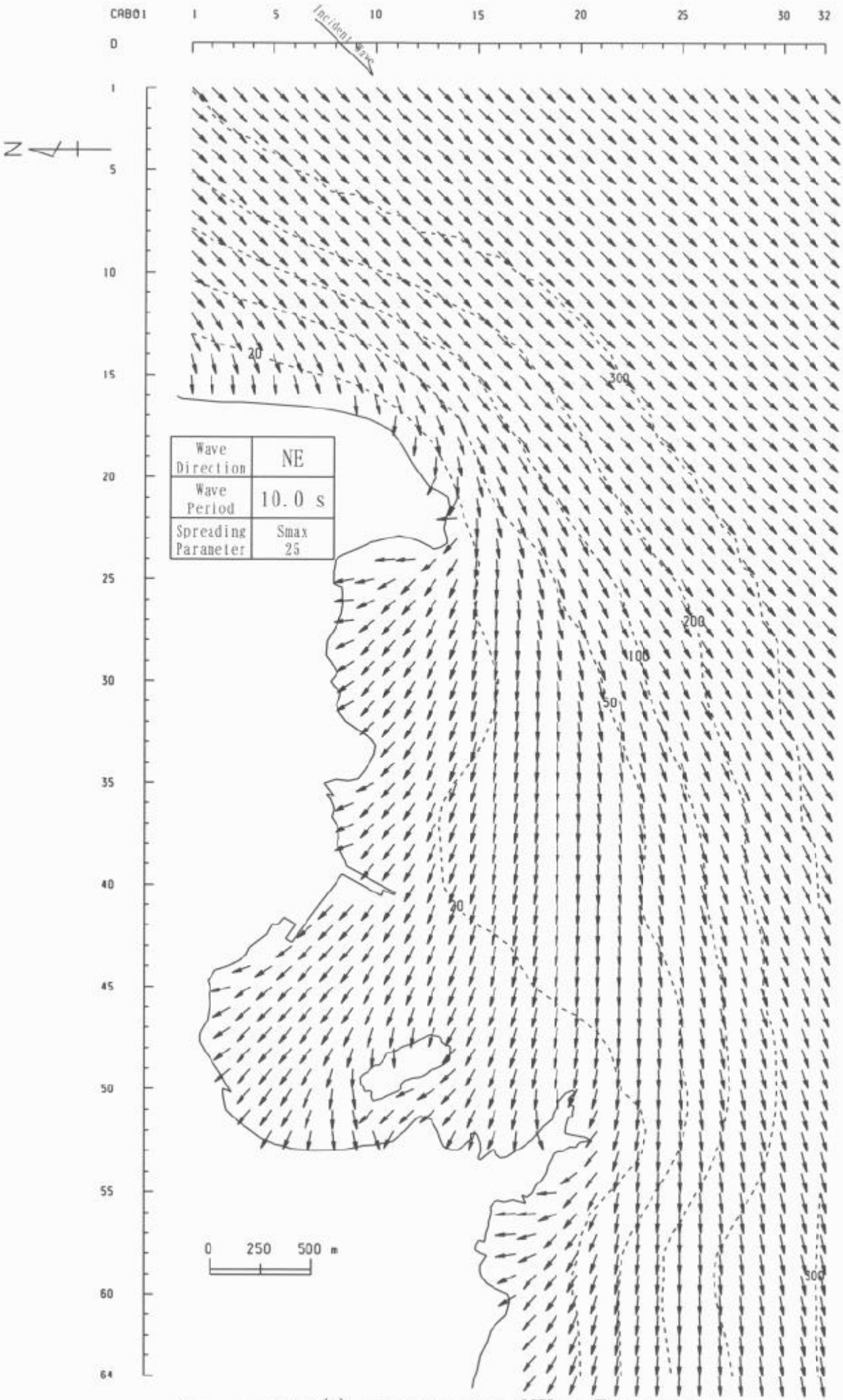


Figure 1.3.2-3(2) Distribution of Wave Direction

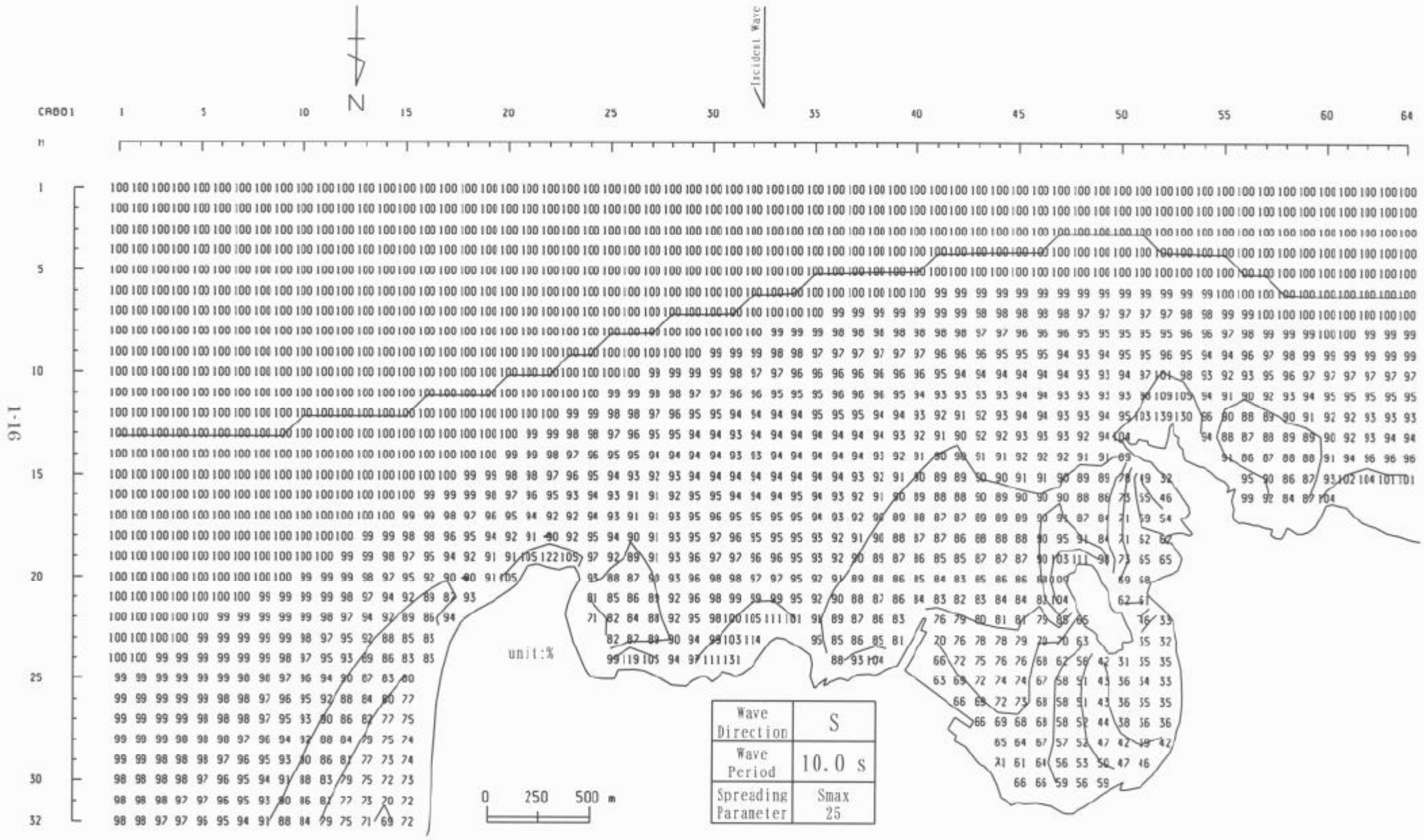


Figure 1.3.2-3(3) Distribution of Wave Height Ratio

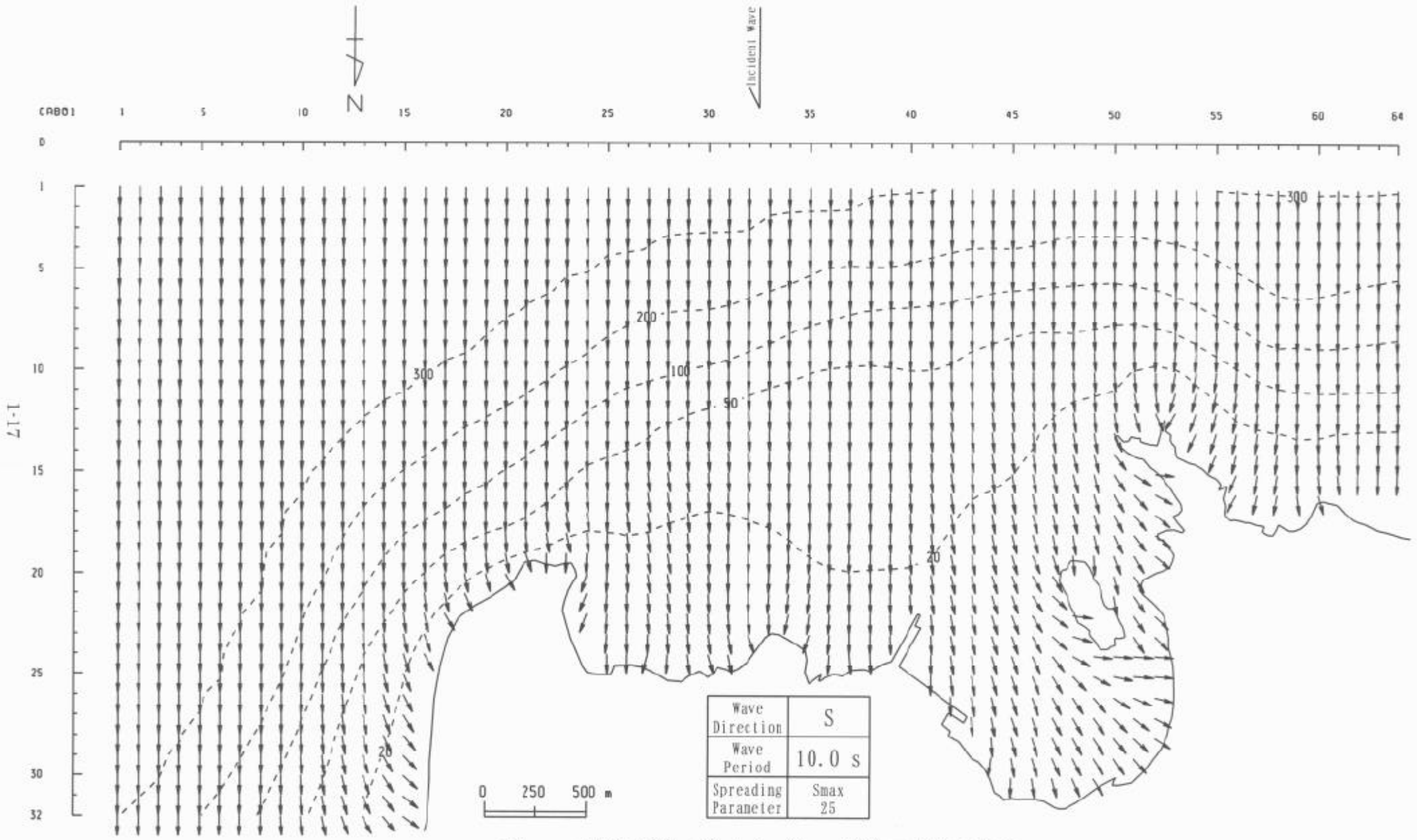


Figure 1.3.2-3(4) Distribution of Wave Direction

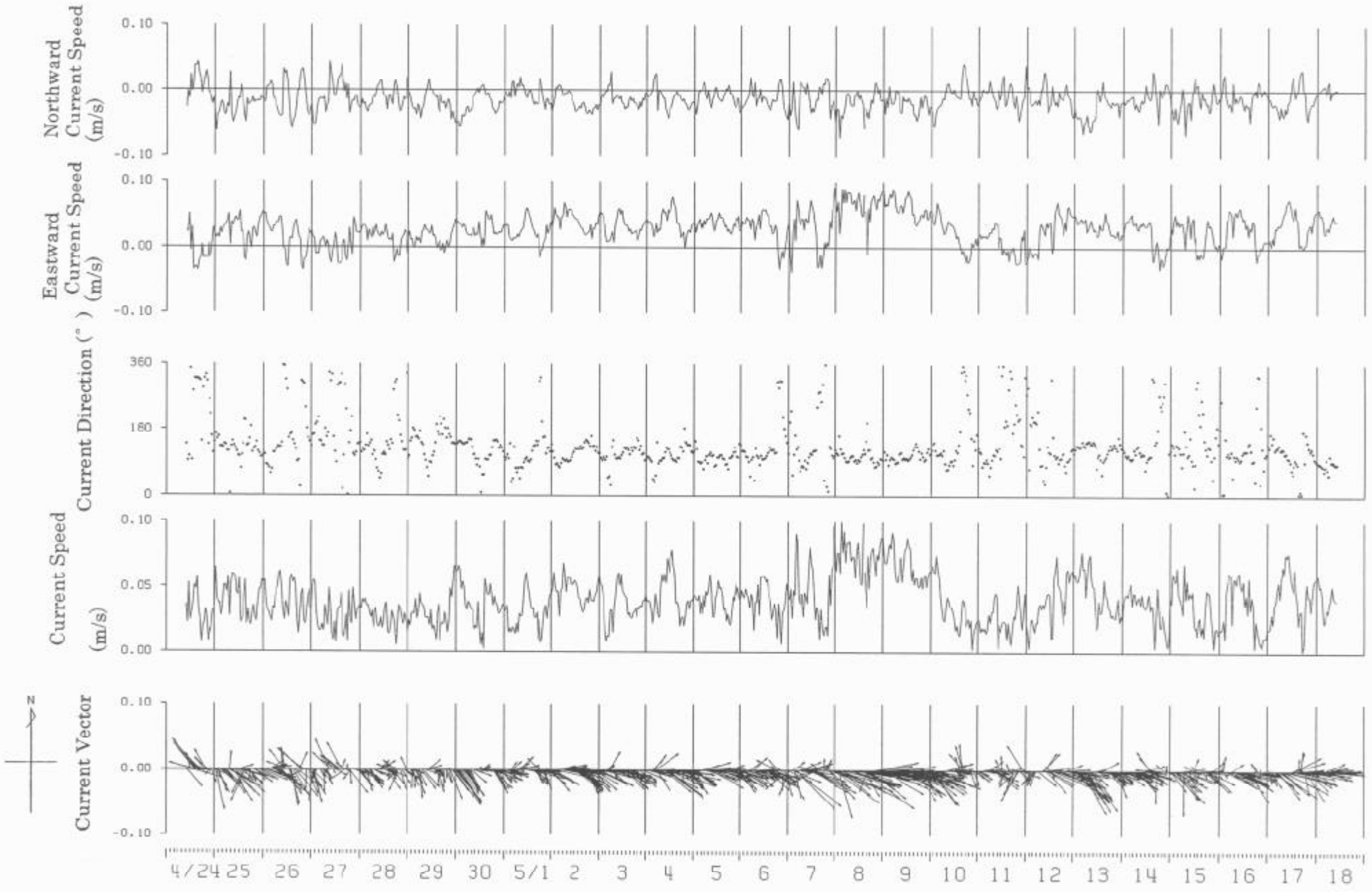


Figure 1.3.2-3 Time Series of Currents

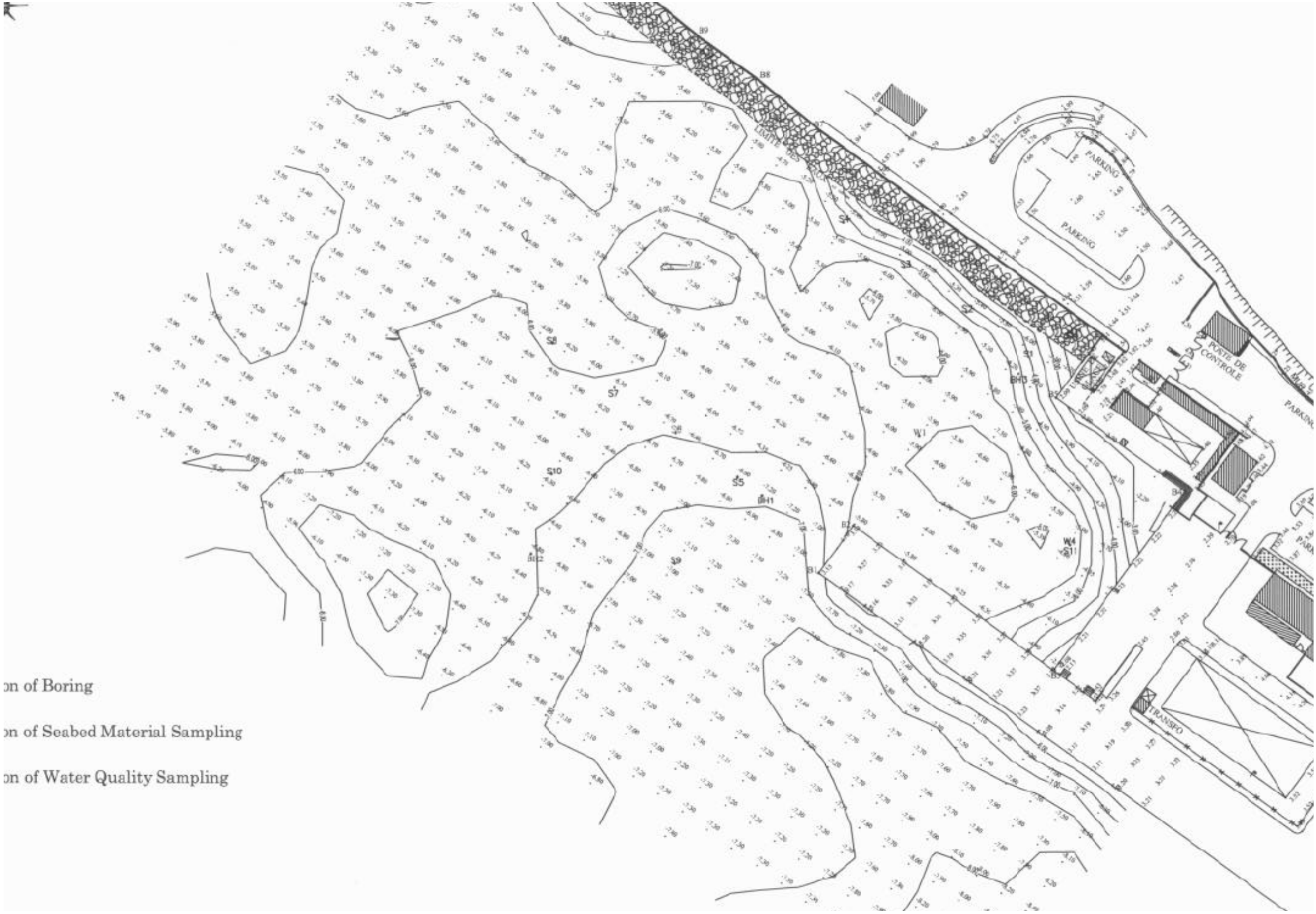
Cape Verde
2001/4

1.3.3 Topography

Topographical and sounding survey was conducted in respect of the land and the sea bottom to understand the topography in the vicinity of the project site. The results are shown in Figure 1.3.3-1. The Topography of the Project site is outlined as follows.

The Project site is located in the bottom of Praia Bay. Praia Bay is shaped like a small bow with about 4 km coastline extending from Ponta do Visconde to Ponta Temerosa. There is a small island named Santa Maria at west side of the Bay.

① There is a sandy beach at the west side of the bay and the bottom sediments consist of sand.
② The water depth in the bay is relatively shallow at less than –20 m and the bottom gradient 1/20 up to the depth of -5 m and 1/100 between －5 and －10 m.
③ The water depth of the Project site is around from –5m to –7m. The bottom sediments consists of sand.
④ Commercial Port located in the eastern part of the bay is dredged to － 10 m.
⑤ The coastline of the project site is protected by road revetment (height + 3.0 m to +3.4 m).



on of Boring

on of Seabed Material Sampling

on of Water Quality Sampling

1.3.4 Soil Conditions

The soil investigation was conducted by three marine borings at project site (refer to Figure 1.3.4-1). The boring points, the boring logs and grain size analysis are presented in Figure 1.3.4-2. Soil conditions at the project site are characterized as follows (refer to Appendix-6.2).

① The soil layer consists of silty-sand layer of N value less than 10, the thickness of this layer is 1m to 2m.

② The soil layer of over 1.5m to 2m depth consists of stiffed coral gravel layer of N value ≧30.

③ The soil layer of 4m to 10.4m depth consists of black colored sand of N value 10 to 20.

④ Basalt rock exists under 10.4m depth.

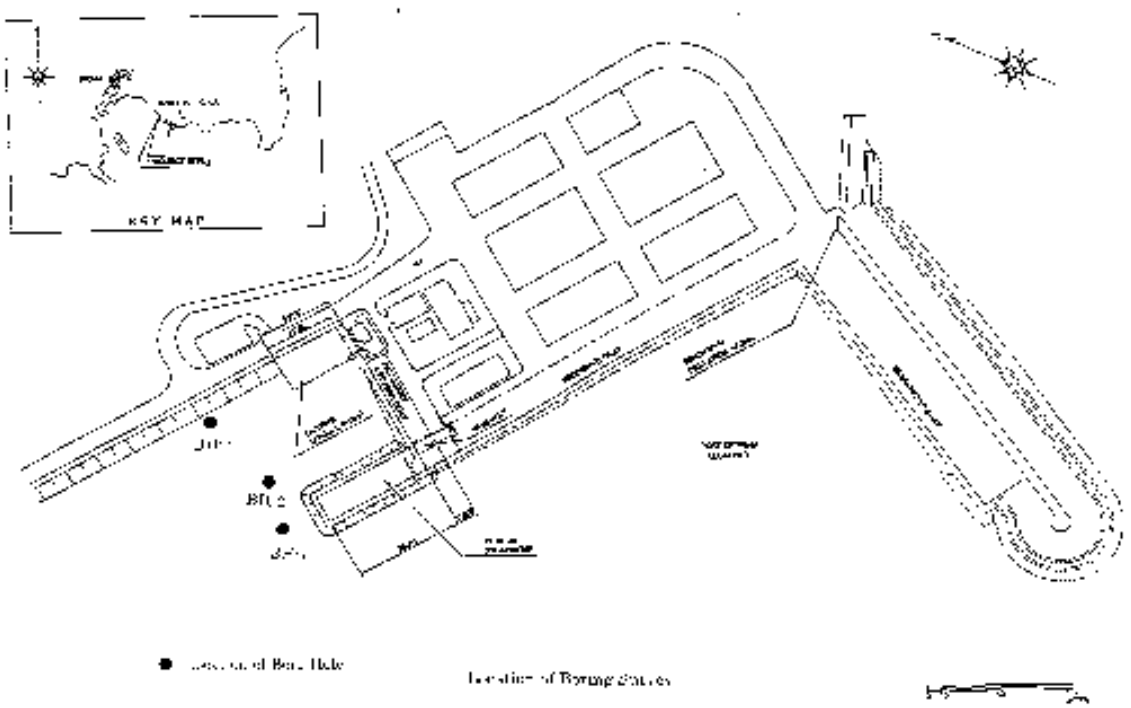


Figure 1.3.4-1 Location Map of Boring

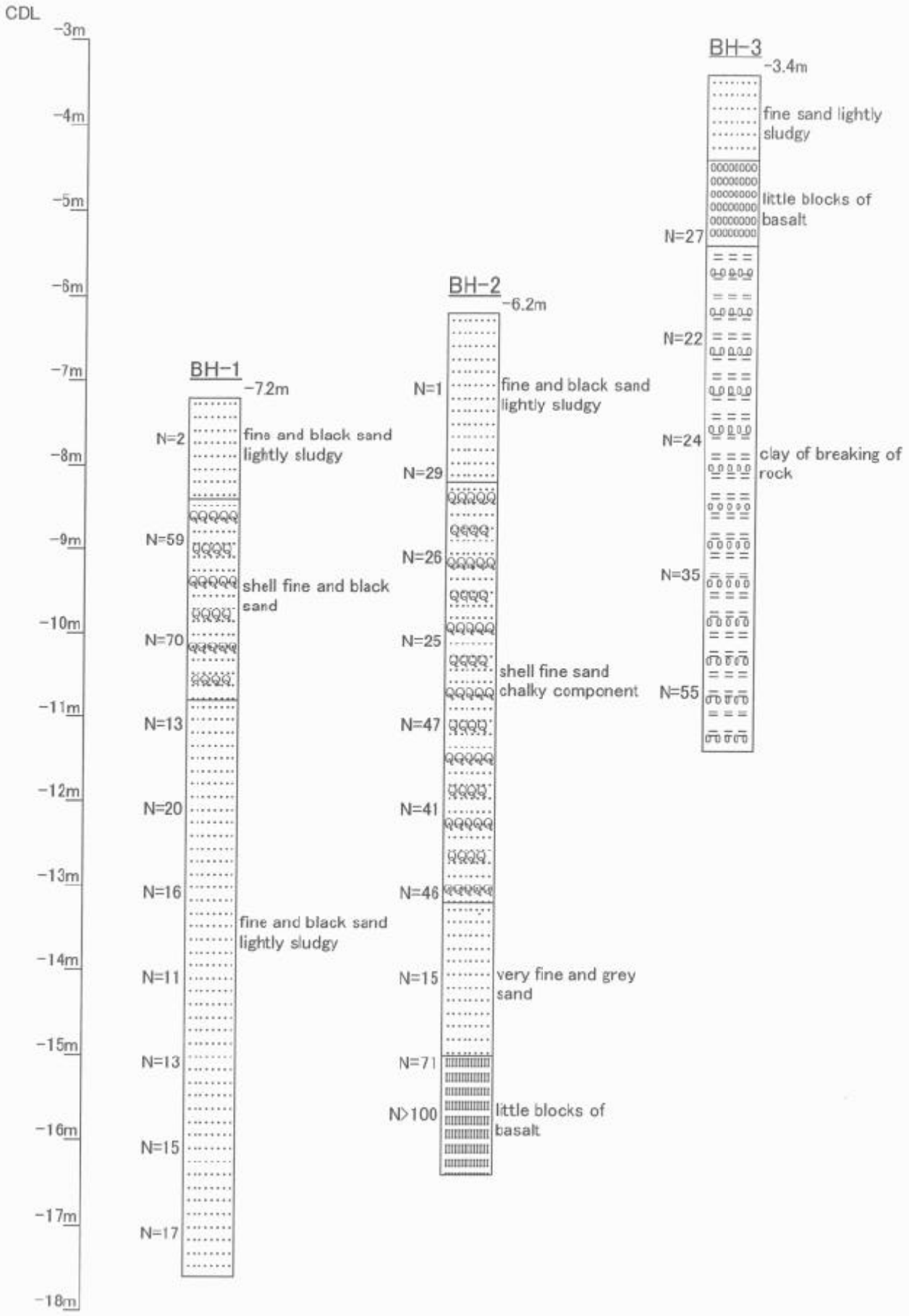


Figure 1.3.4-2 Boring Logs

1.3.5 Earthquake

Cape Verde Islands belongs on African Plate geologically, the foundation of islands is stable. There is an active fault in the west part of Islands, cause of this fault, several earthquakes had been observed, and the earthquake of magnitude 6 had been recorded. But seismic center of these earthquakes are far from the Islands, therefore, seismic force is not severe.

Fogo Island is active volcanic island. When the volcano had erupted in 1994, seismic wave had been propagated to Santiago Island. But there was no damage to buildings in that time.

In this Project, it will be considered the seismic force for structural design of wharf and buildings etc.

Chapter 2

Contents of the Project

Chapter 2 Contents of the Project

2.1 Basic Concept of the Project

2.1.1 Objectives of the Project

Annual fishery production of Cape Verde had been kept around 7,000 tons in the period of 1986-1993. It has exceeded 10,000tons in 1999 as a result of year-on year increases in catches after 1994 (see Figure 2.1-1). The average annual export of fishing industry was 200 million Ecv in the period of 1992-1998 accounted for 27% of average total exports for that period (728 million Ecv). Thus, the country's fishery industry has an important role as a source of acquisition of foreign currency. It also plays a big role in terms of supplying animal protein to the people, providing approximately 30% of the animal protein consumed by it as the only food supply source being self-supported under the circumstance that the country relies on imports for a large percentage of its food supply.

Therefore, the fishery industry in this country is regarded as an extreme important one.

The population of Santiago Island is 236,000 people and it is approximately a half of 435,000 people that is whole population of the country according to the estimate in 2000. Praia, where the project site is located, has a population of 106,000 and it is about a half of whole island, and therefore, it is major consumption area of the catch.

The volume of fishery catches of 1998 and 1999 in the island of Santiago was 2930tons and 3324tons, respectively and they are 31% and 32% of the volume for the whole country. Praia fishing port has a large consumption area as hinterland having about 32% share of the catches landed on the island (1007tons in 1998 and 1049tons in 1999). This is the largest production area of fishery catches in the country.

The fishery catches landed in Praia fishing port are sold to fish vendors and they sell to general consumers at public market in Praia and or by peddling. The fish vendors distribute and sell fish to consumers in inland area and also they buy fish distributed from other landing points at Praia fishing port and sell to Praia city area.

Like this, Praia Fishing Port can be considered as a major base for both production and distribution of fishery products on Santiago Island.

Praia Fishing Port was constructed in 1991 by the Japanese Grant Aid for the purpose of increasing catches, raising the income of fishermen and

increasing supply of animal protein to the people through the provision of port landing facilities and other basic infrastructure. The initial plan was to be utilized by 3 industrial-fishing boats (the total number boats in question were 15), and 23 artisanal fishing boats in a day (total 79 boats utilizing nearby landing places in Gamboa, Quebra Canela and Achala Grande Frente were objectives), and a total wharf length of 55m was completed. (11.5m was for the artisanal fishing boats and 43.5m was for the industrial fishing boats)

Presently, Praia Fishing Port is being utilized by 77 fishing boats (by the catch landing record in 2000) and 48 of them are the artisanal fishing boats and the other 29 are industrial fishing boats (refer to Appendix-6.3). The total number of industrial fishing boats became double than the Port Plan Conditions and the number of fishing boats to utilize in a day became 8 to 9 (annual maximum is 14 for a single day) also being far more than what the plan foresaw.

As the result of such increase, the wharf at Praia Fishing Port currently become full by just three of industrial fishing boats therefore, the fishing boats have to moor in 3-5 rows, and that makes very poor landing efficiency. Beside that, there is a lot of waiting time for landing and sometimes the landing work delays to next day. This causes the declining of fish freshness and inability to supply good quality fishery products to consumers. The deals between fishermen and fish vendors are done on the wharf and the landing work is tied up with that deal. This also is a cause of less efficiency of the landing work. The deals between fishermen and fish vendors are done with fish putting down directly on the surface of wharf apron under the scorching sun that are unsanitary. That results various problems including decreasing freshness and fish distribution to consumers with unhealthy condition.

It is very significant to have extension of wharf and the construction of fish market in Praia Fishing Port where is major base of fishery production and the distribution in order to solve the problems that they have now.

It is therefore, judged to implement the project for the purpose of the improvement of efficiency of landing work including other fishing port activities and the improvement of the sanitary environment so that consumers can ultimately be supplied with good-quality fish.

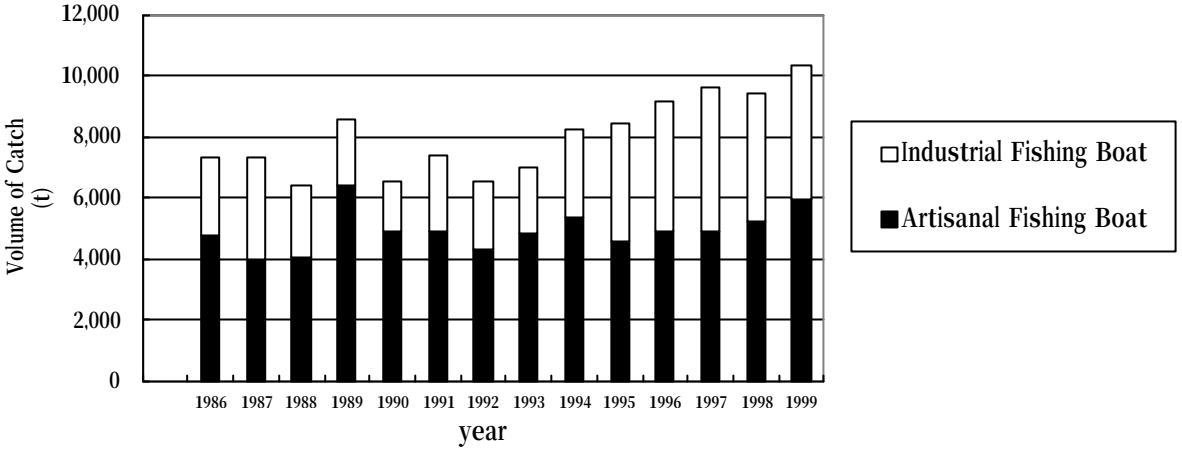


Figure 2.1-1 Volume of Catches over the Years (1986-1999)

2.1.2 Basic Concept of the Project

A fishing port is the junction point of fishery activities of fishing boats at fishing grounds and the activities of processing and distributing the landed catches. This project for extension of the fishing port in question aims at making it possible for the port to accomplish the following roles as a fishing port:

(1) Role as a Base for Production Activities and Distribution:

- Place for landing of catches
- Place for making preparations for going out to sea (preparation of fishing gear, fueling fishing boats and supplying them with water and ice, repair of fishing boats, rest and recuperation of fishing boat crews, etc.)
- Place for safe mooring of fishing boats as valuable property of fishermen
- Place for sorting of the catch and market transactions
- Distribution base for shipment of fishery products to consumption areas

(2) Role as core of Local Society

- Basis of livelihood of fishermen
- Basis for local economic development based mainly on fisheries-related industry

The insufficient length of wharf at this fishing port is a big obstacle to its fishery activities. This project covers the same types of fishing boats as those already making use of Praia Fishing Port—larger industrial-type fishing boats and small artisanal fishing boats. The number of boats of that first type operating at the port is considered to be 29 on the basis of its catch landing records. As for the small artisanal boats, they are considered to be the 48 that mainly use Praia Fishing Port. This project is for provision of wharf frontage that will make it possible to land catches safely and efficiently, basic fishing port facilities such as wharf space for preparations and rest and recuperation and breakwaters that will secure calm and safe water basin in the port, fishing port functional facilities supporting preparations for putting out to sea, such as ice production and storage facilities and fishing gear storerooms and a fish market and other distribution facilities with the necessary sanitary conditions as a place for first processing of fish after the

catches are landed as well as an access road, parking space and other necessary public facilities supporting fishery activities so that the extended fishing port will be able to function with sufficient efficiency.

On the basis of the above points the following items are formulated as the basic policies in this project for making Praia Fishing Port a base of fishery activities and distribution on the island of Santiago:

(1) Content of extension and improvement that is in line with the country's fishery development plans
(2) Raising of the efficiency of fishing operations and increasing the volume of catches
(3) Securing safety of channels and anchorage for the fishing boats
(4) Maintaining the freshness of catches
(5) Prevention of water pollution at the fishing port through treatment of catches
(6) Establishment of an appropriate management and operation system
(7) Determining the scale of the different facilities in line with degree of necessity, priority and effectiveness

In formulating the project, Praia Fishing Port's activities under present circumstances will be fully studied, taking into account the particular local conditions of landing and distribution of catches, so as to make the project suitable as a Japanese grant aid project.

2.1.3 Examination of the Project

The content requested by the Government of Cape Verde for the project for extension of the Praia Fishing Port is as follows:

Fishing port facilities:

- 70 m extension of the wharf
- 70 m extension of breakwater/pier
- Provision of mooring facilities and lighting facilities for the port grounds

Buildings and accessory facilities:

- Fish market (350 m^2)
- Ice production and storage equipment (capacities of 10 tons/day and 30 tons/day, respectively)
- Fishermen's lockers
- Parking area

Related materials:

- fish boxes, refrigerated containers for preservation of fish, conveyance carts, etc.

Fishing boats and fishing gear:

- seven 8-meter-class small fishing boats and the corresponding fishing gear

Regarding the above requested project content, in discussions with Cape Verde government officials the request for fishing boats and gear was canceled as not being in line with the project's main aim of mitigating the fishing port's congestion. As for the other requested components, it was confirmed that they are in line with the project's main aim and that their necessity should therefore be further studied.

(1) Basic Fishing Port Facilities

1) Extension of the Wharf

This is the most basic of the facilities of a fishing port. It is considered to be necessary to extend the wharf in order to relieve the fishing port's present state of congestion and thereby raise its efficiency of landing of

catches. Furthermore, besides landing catches, the wharf also has the function of preparatory work such as loading fuel, food, fishing gear, etc. on board and use for rest and recuperation purposes and therefore needs to have adequate space for them as well in order to function efficiently.

2) Breakwater

Breakwaters are basic fishing port facilities for keeping the calm water basin in the port for the sake of ensuring high rate of operation in landing of catches and other fishery activities and safe mooring of fishing boats.

Since the project site is subjected to high swells from the south in the period June-October, it was provided with a breakwater to keep the calm water basin at the wharf. If the wharf is lengthened in this project, it will therefore be necessary to lengthen the existing breakwater to secure the calm water basin for the extended part of the wharf as well.

In order to make the existing No. 3 wharf that is shared by fishing boats and vessels from the commercial port side a wharf for exclusive use by fishing boats it will be necessary to secure a place for transferring the inter-island cargo vessels, tugboats, etc. from the commercial port side that are presently using it, and for that purpose it will be necessary to add a mooring function to the breakwater.

(2) Facilities on Land

1) Ice Production and Storage Facilities

The larger industrial-type boats and small artisanal fishing boats making use of Praia Fishing Port use ice to keep their catches fresh. Furthermore, ice is also used by the fish venders to keep their fish fresh in transportation and sale in Praia.

Presently Praia Fishing Port has in operation an existing ice production facility with a planned production capacity of 10 tons/day (nominal capacity of 11.4 tons/day). However, some ten years have passed since it went into operation, and it has become run-down. Its capacity is estimated to have declined to only about 5 tons/day. Furthermore, its operation is often interrupted due to malfunctioning, and there are difficulties in supply of spare parts for various reasons, including cessation of operations by the manufacturer. All that leads one to conclude that it is practically impossible to improve the operating performance of the existing ice-making

machine. In such a situation and in view of increasing fishery production it is considered that the necessary volume of ice for fishery production and distribution purposes is greatly in excess of the existing ice-making machine's production capacity and that therefore there is a shortage of ice. Furthermore, it is therefore considered that a new ice production facility is needed to supply the fishermen and fish venders with the quantities of ice that they need.

2) Fish Market

The fact that transactions between the fishermen and the fish venders regarding the landed catches take place on the wharf apron causes lowering of the work efficiency of landing of catches because of the resulting congestion. Furthermore, in such transactions on the wharf the fish are laid out directly under the hot sun under bad sanitary conditions, which makes for the problem of decline in freshness and that of distribution to consumers of fish of not good quality because of sanitary state as well. It is considered that a proper fish market must be provided in order to solve such problems.

3) Fishing Gear Lockers

The existing fishing port facilities include 25 fishing gear lockers leased to fishermen, 15 for larger industrial-type boats and 10 for small artisanal fishing boats. Since demand for use of such fishing gear lockers has increased with increase in the number of fishing boats using the port, it is considered that it is necessary to increase the number of fishing gear lockers.

4) Equipment and Materials Needed by the Above-Mentioned Facilities

As accessory equipment the fish market and ice production facility need seawater intake and supply equipment, electric power receiving equipment, emergency power generator and water storage tanks (which it should be possible to use together with the existing ice production facility). Also necessary are lighting equipment to make fishery activities possible even in the case of putting out to sea or returning to port at night and removal/replacement of the out-of-order light beacon installed on the existing fishing port breakwater.

Fish boxes for landing catches, containers for sale of fish at the fish market, carts for conveyance of the catch from the wharf to the fish market

and other materials are also necessary.

2.2 Basic Design

2.2.1 Design Policy

(1) Design Standards

In view of the fact that Cape Verde has not established any design standards of its own concerning fishing port structures, we are going to use Japan's Fishing Port Structures Standard Design Law instead. Furthermore, we will also basically be using Japanese architectural standards and specifications for the buildings and building facilities.

(2) Design Policy of Basic Fishing Port Facilities

The project will take the form of coastal reclamation and protection of the reclaimed land by a breakwater and other outer perimeter facilities. Appropriate materials for use in the reclamation work will be determined on the basis of grain size analysis tests and compaction tests.

The following points will be adhered to in the design:

①Although the project site is a place with calm water area without direct incidence of prevailing waves, it is not shielded from waves coming in from the south, which leaves it open to incursion of open-sea swells, resulting in poor rate of operation of the commercial port wharf (wharf No. 2). That being the case, the breakwater length will be made adequate to maintain sufficient calmness of port water basin against incursion of waves from the south, and the normal line layout will be made such as to make maneuvering of fishing boats and inter-island cargo vessels easier.

②In order to mitigate existing wharf congestion there will be division of the different work functions of catch landing, preparatory work, rest and recuperation, etc., and an appropriate scale of each will be set. There will be appropriate planning of the layout of the wharf with division of functions taking into account fishing boat movement from entering the port to leaving it and the existing fishing port facilities layout.

③Since the records show that there have been earthquakes near the island of Santiago in the past, seismic force will be taken into account.

④In the design full consideration will be given to local natural conditions and the local construction situation.

⑤The height of the reclaimed ground level will be matched with the existing

ground level for compatibility with the existing fishing port facilities.

⑥In the structural design of the different structures economy and ease of execution will be aimed for taking into account the soil and other natural conditions.

(3) Design Policy of Land Facilities

The land facilities to be built on the reclaimed land will be designed in accordance with the following basic policies:

①The soil of the natural ground foundation is good, but the building foundation structure has to be properly planned in order to prevent unequal subsidence in the case of construction on reclaimed land.

②The distribution-related facilities will be planned on a appropriate scale taking into consideration the findings of study of fishery production, distribution and present dealing custom.

③Since the records show that there have been earthquakes near the island of Santiago in the past, seismic force will be taken into account.

④In the design full consideration will be given to local natural conditions and the local construction situation.

⑤The facilities layout will be optimally planned from the viewpoint of lines of movement of the catches, people, vehicles, etc.

⑥The different facilities will be provided with the minimally necessary fixtures and equipment to ensure that they function smoothly.

(4) Layout Plan

1) Fishing Port Basic Facilities

The fishing port basic facilities are comprised by the breakwater, the wharf for landing of catches, preparatory work and rest and recuperation, the access road and parking area.

2) Land Facilities

The land facilities to be laid out in the fishing port in this project are the following:

① Ice-making facility building

② Fish market

③ Fishing gear lockers

3) Layout Plans

(a) Line-of-Movement Plans

Because of the insufficient wharf length of the existing fishing port all sorts of work from catch landing to preparatory work and even rest and recuperation take place at the same wharf. That makes for poor efficiency of catch landing work, particularly as a result of the time it takes for fishing boats to move for that purpose, and there is a lot of waiting time involved. Furthermore, on the wharf apron the catches are sold by the fishermen to the fish vendors, and the fish undergo treatment, including removal of gills, intestines and scales. Since those activities take place on the wharf apron, the flows of fish and people interfere with one another, adding to the confusion and congestion. Because of that the work also gets bogged down on the fishing boat side, with lots of waiting time for both landing of catches and replenishing supplies of ice. The preparatory work for putting out to sea, including loading of fuel and water on board, is accomplished around 4 o'clock in the afternoon after the fish vendors have left. It is therefore necessary to have division of functions at the extended fishing port wharf regarding the different kinds of work of the fishing boats in the fishing port and to separate the purchasing activities of the fish vendors from the work of landing the catches. Furthermore, because of the fact that the entrance to the existing fishing port is near that of the commercial port there is congestion of flow of people and vehicles into the commercial port and fishing port which makes for marked traffic congestion at the entrance to the fishing port. It is therefore intended to move the entrance to the fishing port away from the entrance to the commercial port, locating it in the new extended part of the fishing port.

Considering the above, the facilities will be laid out according to the following line-of-movement plan.

Figure 2.2.1-1(1) shows the zoning plan proposed for the project, and Figure 2.2.1-1(2) shows the overlapping of lines of movement of people, fish and vehicles.

Figure 2.2.1-2 shows the line of-movement plan for separation of the catch landing work from the fish dealing activities.

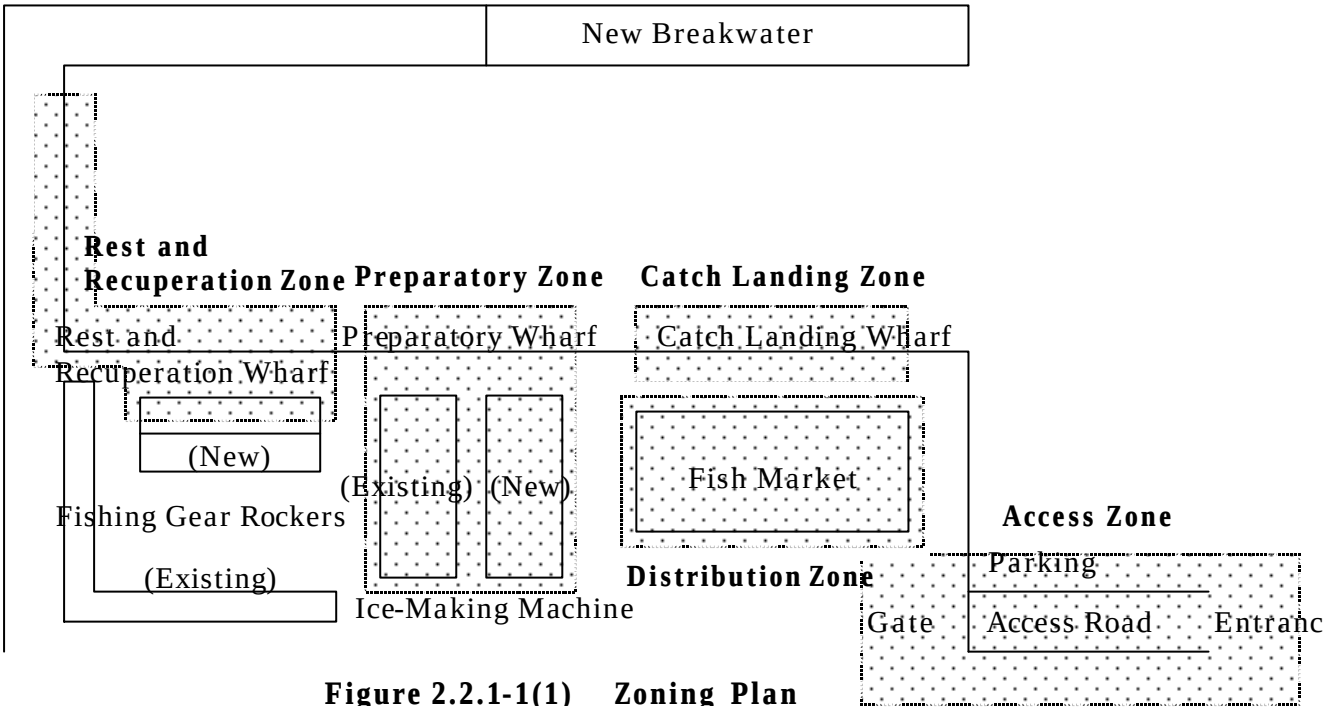


Figure 2.2.1-1(1) Zoning Plan

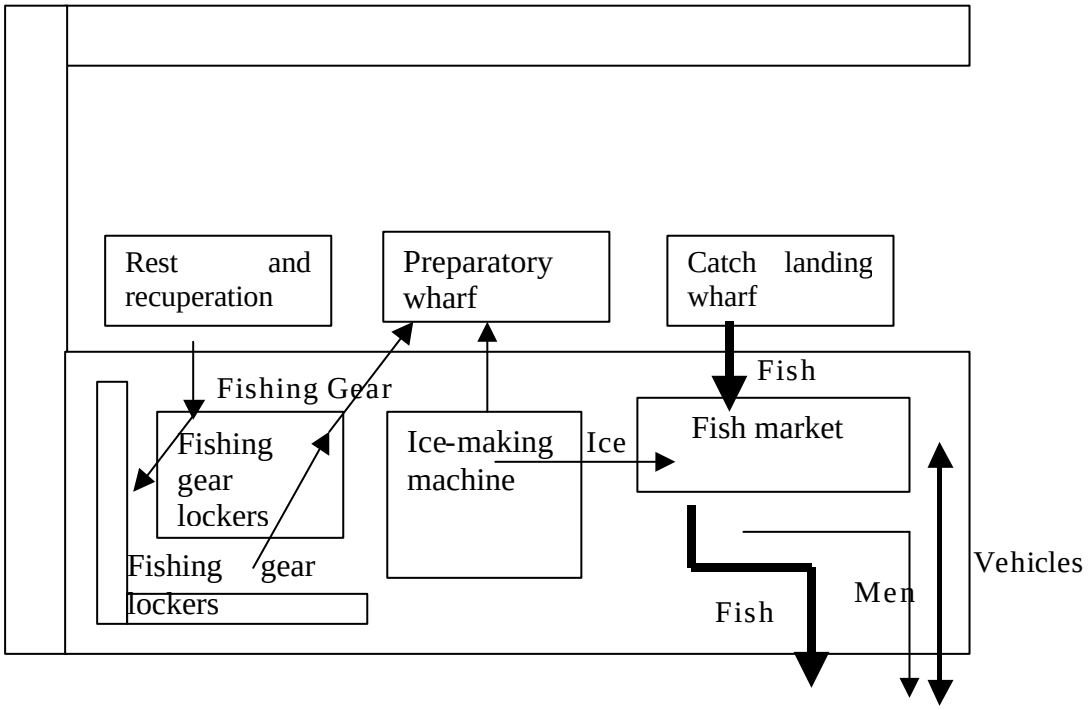
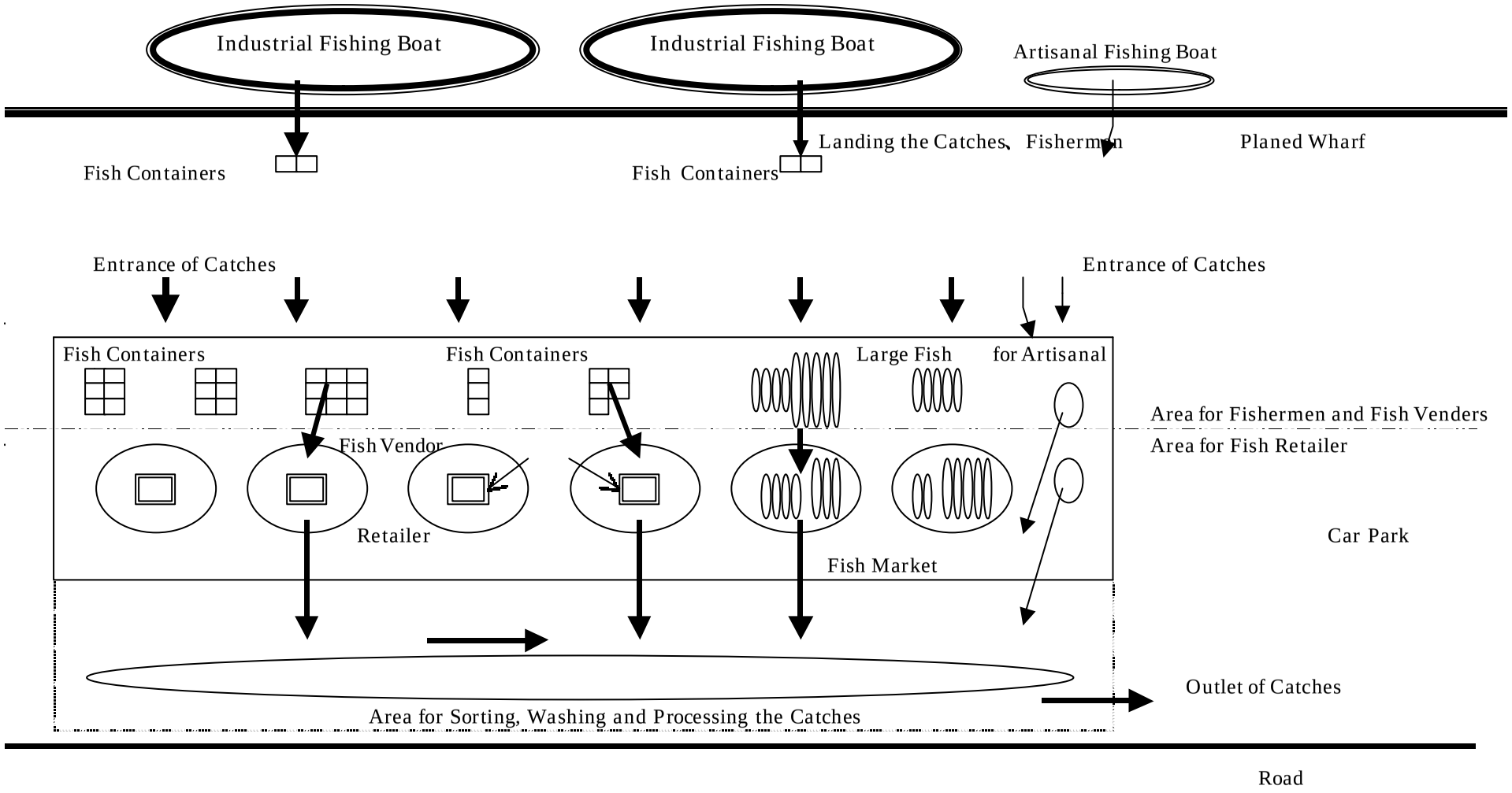


Figure 2.2.1-1(2) Plan of Line of Movement



＊Conditions for the Plan of Line of Movement

1. Dealings of fishes cannot be performed at wharf area. All dealings are performed at fish market..
2. Fish retailers cannot enter wharf area. They can enter only fish market.
3. Sorting, washing and processing of fishes are performed at planned processing area.

Figure 2.2.1-2 Plan of Line of Movement in Fish Market

(b) Layout of the Basic Facilities

The facility layout in the project is determined by the line-of-movement plans set forth in the preceding section.

a) Breakwater Layout

It is planned to have the center line of the existing breakwater extend outward at an angle into the offing to secure calm water basin for the fishing port wharf part and to make maneuvering of fishing boats entering the port easier.

In addition, as a result of considering the influence of the reflective waves by extending of breakwater (refer to Appendix-6.4, P.- A-41～A-47), it was confirmed that the waters where wave heights are high than present condition is restricted in front of breakwater, and influence of the reflective waves is not so high.

The advantages of such a center-line type of breakwater are:

①It secures waters for turning around, making maneuvering of fishing boats easier, and also increases the safety of such maneuvering.

②It effectively screens off the swells coming into the project site from the south and makes it possible to make the breakwater length shorter than it would otherwise have to be.

③It makes it possible to prevent the secondary undulation that would occur in case of direct-line extension of the existing breakwater (refer to Appendix-6.5, P.- A-48～A-51).

The basic idea of the center line of the breakwater is shown in Figure 2.2.1-3.

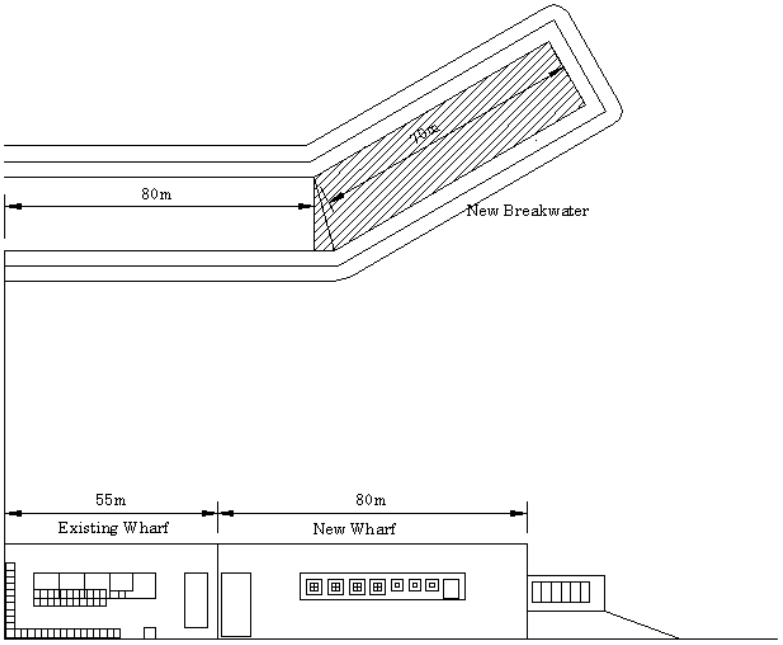


Figure 2.2.1-3 Proposed Breakwater Center Line

b) Face Line of the Wharf

The layout of the catch landing wharf and preparatory work wharf is planned so as to secure the linearity of the existing wharf length and the extended part and avoid any dead space. A rest and recuperation wharf will be provided on the No. 3 wharf side.

(c) Layout of Land Facilities

The layout plan for the facilities to be provided on land will be studied from the viewpoint of enabling smooth utilization thereof and that of the convenience of users, including the flow of fish and the flow of people.

The main ideas behind the facility layout are as follows:

a) Fish Market

The fish market will face on and be located immediately behind the landing wharf for the sake of landing of the catches and preservation of freshness thereof.

b) Ice-Making Facility Building (Ice-Making Machine and Ice Storage Facility)

The ice-making facility building will be located next to the existing ice-making machine near the fishing market behind the preparatory work wharf for the sake of smooth supply of ice to the fishing boats and the fish market.

c) Fishing Gear Lockers

The fishing gear lockers will be located at the same place as the existing fishing gear lockers near the rest and recuperation wharf as a place that makes for ease of loading of fishing gear and outboard motors on board. The space for building them will be secured by changing the use of a part of the existing fish handling shed.

d) Parking Area

The parking area will be located at the entrance to the fishing port near the fish market for the convenience of the vehicles that comes in for transportation of the fish.

The layout plan incorporating all of the above points is indicated in Figure 2.2.1-4 below.

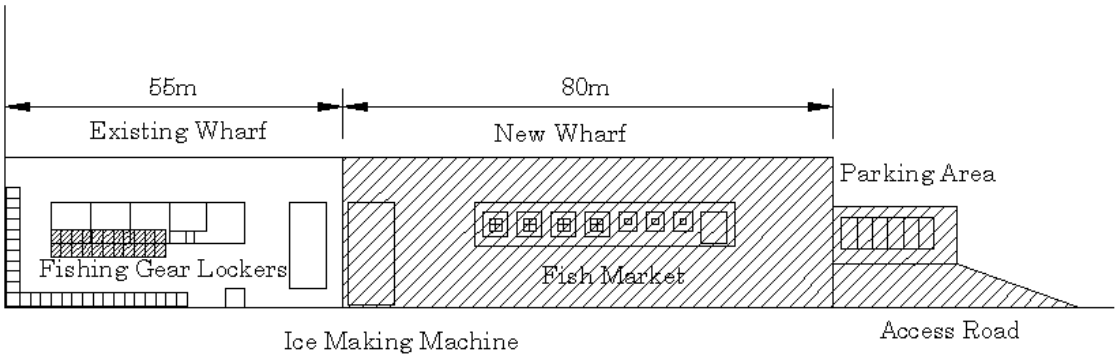


Figure 2.2.1-4 Fishing Port Facilities Basic Plan

2.2.2 Basic Plan

(1) Basic Design of Fishing Port Facilities

1) Design Conditions

(a) Dimensions of the Fishing Boats

The fishing boats covered by the project are the 29 industrial fishing boats and the 48 artisanal fishing boats that presently utilize the Praia Fishing Port.

a) Dimensions of Industrial Fishing Boats

The dimensions of industrial fishing boats are shown in Appendix-6.3 (P.-A-36). According to it, the maximum Loa (boat length: Length overall) is 24.9 m, and the average Loa is 10.75 m. In this project the fishing boats that will be covered are those of the type with a length of 10.9 m, the number of which is the greatest and the fishing port use frequency of which is the highest. Furthermore, since the maximum draught is 2.32 m, the draught used in the project will also be 2.32 m.

Dimensions of industrial fishing boat:

- Boat length: L = 10.9 m
- Boat breadth: B = 4.0 m
- Maximum draught: 2.32 m
- Boat tonnage: 20 GT

b) Dimensions of Artisanal Fishing Boat

According to the data of dimensions of artisanal fishing boats registered at Praia Fishing Port (information from the Port Authority, refer to Appendix-6.3, P.-A-37～A-40), their maximum length is 7.0, and their average length 5.65 m. Since 49, or 64%, of them have a length equal to or greater than 6.0 m, the boat length for the artisanal fishing boats that will be used in the project is 6.0 m. Likewise, their maximum draught of 1.96 m will be used as the draught for the project.

Dimensions of the small artisanal fishing boats:

- Boat length: L = 6.0 m
- Boat breadth: B = 1.8 m

- Maximum draught: 1.96 m
- Boat tonnage: 2.0 GT

2) Natural Conditions

The wave conditions at Praia Fishing Port have been studied on the basis of past information, wave estimates and observed wave values.

(a) Data on Offshore Waves

In the design of the Praia Fishing Port breakwater carried out last time in 1992 the design offshore waves from the south were set at 3.6 m. The result for offshore waves from the south of the 10-year wave estimate carried out this time is compatible with that design wave value, i.e. 3 to 4 m. It has therefore been decided to use here the same design wave as that set in the previous study. The design wave dimensions are indicated below:

Table 2.2.2-1 Design Wave Dimensions (Offshore Wave Conditions)

Wave direction	SE ~ SW
Wave height (Ho)	3.6 m
Period (T)	12 sec
Wave length (Lo)	225 m

(b) Waves in front of the Fishing Port Breakwater

The dimensions of the converted offshore waves in front of the fishing port breakwater have been obtained by carrying out calculation of wave deformation (refraction calculation) in shallow waters of the above-mentioned offshore waves. Furthermore, the wave height in front of the fishing port breakwater has been obtained by carrying out calculation of deformation within the surf zone on the basis of the water depth conditions. The calculated results and the method of calculation are indicated below.

Table 2.2.2-2 Waves in Front of the Fishing Port Breakwater

Pertinent wave direction	SSW
Refraction coefficient, Kr	0.65
Wave height of converted offshore waves, Ho'	2.34 m
Design water depth, h (including tide level)	8.4 m
Ratio of water depth to wave height, h/Ho'	3.58
Waveform gradient, Ho'/Lo	0.010
H1/3/Ho'	1.09
Wave height in front of breakwater, H1/3	2.55 m

Method of estimation of waves in front of the fishing port breakwater:

- From the results of wave deformation calculation with a period of 12 s, the coefficient of refraction in front of the fishing port breakwater is maximum, at 0.65, with waves of direction SSW. The converted offshore wave height therefore comes to 2.34.
- The design water depth is set at 7 m, and the tide level at H.W.L. + 1.42 m.
- The wave deformation coefficient is obtained on the basis of a seabed slope of 1/50 in the waters in front of the breakwater.
- The ratio of water depth to wave height (h/Ho') is 3.58, and the wave steepness (Ho'/Lo) is 0.010.
- The wave deformation coefficient for the point comes to 1.09 (see the figure 2.2.2-1).

The significant wave height in front of the fishing port breakwater comes to 2.55 m, and the incident wave direction is S 3°E.

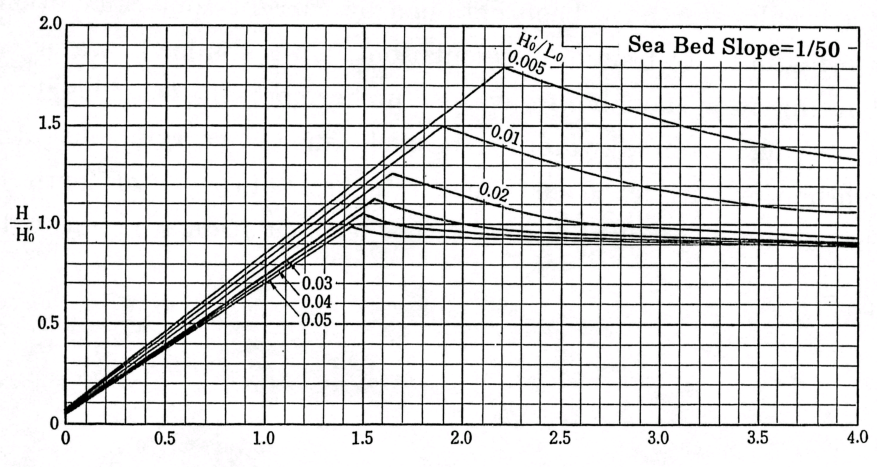


Figure 2.2.2-1 Diagram of Calculation of Wave Height in Surf Zone

It should be added that the waves in front of the fishing port were estimated (see the next and following pages for the method of estimation) on the basis of the design set for the breakwater in front of the No. 1 wharf of the Port of Praia, which is contiguous to the Praia Fishing Port. The results are as follows as shown in comparison with the above-mentioned estimation results. However, in view of the fact that the waves set there are for the first-line breakwater of the commercial port and that they are considered to be waves with a long recurrence interval, here it has been decided to use the waves set in the previous Praia Fishing Port study.

Table 2.2.2-3 Design Wave Comparison

Point of calculation	Dimensions	Previous(1992) design values (also values adopted this time)	Design values(for reference) of Port of Praia (the commercial port)
Offshore waves	Wave direction	SE SW	-
	Wave height (Ho)	3.6m	5.23m(estimated)
	Period (T)	12sec	12sec
	Wave length (Lo)	225m	225m
In front of fishing port breakwater	Direction of waves in question	SSW	SSW
	Coefficient of refraction, Kr	0.65	0.65
	Converted offshore wave height, Ho'	2.34m	3.40m
	Set water depth, h (including tide level)	8.4m	8.4m
	Ratio of water depth to wave height, h/Ho'	3.58	2.47
	Waveform gradient Ho'/Lo	0.010	0.015
	H1/3/Ho'	1.09	1.16
	Front waveheight	2.55m	3.91m

(c) Tidal Conditions of the Project Site

Since the tide level observation results of Chapter 1 (P.1-10) are the same as the findings in the previous project, the same tide levels as those used in the previous project will be used in this project as well. They are as follows:

Tide levels:

Mean monthly-highest water level,	H.W.L.: +1.42 m
Mean sea level,	M.S.L. : +0.80 m
Mean monthly-lowest water level,	L.W.L. : +0.18 m
Chart datum level,	C.D.L. : 0.00 m

3) Basic Design of the Breakwater

(a) Functions of the Breakwater

The functions of the breakwater in this project are securing of calm water basin at the fishing port wharf and mooring of boats at its landward side.

(b) Required Length of the Breakwater

a) Required Calmness at the Wharf

The required length of the breakwater is that necessary for ensuring a calmness of the basin of the port that makes possible landing of catches and preparatory work as well as safe anchorage of fishing boats inside the port even at the time of abnormal waves. The standards for the maximum wave height at the mooring basin and wharf for fishing port activities are indicated in Table 2.2.2-4 below.

Table 2.2.2-4 Standard Calmness in the Port

Depth of wharf and basin(D)	D＜－3 m	D≧－3 m	Wave condition
Wave height: available for using entrance channel	H=0.9m	H=1.2m	Wave height: available for fishing activity
Wave height: available for unloading works	0.3m	0.4m	Same as above
Wave height: available for using lay-by wharf	0.4m	0.5m	About 30 year probability wave

Source: Guidebook for Planning of Fishing Ports, National Fishing Port Association of Japan.

This fishing port is open in the south direction, and since it is necessary to locate the artisanal fishing boats at the end of the extended part of the wharf because of the wharf layout requirements, for the wave height in front of the project site (wave height at normal times: waves with unexceeded rate of occurrence of about 97.5%) it is necessary to satisfy the

value H = 0.3 m indicated in Table 2.2.2-4.

b) Center Line Shape of the Breakwater and Calmness of Basin

Regarding the center line shape of the breakwater in this project, considering the need to improve the maneuverability of the fishing boats and inter-island cargo vessels and to prevent increase in wave height by seiche, etc., the extended part of the breakwater will be swung out at an angle of 30° from the existing breakwater center line.

As the waves to be covered by the design have been set waves at normal conditions with a high rate of occurrence. Figure 2.2.2-2 shows the unexceeded rate of occurrence of offshore waves as based on the estimates of the waves at normal conditions. Looking at all wave directions, the maximum values in wave height rankings (with a rate of occurrence of at least 0.1%) are 4.5-5.0 m. At the same time, the wave height with an unexceeded rate of appearance of 97.5% is 4.1 m. Its ratio to the maximum value in wave height ranking is 0.82. On the other hand, waves from the south direction, which have a big influence on the calmness of basin in the fishing port, have a maximum value in wave height ranking of 3.5-4.0 m, and their design wave height is 3.6 m. Applying the above-mentioned ratio to waves from the direction S as well, we get a wave height with an unexceeded occurrence rate of 97.5% of 2.95 m.

On the basis of that result we have set the wave height for representative waves at normal conditions at 3 m under offshore wave conditions. It might be added that we decided to use the same period of 12 second as for the design waves. Furthermore, the data on the incident waves at the entrance of the fishing port from those offshore waves has been set using the results of calculation of wave deformation in the shallow water zones, the following results having been obtained:

Table 2.2.2-5 Data on Waves at Normal conditions

Data on offshore waves	Wave direction	S
	Wave height (Ho)	3.0m
	Period (T)	12sec
At entrance to the fishing port	Wave direction	S10 ° E
	Wave height (Ho)	2.01m
	Period (T)	12sec

The “Takayama method” has been used for calculation of the calmness of basin with the above wave conditions in case of extension of the fishing port breakwater.

Regarding the center line shape, calculation has been carried out for two cases that of 80 m extension on the center line of the existing fishing port breakwater (case-1) and that of 70 m extension at an angle of 30° outward from the existing fishing port breakwater (case-2).

The results of such calculation are indicated in Figure 2.2.2-3. Table 2.2.2-6 gives the mean wave height ratios in front of the wharf and the mean wave heights with respect to the waves at normal conditions with an unexceeded rate of occurrence of 97.5%.

Thus, in cases-1 and 2 the wave height ratio in front of the part of wharf for artisanal fishing boat is less than 0.15, and the mean wave height is less than 30 cm.

It has thus been confirmed that for just about the same calmness of basin the necessary length of extension is shorter if the normal line direction is swung outward to the offing side of the breakwater. It has therefore been decided to swing the center line of the extension part of the breakwater outward in the direction of the offing at an angle of 30° from that of the existing breakwater and to make the length of extension 70 m considering the convenience of maneuvering of fishing boats and commercial vessels inside the port and preventing the effect of seiche inside the port. The layout of the breakwater is given in Figure 2.2.2-4.

Table 2.2.2-6 Comparison of Mean Wave Height Ratios

Center line shape	Lay-by wharf	Preparatory wharf	Landing wharf
Case-1 (80 m direct extension)	0.113 (0.23)	0.125 (0.25)	0.136 (0.27)
Case 2 (70 m extension at an angle of 30°)	0.115 (0.23)	0.120 (0.24)	0.144 (0.29)

Upper-tier figures: wave height ratio with respect to incident waves at the port entrance

Lower-tier figures (in parentheses): wave height for waves at normal conditions (unit: m)

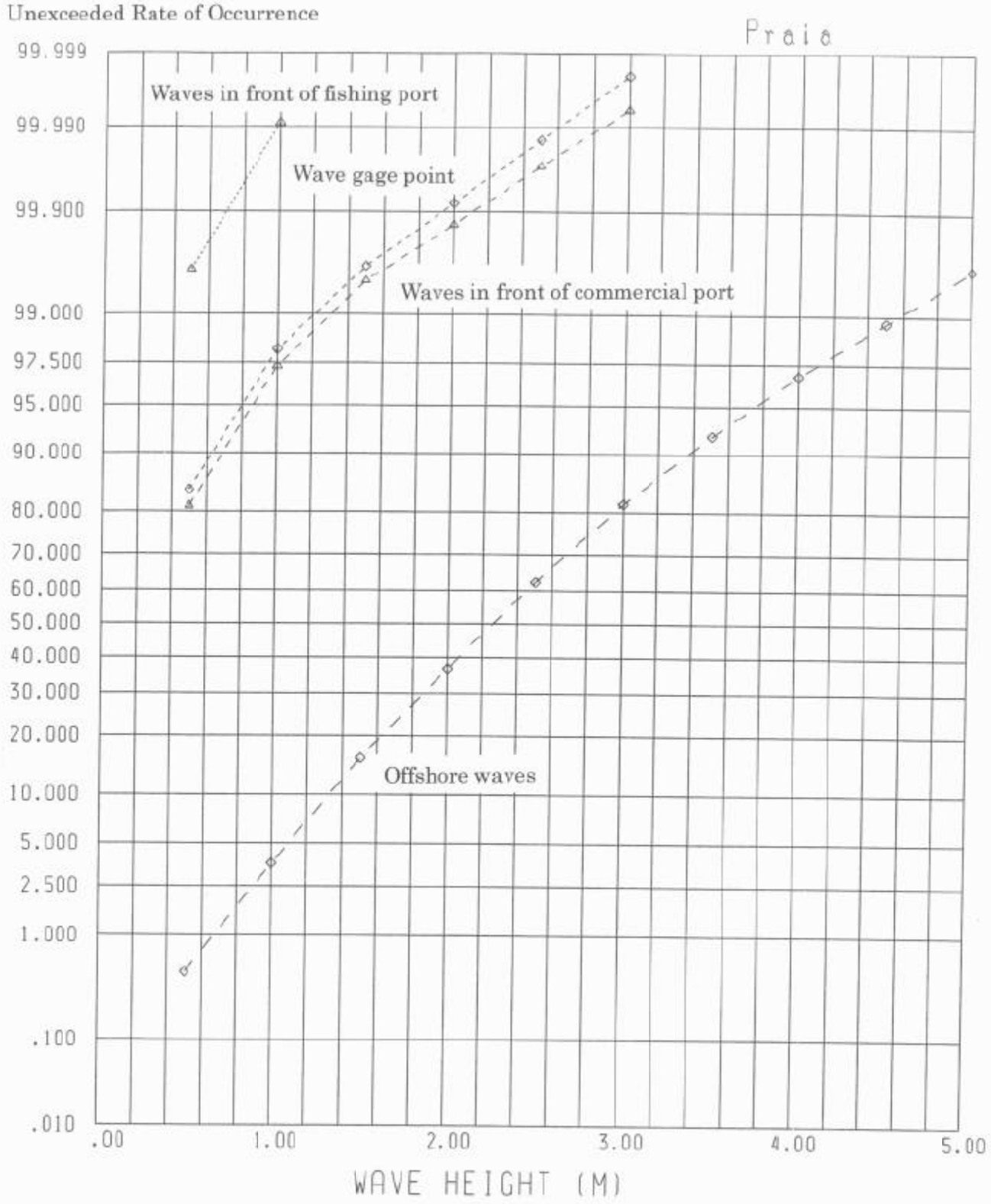
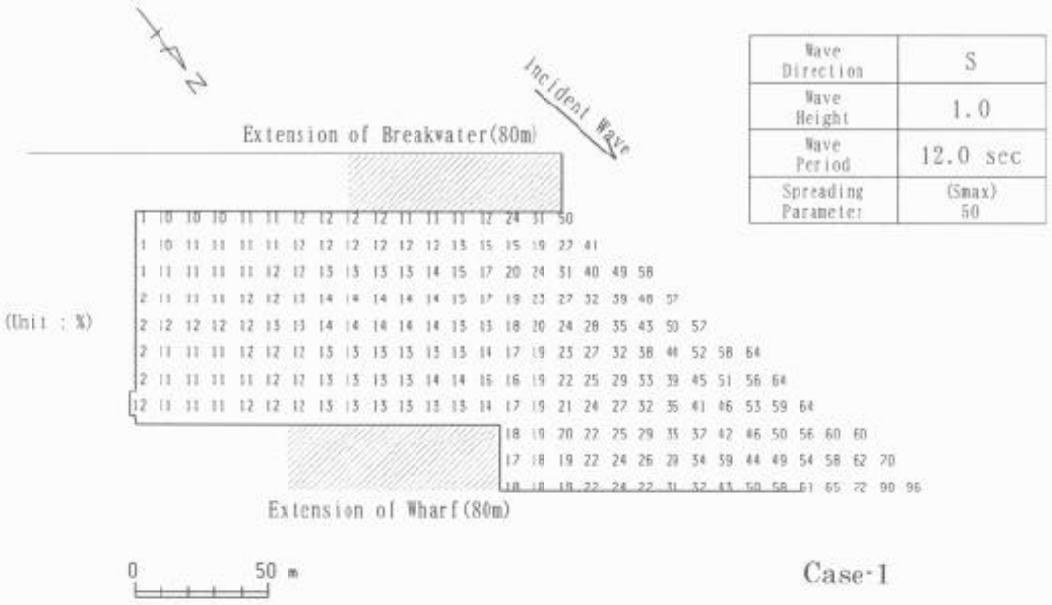
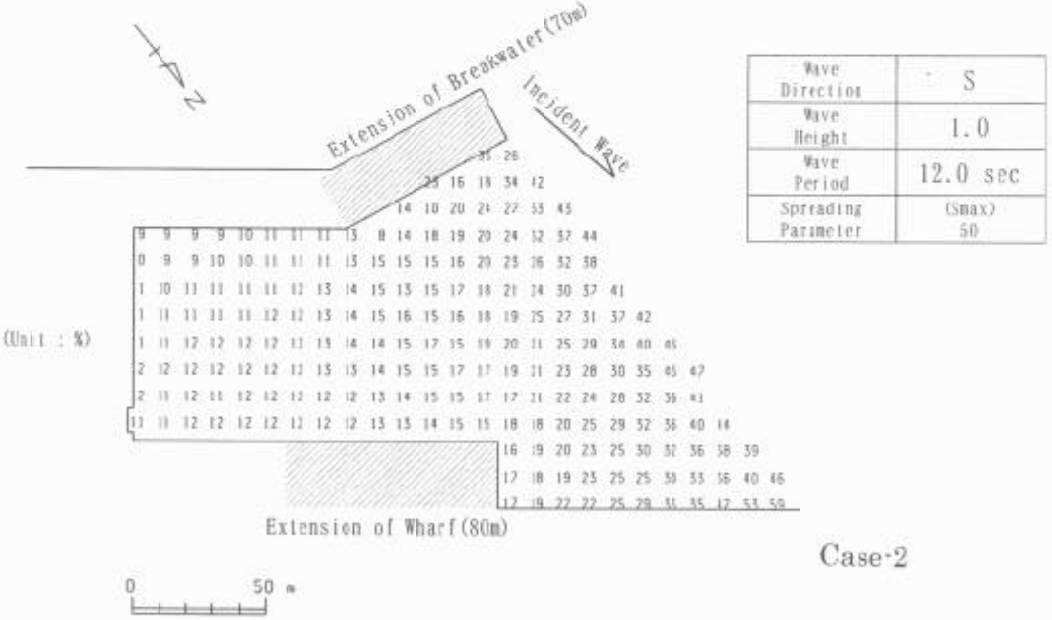


Figure 2.2.2-2 Diagram of Unexceeded Rate of Occurrence



Wave Direction	S
Wave Height	1.0
Wave Period	12.0 sec
Spreading Parameter	(Smax) 50



Wave Direction	S
Wave Height	1.0
Wave Period	12.0 sec
Spreading Parameter	(Smax) 50

Figure 2.2.2-3 Distribution of Wave Height Ratio

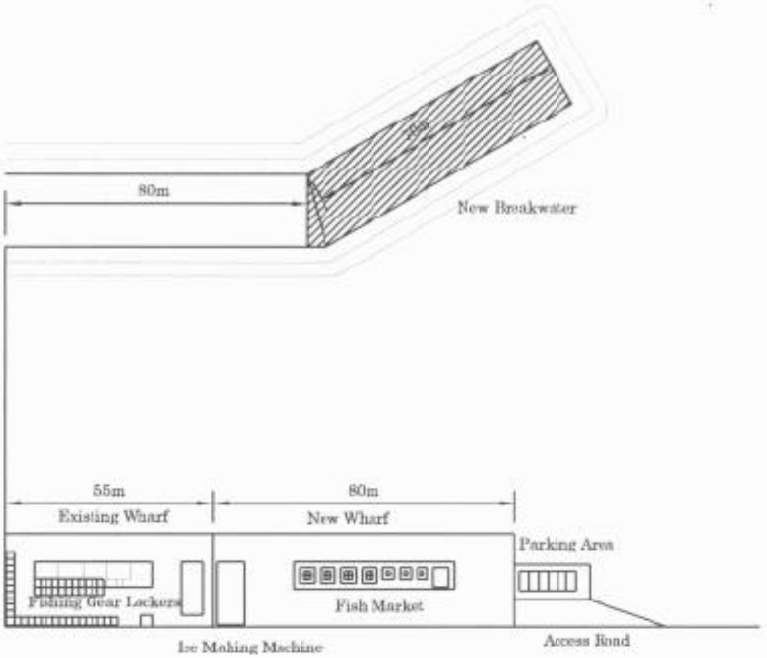
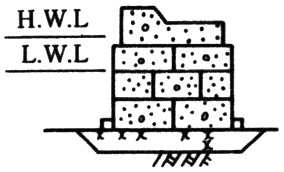


Figure 2.2.2-4 Basic Top-View Plan

(c) Cross-Sectional Structural Design

The structural types of breakwaters are the vertical type based on caissons/rectangular blocks and the sloping faced type based on a rubble mound or armor concrete blocks. In this project the structural type has to be the vertical type in view of the additional vessel-mooring function. The characteristics of those structural types are as indicated in the table below.

Table 2.2.2-7 Characteristics of the Different Structural Types

	Vertical type	Sloping face type
Cross Section		
Layout conditions	Suitable for cases in which there is also mooring of vessels. Since the reflected waves are large, the waters in front might be disturbed, depending on the layout.	Since the area taken up by the breakwater is large, the width of the port entrance and the useable zone of water are decreased.
Natural conditions	Since the bottom reaction is large and there is danger of scouring at places where the water depth is shallow, the ground foundation must be sturdy. Sometimes this type is suitable for places subject to enormous wave force.	This type is no longer suitable if the wave force that the place in question is subject to exceeds a certain limit.
Material conditions	Generally it is necessary for the concrete aggregate to be easily procurable.	When the water is deep, large quantities of stone materials are needed.
Execution condition	A yard and loading facilities, etc. are needed.	
Evaluation	Suitable for this Project	

The design of the vertical type breakwater is as follows:

a) Design Conditions

Wave conditions:

Offshore wave height: Ho = 3.6 m

Offshore wave period: To = 12 sec

Offshore wave direction: SSW; S after refraction and deformation

Equivalent deep water wave height: Ho'= 3.6 × 0.65 = 2.34 m (Kr = 0.65)

Tide level:

H.W.L.: +1.42 m

M.S.L.: +0.80 m

L.W.L.: +0.18 m

C.D.L.: 0.00 m

b) Calculation of Design Wave Height

The design wave height in the water depth of the places of construction of the breakwater and revetment as based on the design offshore waves (wave height of 5.20 m and period of 12 s) is as follows.

Table 2.2.2-8 Design Waves of Breakwater

Structure	Design wave height (m)	Water depth (m)
Breakwater	2.25	−7.0

c) Cross-Sectional Dimensions

* Crown Height

The crown height is calculated as follows when obtained by the formula below:

Crown height = 0.6 H (wave height in front) + H.W.L. + allowance height

= 0.6 × 2.55 m + 1.42 m + 0.35 m = +3.30 m

Thus, we have the same crown height, +3.30 m, as that of the existing breakwater.

* Crown Width

Since the crown of the breakwater will be used as an apron for loading and unloading work, there will have to be space for a loading and unloading crane, space for temporary placement, sorting space, a road for traffic, etc. In the previous project the crown width was set was set as follows considering loading and unloading work on the breakwater with a 16 t crane vehicle and 5 to 7 t trucks:

Required width = 3.0 (safety strip) + 10.0 (vehicle length) + 1.5 (allowance) + 2.4 vehicle width) + 1.0 (allowance) + 1.5 (vessel mooring post) = 19.5 m

Since in this project, too, loading and unloading work will be carried out

on the extension part of the breakwater as in the case of the existing part, the crown width of the extension part has been set at the same width of 19.5 m for compatibility with the previous project.

* Planned Water Depth (for mooring function)

Judging from the maximum draught (4.1 m) of the inter-island cargo vessels that will also be using the part of the breakwater provided in this project, the planned water depth is －5.0 m, as for the existing part.

Table 2.2.2-9 Breakwater Dimensions

Structure dimensions	Crown height (m)	Crown width (m)	Water depth (m)
Breakwater	+3.30	19.5	－5.0

d) Breakwater Standard Cross Section

The standard cross section of the breakwater is shown in Figure 2.2.2-5.

(d) Accessory Facilities

a) Beacon Lights

A beacon light (solar type) will be installed at the end of the breakwater to ensure the safety of fishing boats entering and leaving port at night. The specifications of the beacon light is as follows:

Distance reached by the light and flashing interval: 3 miles and 4 seconds

Type of light emission: light-emitting diodes

Color of emitted light: yellow

b) Fenders

Fenders capable of absorbing the effective berthing energy of the inter-island cargo vessels will be used on the basis of a berthing speed of V = 0.15 m/sec.

The intervals of installation of the fenders will be such that the vessel hulls do not come into direct contact with the mooring wall. The standard interval is 5 to 20 m. They will be spaced at intervals of 5 m in view of the fact that the inter-island cargo vessels that will be using such berths are small cargo vessels with a length of 30 to 70 m.

c) Mooring Bitt

The inter-island cargo vessels that will be using those mooring facilities vary considerably in size, from 142 GT to 1,364 GT. Since it is standard practice to provide 15 t mooring bitts for the traction exerted on the mooring bitts by vessels in the 500 to 1,000 GT class, 15 t bitts will be used in this project. As for the interval thereof, the standard is a maximum interval of 10 to15 m for vessels under 2,000 GT and 4 mooring bitts per berth. The mooring bitts will therefore be installed at intervals of 10 m.

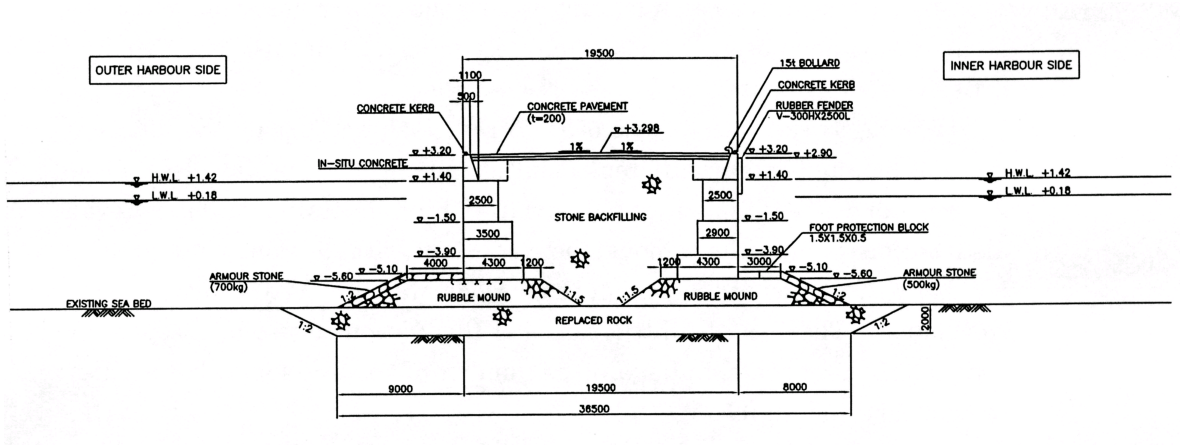


Figure 2.2.2-5 Standard Cross-Section of the Breakwater

4) Basic Design of the Landing Wharf

(a) Necessary Length of the Wharf

a) Fishing Vessels Concerned

The fishing boats that will use the landing wharf are the industrial fishing boats and the artisanal fishing boats that have been using the wharf of the Praia Fishing Port. From the catch landing records of that fishing port, the number of fishing boats that will be using the landing wharf provided in this project is 29 industrial fishing boats and 48 artisanal fishing boats.

The dimensions of the fishing boats concerned are given in Appendix-6.3.

b) Total Wharf Length

The lengths of the catch landing wharf, the preparatory wharf and the lay-by wharf have been studied separately for industrial fishing boats and artisanal fishing boats.

Looking at the state of use of the Praia Fishing Port by the different types of fishing boats in different months and on different days (see Table 2.2.2-8), one sees that the industrial fishing boats have fairly even distribution of use throughout the year but with a somewhat greater number of boats using the port in the periods March to May and October to November. There is also little seasonal fluctuation in use of the port by artisanal fishing boats, but again the number of boats is somewhat greater in February and March.

Furthermore, Figure 2.2.2-6 gives a picture of the time that the fishing boats remain alongside the wharf as based on the findings of the 2000 survey of the dynamic state of the fishing boats, and Figure 2.2.2-7 shows the activity time of the fishing boats according to type, i.e. industrial fishing boats or artisanal fishing boats, as based on the findings of the field survey carried out this time.

According to those findings, the peak hour for both types of fishing boats for coming back to the port is at 7:00 to 8:00 a.m., 80% of the total number starting landing of their catches in that time span. As for the peak hour for completion of landing of catches, it is around noon in the case of the industrial fishing boats and 7:00 to 9:00 a.m. in the case of the artisanal fishing boats. Furthermore, Table 2.3.3-10 shows the findings in the local interview survey concerning the time that it takes the fishing boats to land

their catches and the amount of time that they have to wait before they can start landing them. What is meant here by waiting time is the time during which a fishing boat cannot start landing its catch, whether because the fishing boats that came in before it have not yet finished landing their catches or for any other reason, in spite of the fact that it has entered port and is ready to land its catch.

The figures show that it takes the industrial fishing boats about 4 hours to land their catches and the artisanal fishing boats a little under one hour, but the real time that it takes to completion of landing of the catch, i.e. from the boat's entry into the port to completion of landing of its catch, is much greater than that, which clearly shows that congestion at the wharf is responsible for low efficiency of landing of catches.

Table 2.2.2-10 Landing Time of Catches on Existing Wharf

(unit: hour)

Type of fishing boat	Time needed to land the catch	Waiting time for landing the catch	Total time
Industrial fishing boat	3.96	8.83	12.79
Artisanal fishing boat	0.81	3.21	4.02
Average	1.44	4.44	16.81

Table 2.2.2-11 Volume of Catches by Month of the Year

	Month	Number of Fishery Boats			Average Working Days		Tuna		Pelagic Fish		Bottom Fish		Total		Total Catch (kg)	Fishing Method (%)*			
		Artisanal	Industrial	Total	On the Sea	Fishing Days	Average Catch (kg)	Price (Ecv/kg)	Average Catch (kg)	Price (Ecv/kg)	Average Catch (kg)	Price (Ecv/kg)	Average Catch (kg)	Price (Ecv/kg)		net	Hand Line	Long Line	Others
Total	1	57	47	104	2.47	1.91	198.1	206.6	358.1	93.3	63.6	239.4	619.8	144.5	64,459	48.1	54.8	0.0	0.0
	2	94	54	148	2.32	1.80	164.8	209.5	390.2	88.4	36.4	263.4	591.4	132.9	87,523	38.5	60.8	0.0	1.4
	3	95	70	165	2.47	1.87	479.7	151.3	458.9	70.9	32.8	278.8	971.4	117.7	160,289	35.2	64.8	0.0	1.2
	4	84	69	153	2.41	1.81	334.8	156.4	482.5	81.0	53.9	271.9	871.2	121.8	133,295	44.4	56.2	0.0	2.6
	5	78	68	146	3.09	2.36	216.3	207.4	478.4	88.6	69.8	278.7	764.5	139.6	111,624	43.8	57.5	0.0	0.7
	6	91	62	153	3.56	2.73	367.5	154.1	405.0	82.5	64.2	248.8	836.7	126.7	128,008	29.4	68.0	0.0	3.9
	7	58	68	126	3.55	2.63	308.8	150.4	598.7	72.5	134.0	226.5	1041.5	115.4	131,232	33.3	69.0	0.0	0.0
	8	72	60	132	3.37	2.67	243.7	163.1	412.0	85.0	184.3	243.3	840.0	142.4	110,877	32.6	67.4	0.0	0.0
	9	49	45	94	2.93	2.29	207.8	113.1	471.2	96.6	115.1	217.5	794.1	118.4	74,641	43.6	52.1	0.0	6.4
	10	63	70	133	2.56	2.02	453.2	96.5	301.1	87.5	84.0	263.5	838.3	110.0	111,494	33.8	51.9	0.0	18.0
	11	59	78	137	2.56	1.96	453.8	116.1	464.1	74.9	62.2	214.6	980.1	102.9	134,269	24.8	66.4	0.0	8.0
	12	77	62	139	2.76	2.17	270.9	168.7	407.8	83.4	55.3	199.9	734.0	123.7	102,023	46.0	55.4	0.0	0.0
	Total	877	753	1630	2.83	2.18	315.3	150.4	436.0	82.4	76.7	243.4	828.1	123.2	1,349,734	37.5	60.7	0.0	3.4
Artisanal	1	57	0	57	2.65	2.04	91.5	229.7	119.2	85.9	72.1	241.2	282.8	172.0	16,120	38.6	61.4	0.0	0.0
	2	94	0	94	2.59	2.04	93.1	216.0	133.7	79.9	52.7	266.0	279.5	160.4	26,273	31.9	67.0	0.0	1.1
	3	95	0	95	2.96	2.22	300.6	165.6	120.0	79.6	50.5	274.3	471.1	155.3	44,753	21.1	78.9	0.0	2.1
	4	84	0	84	2.64	1.99	143.2	148.9	82.9	71.0	68.1	263.2	294.2	153.4	24,712	31.0	69.0	0.0	0.0
	5	78	0	78	3.32	2.55	116.9	236.2	55.3	81.0	75.4	270.2	247.6	211.9	19,314	21.8	76.9	0.0	1.3
	6	91	0	91	3.85	2.99	166.0	176.7	62.1	85.3	72.0	246.5	300.1	174.5	27,308	15.4	83.5	0.0	1.1
	7	58	0	58	4.12	3.17	56.1	175.9	39.6	67.6	153.3	243.9	249.0	200.5	14,442	1.7	98.3	0.0	0.0
	8	72	0	72	3.76	3.01	79.4	168.8	88.8	87.0	134.6	239.7	302.7	176.3	21,797	22.2	77.8	0.0	0.0
	9	49	0	49	3.12	2.51	58.4	152.1	142.1	100.6	87.6	239.7	288.2	153.3	14,121	28.6	71.4	0.0	0.0
	10	63	0	63	2.86	2.25	69.6	108.8	80.3	68.3	78.8	251.7	228.7	143.8	14,405	20.6	68.3	0.0	11.1
	11	59	0	59	3.05	2.36	165.3	133.4	28.6	102.6	62.9	269.4	256.9	163.3	15,155	5.1	88.1	0.0	5.1
	12	77	0	77	2.78	2.22	68.2	170.9	92.9	91.5	57.6	257.0	218.7	159.9	16,839	37.7	62.3	0.0	0.0
	Total	877	0	877	3.13	2.43	125.4	173.5	88.1	82.9	77.5	253.6	291.0	167.4	255,239	23.4	75.0	0.0	1.7
Industrial	1	0	47	47	2.26	1.77	327.4	198.8	647.8	95.0	53.3	236.5	1028.5	135.4	48,339	59.6	46.8	0.0	0.0
	2	0	54	54	1.85	1.39	289.5	205.9	836.8	90.8	8.0	233.7	1134.3	121.2	61,250	50.0	50.0	0.0	1.9
	3	0	70	70	1.80	1.39	722.8	143.3	918.9	69.4	8.9	313.9	1650.5	103.1	115,536	54.3	45.7	0.0	0.0
	4	0	69	69	2.12	1.59	568.1	158.7	969.1	82.0	36.5	291.6	1573.7	114.6	108,583	60.9	40.6	0.0	5.8
	5	0	68	68	2.82	2.15	330.4	195.8	963.7	89.1	63.4	290.3	1357.5	124.5	92,310	69.1	35.3	0.0	0.0
	6	0	62	62	3.15	2.35	663.2	145.8	908.2	82.2	52.7	253.5	1624.2	113.7	100,700	50.0	45.2	0.0	8.1
	7	0	68	68	3.06	2.16	524.3	148.1	1075.6	72.7	117.6	207.1	1717.5	104.9	116,790	60.3	44.1	0.0	0.0
	8	0	60	60	2.90	2.25	440.8	161.9	799.8	84.8	244.0	245.8	1484.7	134.1	89,080	45.0	55.0	0.0	0.0
	9	0	45	45	2.71	2.04	370.4	106.4	829.6	95.9	145.0	202.9	1344.9	110.3	60,520	60.0	31.1	0.0	13.3
	10	0	70	70	2.29	1.80	798.5	95.5	499.7	90.3	88.8	272.9	1387.0	105.0	97,089	45.7	37.1	0.0	24.3
	11	0	78	78	2.19	1.67	672.1	112.9	793.5	74.2	61.6	172.2	1527.1	95.2	119,114	39.7	50.0	0.0	10.3
	12	0	62	62	2.74	2.11	522.6	168.4	798.9	82.2	52.5	122.1	1373.9	116.5	85,184	56.5	46.8	0.0	0.0
	Total	0	753	753	2.48	1.88	536.4	144.1	841.3	82.4	75.8	231.2	1453.5	112.9	1,094,495	53.9	44.1	0.0	5.4

＊Duplication is allowed.

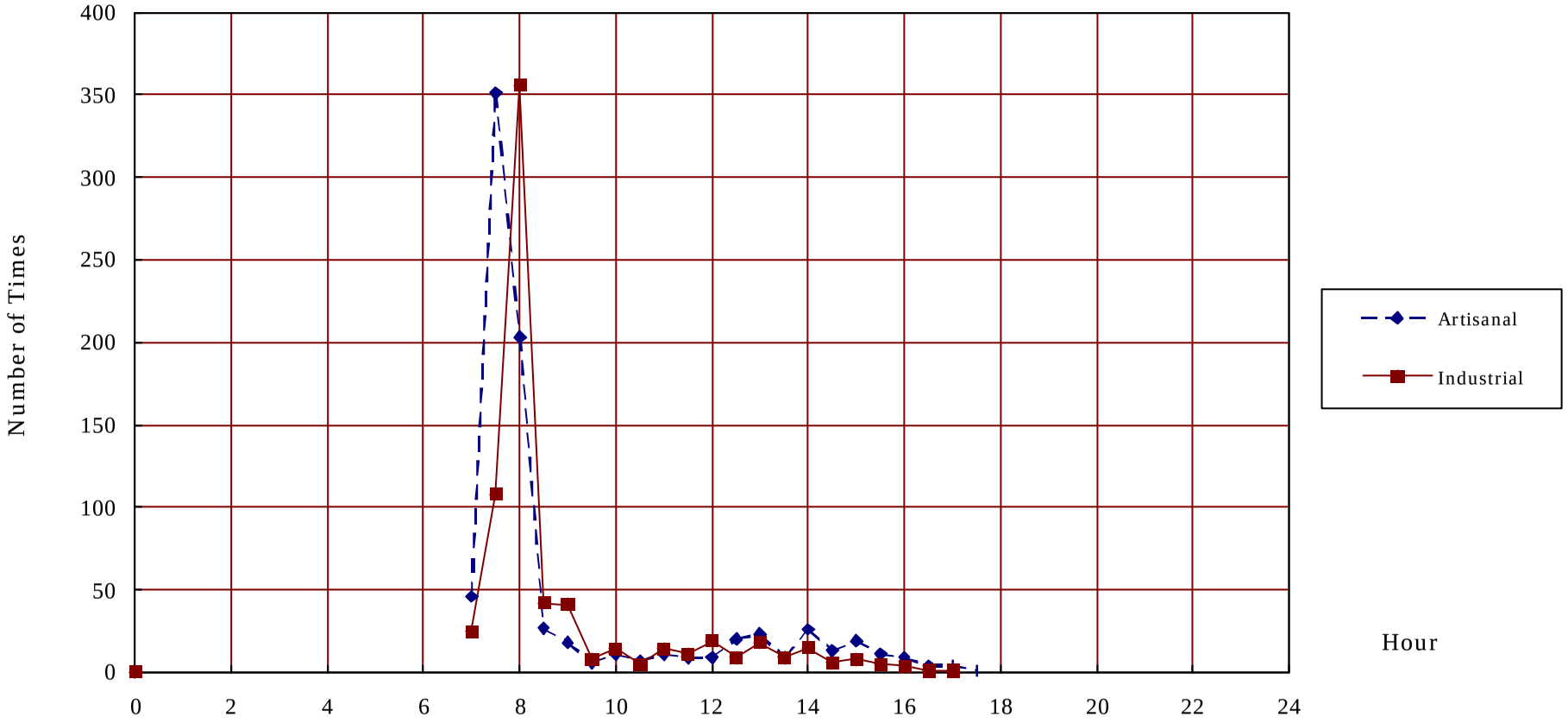


Figure 2.2.2-6 Distribution of Fish Landing Time (2000)

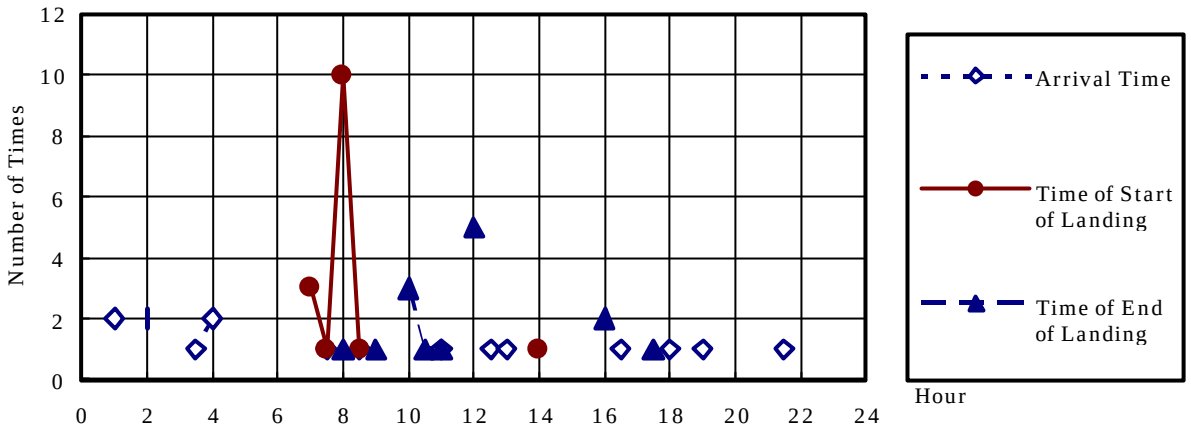


Figure 2.2.2-7(1) Time Distribution of Industrial Fishing Boats Activity

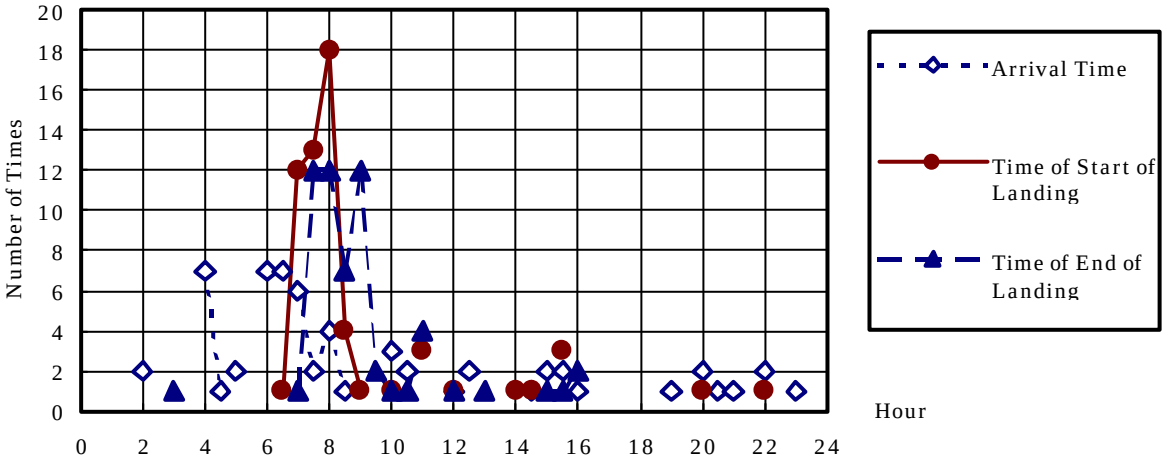


Figure 2.2.2-7(2) Time Distribution of Artisanal Fishing Bort Activity

Let us now calculate the necessary wharf lengths on the basis of the different results presented in the above.

1) Landing Wharf

a) Industrial Fishing Boat

October and November are taken as the peak season for number of industrial-type boats using the port. The average number of such boats a day for the top ten days during that 2-month period is 7.5 boats (rounded off to 8 boats). Furthermore, from the above-mentioned survey results, the time span for landing of the catches is the 4 hours from 8:00 to 12:00.

Regarding the time that it will take for catches to be landed after the wharf is extended in this project, it has been taken as only the actual time that landing of the catches takes, it being assumed that almost all of the present 8 hours of time that has to be waited before starting to land the catch will be eliminated. In the local interviews we were told that sometimes it takes as much as 8 hours to land the catch, but in view of the fact that all of that amount of time can hardly be considered to be necessary for landing of the catch, those values have been eliminated from consideration, after which the average for catch landing time comes to 3 hours.

Number of fishing boats a day:	7.5 (rounded off to 8) as the average for the top 10 days in the continuous 2-month period
Catch landing time:	3 hours
Span of catch landing time:	4 hours (8:00 to12:00 O'clock)

Wharf length = Berth length (1.15 × Loa of boat) × Number of fishing boats × Time needed for landing the catch ÷ Span of catch landing time = 10.9 × 1.15 × 8 × 3 ÷ 4 = 75.2 m

b) Artisanal Fishing Boat

The average number of fishing boats a day for the top 10 days in the peak season of use by artisanal fishing boats, i.e. February and March, comes to 8.3 boats. For them the time needed to land the catch according to what was observed in the field survey is 0.81 hours (approximately 45

minutes). Here, again, it has been assumed that waiting time before starting to land the catch will be practically eliminated by extension of the wharf. Furthermore, the span of catch landing time has been set the same as for the industrial-type boats, i.e. as 4 hours from 8:00 to 12:00.

The required wharf length is calculated as follows on the basis of those results:

Number of fishing boats a day: 8.3 (rounded off to 9) as the average for the top 10 days in the continuous 2-month period.

Catch landing time: 45 minutes (0.75 hours)

Span of catch landing time: 4 hours (8:00 to 12:00 O'clock)

Wharf length = Berth length (Loa of boat × 1.15) × Number of fishing boats × Time needed for landing the catch ÷ Span of catch landing time

= 6.0 × 1.15 × 9 × 0.75 ÷ 4 = 11.6 m

2) Preparatory Wharf

The length of the preparatory wharf has been studied in the same way as that of the landing wharf. In the way of preparation is needed supply of ice, fueling and loading water on board. Since in the case of the Praia Fishing Port there are no particular facilities for fueling and loading water on board, both having to be accomplished using motor vehicles, it has been assumed that they take 60 minutes in view of the low efficiency and the considerable required waiting time for such work. The span of time of use of the wharf for preparations has been set at 8 hours.

a) Industrial Fishing Boats

Wharf length = Berth length (Loa of fishing boat × 1.15) × Number of fishing boats × Required preparation time ÷ Span of preparation time

= 10.9 × 1.15 × 8 × 1.0 ÷ 8 = 12.5 m

b) Artisanal Fishing Boats

Wharf length = Berth length (Loa of fishing boat length × 1.15) × Number of fishing boats × Required preparation time ÷ Span of preparation time

$$= 6.0 \times 1.15 \times 9 \times 1.0 \div 8 = 7.8 \text{ m}$$

3) Lay-by Wharf

The length of lay-by wharf has been calculated on the basis of the average number of moored fishing boats obtained in the field survey. However, considering the present state of use, it has been assumed that the fishing boats will come alongside in two rows.

a) Industrial Fishing Boats

The number of industrial fishing boats regularly use of the Praia Fishing Port is about 15. In the field survey (covering a period of 14 days) an average of 6.6 (rounded off to 7) such boats were observed in the fishing port in the morning (about 7:00 O'clock). That shows that a little less than 50% of the industrial fishing boats regularly use of the Praia Fishing Port are moored there everyday.

The wharf length has been calculated in the following manner:

Wharf length = Berth length (Loa of fishing boat × 1.15) × Number of fishing boats ÷ 2 (rows)

$= 10.9 \times 1.15 \times 7 \div 2 = 43.9 \text{ m}$

b) Artisanal Fishing Boats

In the field survey it was observed that an average of 10.0 such boats were moored at the fishing port in the morning (at about 7:00 O'clock).

The wharf length was calculated in the following manner:

Wharf length = Berth length (Loa of boat × 1.15) × Number of fishing boats ÷ 2 (rows)

$= 6.0 \times 1.15 \times 10 \div 2 = 34.5 \text{ m}$

Table 2.2.2-12 below summarizes the above:

Table 2.2.2-12 Required Wharf Length (unit: m)

Type of fishing boat	Landing wharf	Preparatory wharf	Rest and Recuperation wharf	Total
Industrial fishing boats	75.2	12.5	43.9	131.6
Artisanal fishing boats	11.6	7.8	34.5	53.9
Total	86.8	20.3	78.4	185.5

The existing Praia Fishing Port has a 55 m length of wharf for fishing boats, and with extension of the breakwater in this project, the No. 3 wharf will come to be used mainly by fishing boats. However, not all of the length of the No. 3 wharf can be used by fishing boats because of the inter-island cargo vessels that will be moored at the rear of the breakwater. It is expected that actually it will be possible to use only above 50 m of it for that purpose.

That being the case, the necessary wharf length to be newly provided in this project is 80 m (185.5 m −55 m − 50 m = 80.5 m 80 m).

(b) Crown Height of the Wharf

The crown height of the landing wharf and the preparatory wharf has been set using the average dimensions of the fishing boats. As indicated in Table 2.2.213, the wharf crown height has been set on the basis of the gross tonnage (GT) of the fishing boats that will be using the wharf and the tidal range.

Table 2.2.2-13 Standard of Crown Height (above H.W.L.)

Tidal rangel (H.W.L. – L.W.L.)	Size of Fishing boat (GT)			
	0～20	20～150	150～500	500＞
0～1.0m	0.7m	1.0m	1.3m	1.5m
1.0m～1.5m	0.7m	1.0m	1.2m	1.4m
1.5m～2.0m	0.6m	0.9m	1.1m	1.3m

Source: Fishing Port Structures Standard Design Methods, National Fishing Ports Association of Japan.

The average gross tonnage of the fishing boats concerned by this project is about 20 GT, and the tidal range is approximately 1.0 m. That means a

wharf crown height of +2.10 m. For compatibility with the previous project, it is taken as +2.00 m in this project as well.

Wharf crown height = H.W.L. + 0.70 m
= 1.42 m + 0.70 m
= +2.12 m
+2.00 m

(c) Water Depth

The water depth has been set in the following manner on the basis of the draught of the industrial fishing boat (2.32 m) plus an allowance of 0.5 m (as per Fishing Port Structures Standard Design Methods, National Fishing Ports Association of Japan):

Water depth of catch landing wharf and preparatory wharf: －3.0 m

(d) Setting of Apron Width

In Fishing Port Structures Standard Design Methods, in the case of a fish handling facility directly behind the landing wharf, the standard for the apron width of the wharf is 3 m, and that for the apron width of the preparatory wharf is 6 m. In this project a fish market will be located behind the catch landing wharf, and considering some allowance, the apron width of the landing wharf has been set at 5.0 m.

(e) Accessories

As wharf accessory facilities will be installed, in front of the wharf, fenders for preventing damage to the boat hull when the fishing boats come alongside the wharf and, on the crown of the wharf, mooring posts for receiving the mooring lines for mooring and fixing the fishing boats and stops for preventing motor vehicles from falling off into the water.

a) Fender

Fenders capable of absorbing the effective berthing energy of the fishing boats assuming a berthing speed of V = 0.40 m/s will be installed.

The fenders will be installed with 4m intervals

b) Mooring Bitt

The fishing boats that will be using this wharf are of the class of about 20 GT. Since it is standard practice to use 3t bitts for the traction force exerted by 20 GT boat, such bitt will be used.

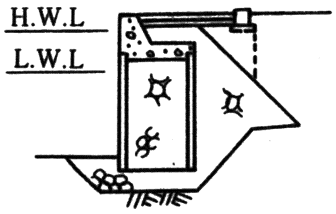
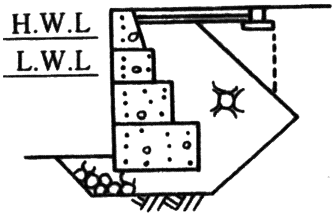
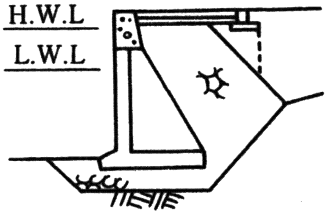
The bitts will be installed at 5m intervals.

(f) Structural Design

Considering the fact that the landing wharf is one of the main facilities to be provided in this project, cross-sectional comparative design has been carried out for selection of the structural type. The results of the soil investigation show the existence of a stiffed coral gravel layer of N-value over 50 under the surface layer (which is 1.3 m thick). Since it would therefore be difficult to drive piles or sheet piles, etc., into the ground foundation, the gravitational type of structure has been adopted for the wharf.

We have carried out a comparison of three different gravitational structure types — with concrete blocks, with cellular blocks and with L-shape blocks — as regards ease of execution, construction cost and period for the wharf. The results of such comparison are indicated in Table 2.2.2-14. On the basis of those results the cellular block type has been adopted as not only being superior in terms of ease of execution and construction cost but also having short construction period.

Table 2.2.2-14 Comparison of Wharf Structural Types

	Cellular block type	Concrete block type	L-shape block type
Structural cross section			
Engineering performance	The quantity of production of blocks and installation is small. The capacity of machinery used does not have to be very great because of the weight of block being light.	This type involves the largest quantity of production and installation. The block weight is heavier than cellular block. The capacity of machinery is bigger than cellular block.	Although the quantity of production and installation is less than in the case of cellular blocks, the block weight is considerably greater, requiring use of a bigger crane.
Construction cost	Lowest construction cost of the three types	More expensive than the cellular block type	Highest construction cost of the three types
Construction period	Shortest construction time	Longer construction period than in the case of the cellular block type	Longer construction time than in the case of the cellular block type
Evaluation	○	△	×

a) Design Conditions

The wharf design conditions are as follows:

Crown height: +2.0 m
Planned water depth: −3.0 m for the catch landing wharf
Tidal level: H.W.L. + 1.42 m
L.W.L. + 0.18 m
Waves and tidal currents: Not effect
Surcharge of landing wharf: 1.0 t/m²(Normal), 0.5 t/m²(Seismic).
Design boat: 20 GT type, Loa of 11.6 m, Draught of 2.5 m
Berthing speed: 0.4 m/s
Tractive force: 3.0 t
Design seismic force: 0.05
Subsoil conditions: Gravel, N-value 50
Materials:

Backfill rocks and filling materials:

Internal friction, $\psi = 40°$

Wall friction angle $\psi = 15°$

Foundation rubble: Internal friction, $\psi = 40°$

Specific weight :

Reinforced concrete: 2.45 t/m³ in air, 1.42 t/m³ in water

Plane concrete: 2.30 t/m³ in air, 1.27 t/m³ in water

Backfill material, filling material: 1.80 t/m³ in air, 1.00 t/m³ in water

Seawater: 1.03 t/m³ in air

b) Results of Calculation of Stability

Stability with respect to sliding and overturning has been calculated for each inspected section indicated in Figure 2.2.2-8. The results of such calculation are given in Table 2.2.2-15.

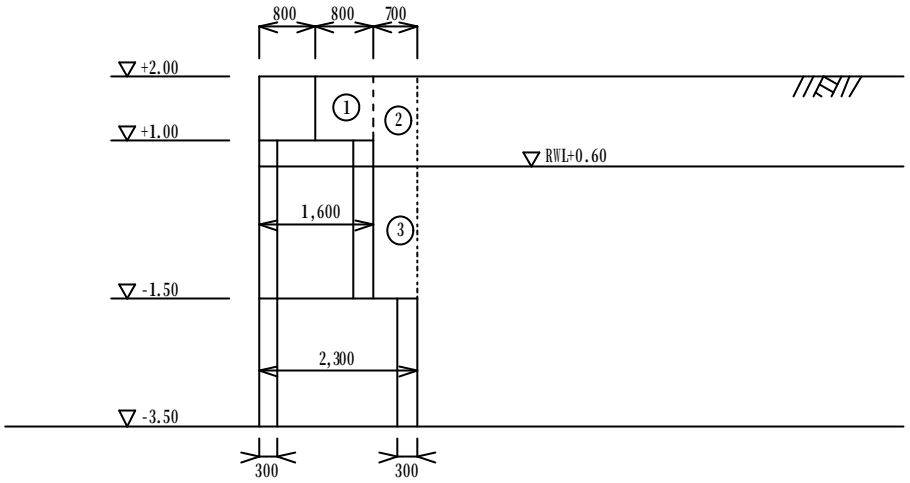


Figure 2.2.2-8 Stability Calculation Cross Sections

Table 2.2.2-15 Results of Stability Calculations

Condition	Section	Safety Factor (F)		
		Sliding	Overturning	Overturning (Consideration of separation of the filling)
Normal	Section-1、+1.00m	3.18	5.33	
	Section-2、-1.50m	2.02	1.88	2.69
	Section-3、-3.30m	1.98	1.61	1.73
At the Time of Earthquake	Section-1、+1.00m	2.85	4.65	
	Section-2、-1.50m	1.64	1.51	2.15
	Section-3、-3.30m	1.54	1.23	1.31
At the Time of Traction	Section-1、+1.00m	2.16	3.22	
	Section-2、-1.50m	1.73	1.25	1.78
	Section-3、-3.30m	1.83	1.30	1.40

The results of the calculation show that the safety factor is lower at section 1, but it is still safe at F > 1.2. The cross sections of the catch landing wharf and the preparatory wharf are given as Figure 2.2.2-9 on the basis of the above results.

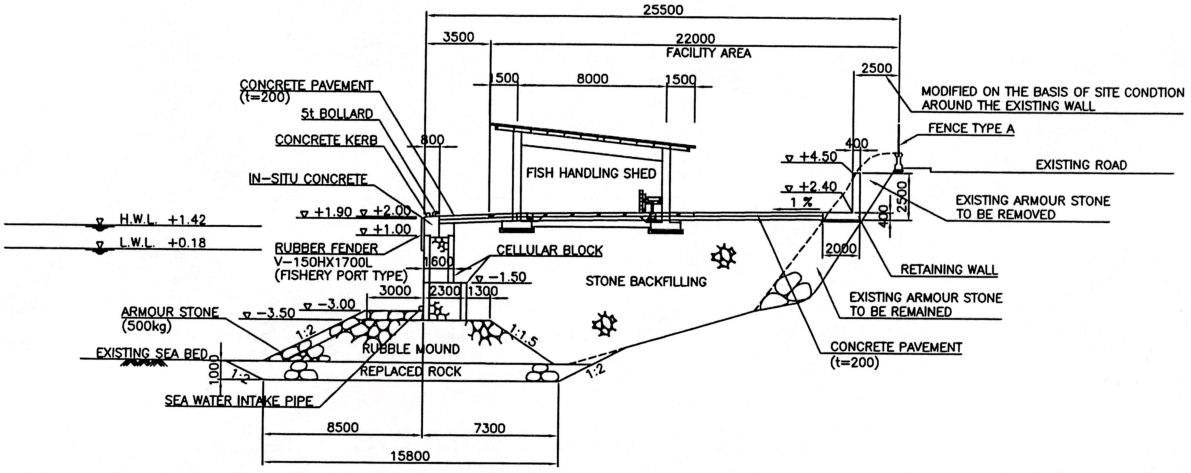


Figure 2.2.2-9 Standard Cross Sections of the Landing Wharf

5) Basic Design of Access Road

The roads within the fishing port will be planned so as to make flows of things and people between its different facilities as smooth as possible.

The motor vehicles using the road within the fishing port include the passage cars used by the fishermen, the pickup trucks with a load capacity of 1-2 tons used by the fish vendors and the tank lorry with a load capacity of about 10 t used to supply the fishing boats with water and fuel. Since there is no asphalt plant on the island of Santiago, concrete paving will be used for the sake of small-scale economy.

(a) Lane Width

In view of the fact that among the vehicles using the road will be 10 t trucks with a breadth of 2.5 m, there will be a 3 m lane in each direction, for a total road width of 6 m for the two directions, as well as a sidewalk with a breadth of 2 m on side of the road.

(b) Cross-Sectional Structural Design

Of the traffic volume categories indicated in Cement Concrete Paving Rules (Japan Road Association), traffic category A has been adopted as the one for the least volume of traffic, the thickness of the concrete paving being 20 cm. Furthermore, the sub-base course thickness has been set at 30 cm on the basis of a design CBR of the sub-grade of 3-4. The paving structure is given in Figure 2.2.2-10.

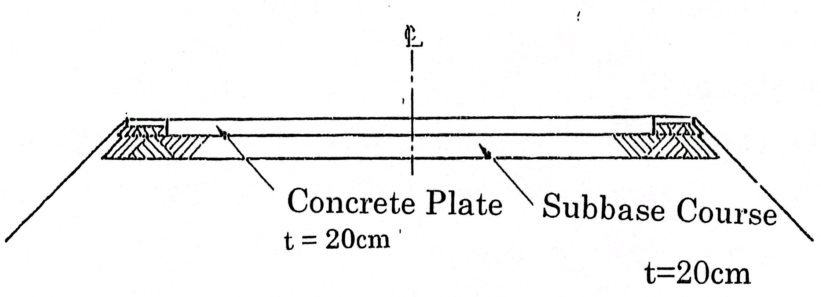


Figure 2.2.2-10 Paving Structure

6) Basic Design of Parking Area

A parking area will be provided within the fishing port to mitigate road congestion caused by the vehicles using the commercial port and those using the fishing port. It will be located near the new entrance of the fishing port.

(a) Number of vehicles Making Use of the Parking Area

According to the vehicle entry records (fee collection records) for 2000, on the average 5 to 8 vehicles enter the port on a given day in any month of the year, and Table 2.2.2-16 gives the number of vehicles that entered the port on each day during the period of our survey as well as the maximum number parked there at the same time on each day.

The time span of entry of vehicles is from around 7:00, when fish vendors start coming in, to around 14:00, by when they leave. There are usually 5-7 vehicles parked at a given time, the average being 6. Six parking spaces will therefore be provided in this project.

Table 2.2.2-16 Number of Vehicles Making Use of Parking Area

	5/3	5/4	5/5	5/6	5/7	5/8	5/9
Number of vehicles that entered the port	13	24	30	-	16	21	20
Number parked at the same time	5	5	6		6	6	7
	5/10	5/11	5/12	5/13	5/14		Average
Number of vehicles that entered the port	18	20	15	-	18		20
Number parked at the same time	5	7	6		7		6

(b) Parking Spaces

Since the vehicles used are pickup trucks and other small vehicles, each parking space will measure 2.5 m × 5.0 m = 12.5 m². The parking area with six parking spaces will therefore be as follows:

12.5 m² × 6 spaces = 75 m² (15.0 m × 5.0 m)

(c) Paving

The parking area paving will have the same specification as the road paving.

(2) Basic Design of Functional Facilities

1) Design Conditions

The natural and other design conditions are as follows:

Outdoor air temperature:	21-32℃
Humidity:	60-80%
Wind force and wind speed:	Prevailing wind direction NE Average wind speed: 6 m/s Maximum wind speed: 16 m/s Design wind speed: 60 m/s
Precipitation:	120 mm/year
Mains electricity supply:	380 V, 3-phase, 50 Hz 220 V, single-phase, 50 Hz
Basic specification:	The ice-making and electrical equipment is basically to undergo brine-resistance, anti-rusting and tropical treatment to prevent damage from the briny atmosphere and rusting.
Applied standards:	Basically the pertinent Japanese standards including the Building Standards Law and its enforcement ordinance, the Japan Industrial Standards (JIS), the Japan Electrical Industry Association's Standards (JEM), the standards of the Electrical Standards Study Group of the Electric Science Association (JEC), the Building Work Standard Specifications (JASS), and the High-Pressure Gas Safety Law (HPGCRJ).

2) Ice-Making and Storage Equipment

(a) Ice-Making Machines

The industrial fishing boats and artisanal fishing boats that use Praia Fishing Port make use of ice produced by the fishing port's ice-making facility. Ice is essential for keeping the catch fresh and is therefore a precondition for delivering good-quality fish to the final consumers. This facility has been planned for the quantity of ice needed both in fishery production (on the fishing boats while they are out fishing) and in

distribution, first at the fish market and then all the way to the final consumers. In setting the scale of the new ice-making equipment, the ice production situation of the existing ice-making facility with an initial capacity of 10 t/day that was constructed on the basis of financing by the African Development Bank and is still in operation will, of course, be taken into account.

a) Production Capacity of the Existing Ice-Making Equipment

Nearly 10 years have passed since construction of the existing ice-making facility, and it has become rather worn-out, which has resulted in frequent reoccurrence of stoppage of operation and decline in ice production capacity.

The conditions of the equipment's operating environment are severe, including high air temperature the whole yearlong and use of hard groundwater for cooling.

Table 2.2.2-17 below summarizes the data for a recent 2-year period entered in the operating log of the existing ice-making facility. It shows that operation of the equipment was interrupted for long periods because of being out of order or because of power outages. The machinery was out of operation 133 days in 1999 (36% of the time) and 93 days in 2000 (25% of the time) because of technical trouble. Matters were made still worse by frequent power outages. In the interviews the fishermen clearly expressed to the study team their strong discontent with the present situation of often not being able to procure the ice they so badly need for their fishing operations.

Table 2.2.2-17 State of Operation of the Existing Ice-Making Equipment

	Item / Year	1999	2000
1.	Number of hours of operation of the ice-making refrigerator, hr/year	6,045	7,745
2.	Number of hours out of operation because of technical trouble, hr/year	2,715	1,015
3.	Number of days out of operation because of technical trouble, days/year	133	93
4.	Percentage of time in the year out of order, %	36	25
5.	Number of days with power outage, days/year	86	46
6.	Percentage of time in the year out of operation because of power outage, %	23	12

Source: Operating log kept by SEFI

The main reason for the equipment trouble has been continuation of operation under abnormal conditions because of inability to get corrective repair parts early enough, which has led to major trouble, and that has accelerated the pace of the equipment's becoming worn down. Table 2.2.2-18 below describes the kind of trouble that has occurred with the ice-making equipment in the last 2 or 3 years.

Table 2.2.2-18 Trouble Records of the Existing Ice-Making Machine

No.	Place of the trouble	Cause of the trouble	Problems
1	Malfunctioning of expansion valve	Wear from aging and blinding of the strainer	Procurement of necessary parts takes too much time.
2	Wear and tear and breakage of refrigerator intake and discharge valves	Wear from aging and deterioration of state of operation	Inexperience in operation techniques and the fact that it is extremely difficult to obtain parts in view of the fact that SABROE, the manufacturer of the refrigerator and supplier of parts for it, has suspended its business operations. Furthermore, the BFO-4 type is no longer being produced.
3	Trouble with accessory equipment	Wear from aging, Technical inexperience	Procurement of parts
4	Trouble with water-cooled condenser	Poor materials and insufficient capacity	Corrosion of cooling coil. It needs to be replaced, but the price is high, and it is difficult to procure.
5	Water feed pump for making ice	Wear from aging	Takes too much time to procure parts.
6	Ice-making machine bearings	Failure to carry out regular checks and wear from aging	Procurement of parts

* Although some recovery in the ice production capacity of the facility could be expected with procurement of parts and raising of the technical level of those responsible for the equipment, probably at best it will be possible only to maintain the status quo in a situation where it is difficult to replace the water-cooled condenser and procure parts for the refrigerator.

Let us now consider the present production capacity of the existing ice-making machine in the state of operation described above.

As shown in Table 2.2.2-19 below, in both years the daily capacity obtained from the annual volume of sales of ice and the annual number of days of operation of the refrigerator is 5 t/day.

Table 2.2.2-19 Actual Production Capacity of the Existing Ice-Making Plant

Item \ Year		1999	2000
1.	Number of hours of operation of the refrigerator for making ice, hours/year	6,045	7,745
2.	Equivalent number of days of operation of the refrigerator for making ice, days/year	251	322
3.	Total volume of ice sales, t/year	1,281	1,743
4.	Actual production capacity of the ice-making machine, t/day	5.1	5.4

Source: INDP and SEFI's operating log.

Even though that capacity does not take into account loss in the production and sales stages, it is still very much lower than the original design capacity of 10 t/day. As mentioned above, in a situation in which the manufacturer of the equipment has suspended business operations and production of the ice-making machine in question has halted, it would be difficult, if not impossible, to raise the present facility's capacity by reequipping it. That being the case, it is considered that the only practical thing that can be done is to try to keep up present production capacity for the time being by providing the facility with surer maintenance.

In such a situation, considering the fact that the new equipment to be provided in the present project will not be commissioned until several years down the road and the fact that lack of supply of parts as mentioned above means that receiving of sufficient maintenance will be impossible as well as the fact that the existing equipment will have been in operation for several years in excess of ten years and thus have reached the end of its service life (in Japan the service life of refrigerating equipment is generally considered to be 13 years), it can hardly be expected that it will be possible to continue ice production with the existing ice-making machine, its production capacity has not been included in calculation of future equipment capacity.

b) Necessary Volume of Ice Production

The demand for ice will be considered to be that for use in fishery production by both larger industrial-type fishing boats and small artisanal fishing boats and that for use in distribution of the fish all the way to the final consumer. The volume of catches covered by the ice will be considered to be the catches landed at Praia Fishing Port and the volume of fish distributed from Praia Fishing Port.

From Table 2.2.2-20 below, the ratios of volume of ice used to volume of

fish obtained from actual ice sales in 2000 are as follows:

Table 2.2.2-20 Volume of Ice Sold and Volume of Catches Landed at Fishing Port

Unit: t/year

Item \ Year		1999	2000
1.	Volume of ice sold for use on fishing boats		1,261
2.	Volume of ice sold for use in distribution		512
3.	Total volume of ice sales	1,281	1,773
4.	Volume of catches landed	1,048	1,352

Source: INDP and SEFI's ice sales records.

Ratio of volume of ice to volume of fish on fishing boats:

Volume of ice used ¸ Volume of catches = 1261 t ¸ 1353 t = 0.9

Ratio of volume of ice to volume of fish in distribution:

Volume of ice sold for used in distribution ¸ Volume of catches = 512 t ¸ 1353 t = 0.4

Ratio of total volume of ice to volume of fish = 1.3

In 2000 the actual ratio of total volume of ice to volume of catches was 1.3.

That figure shows the situation for last year, when there was a shortage of ice. In other words, fishing boats often went out on fishing trips with less than the amount of ice that they really needed because they could not get enough.

That being the case, it has been necessary to carry out a simulation on the basis of the following set conditions in order to get a correct picture of the shortage for the sake of calculation of the necessary volume of ice.

a. The fishing boats covered:
   It has been assumed on the basis of the actual record of fishing boat port entries as obtained from the detailed information of fishing boat activities by month for 2000 at Praia Fishing Port that the fishing boats take on the necessary volume of ice on the day of entering port.
b. Volume of ice loaded on board:
   It has been assumed that the necessary volume of ice each time is 3 t in the case of industrial fishing boats and 0.5 t in the case of artisanal fishing boats .
c. Production adjustment:

This is the temporary production volume at the time of stoppage of production when the ice-making machine cannot continue to produce ice because the ice storage is full.

d. Number of days for calculation:
In the simulation it is assumed that throughout the year there are no obstacles to production such as stopping for maintenance, technical trouble or power outages, the number of days of operation being 365.

In the simulation 24 different combinations for the situation regarding ice production capacity (5, 6, 7, 8, 9 and 10 t/day) and ice storage capacity (15, 20, 25 and 30 t) have been set, and calculation has been carried out separately for the number of days a year of shortage of ice (Table 2.2.2-21) and the total number of tons of shortage a year (Table 2.2.2-22).

Table 2.2.2-21 Number of Days a Year of Shortage of Ice

Production capacity (t/day) / Ice Storage Capacity (t)	5	6	7	8	9	10
15	169	111	63	33	21	16
20	169	109	59	23	15	8
30	167	105	46	14	8	4

Table 2.2.2-22 Tons of Shortage of Ice a Year

Production capacity (t/day) / Ice Storage Capacity (t)	5	6	7	8	9	10
15	900	596	355	184	113	73
20	894	580	309	131	70	40
30	884	560	260	86	31	11

In the above analysis, in the case of a production capacity of the existing ice-making facility of 5 t/day and a storage capacity of 30 t the number of days of shortage a year comes to 167, and the total annual shortage comes to 884 t. It is therefore clear that the necessary annual production could not be secured with the capacity of the existing equipment.

Furthermore, in the case in the table of a production capacity of 10 t/day and a storage capacity of 30 t, the simulation gives only 4 days of shortage a year and a total shortage of only 11 t a year, which means that with that equipment capacity it would be possible to just about secure the necessary production volume.

c) Capacity of the New Ice-Making Facility

From the table of fishing boat activities each month at Praia

Fishing Port one obtains the figure of 2.8 days as the average length of fishing trips (number of days at sea). Considering that situation regarding fishery activities, the figure of about twice the volume of catch is judged to be appropriate for the necessary volume of ice of the fishing boats, and that figure has been adopted for the ratio of volume of ice to volume of fish.

Now let us obtain the ratio of volume of ice to volume of fish for the case in the above table of an ice production capacity of 10 t/day and a storage capacity of 30 t. Since in that case there will be a total annual ice production volume of 2,697 t, that ratio will be as follows:

Ratio of volume of ice to volume of fish on fishing boats:

Volume of ice loaded on board ¸ Volume of catches = 2697 t ¸ 1353 t = 2.0

Ratio of volume of ice to volume of fish in distribution:

Volume of ice sold for use in distribution ¸ Volume of catches = 512 t ¸ 1353 t = 0.4

Total ratio of volume of ice to volume of fish = 2.4

Considering the conditions set in the simulation, that ratio of volume of ice to volume of fish is a reasonable figure.

Therefore it has been decided that the ice production equipment to be provided in the project should have an ice-making capacity of 10 t/day and an ice storage capacity of 30 t.

d) Characteristics of Ice

Ice is roughly classified into block ice, flake ice and plate ice depending on the shape of ice. Plate ice will be produced by the Project as maintenance is easy because of the same type of facilities of Mindelo Fishing Port and melting time is longer than flake ice.

e) Specification of Ice-Making facility

Ice making type:	Automatic plate crushed ice machine
Production capacity:	5 ton/24hrs×2units
Cooling system:	Ammonia direct expansion dry type
Refrigerator:	Single stage, Reciprocating and cylinder open type compressor
Condenser:	Water cooled condensing type

(b) Ice Storage Room and Conveyance System

The purpose of the ice storage room is to make possible to constantly supply ice. The ice making machine has daily capacity of 10 tons and capacity of ice storage room could be three times as large as the ice making capacity, being 30 tons which is determined by the balance of the amount of supplied ice as described in " c) capacity of new ice making facility".

In this ice storage room, automatic conveyance system and weighing system will be provided for supply of ice to fishing boat.

b) Specification of Heat Insulation

Specification of heat insulation for ice storage room is shown as follows.

① Heat Insulation

Items	Ice Storage Room
Ceiling	Flat surface type : 100mm thickness
Wall	Flat surface type : 100mm thickness
Floor	Flat surface type : 125mm thickness

② Door

Insulation Door: Manually operated single swinging door
Surface: Color coated steel sheet

Dimension: 850(W)mm×1800(H)mm×100(T)mm

3) Water Supply Facility

As city water is very expensive and shortage in Praia City. Therefore, it is planned that seawater will be used for cleaning the floor of fish market, wharf apron etc..

The seawater will be supplied, through elevated seawater tank installed on the roof of ice making building, to the fish market and wharf apron for cleaning the floor and cleaning the fish.

(a) Required volume of Seawater

Required volume of seawater for cleaning in each facility is as follows.

Fish case (0.5m^3): 9.5m^3/day
Fish container (40 litters): 3.2m^3/day

Cold insulation fish case (1m^3):	3.0m^3/day
Pallet for large fish (0.14m^3):	2.8m^3/day
Seawater for processing	3.6m^3/day
Cleaning water of fish market:	5.1m^3/day
Cleaning water of wharf apron:	6.0m^3
Total volume of seawater:	33.2m^3

(b) Specification of Seawater Tank

Daily seawater requirement is 33.2m^3. As the operation time of fishing port is 8 hours, use of seawater per hour is 4.15m^3. Therefore, 6.0m^3 capacity tank will be installed on the floor of ice making building. Seawater will be pump up to the elevated tank.

Specification

Capacity:	6.0m^3
Quantity:	1 unit
Material:	FRP

(c) Seawater Pump

Seawater will be pump up to the elevated tank from the intake pit installed in the wharf apron area.

Specification of seawater pump

Type:	Suction two-stage pump
Diameter:	65mmφ
Motor:	3.7Kw
Quantity:	2 unit (mutual operation)

4) Water Discharge System

Since there is no sewage system near the project site, the wastewater must be treated within the site. Discharge of contaminated water is to be planned in view of environmental protection in the port. The wastewater drained from the fish from the fish market containing fish guts and garbage will first pass a garbage-screening pit and then it is discharged to the sea through septic-tank.

5) Electric Installations

(a) Main Feeder Wiring

The main feeder wiring is located underground between the distribution board at the existing substation and distribution board of ice making facility. The electricity to be supplied will be of 3-phase, 4 wires, 380V/220V, and 50 Hz. The incoming cables to conform to power consumption required for the port facilities are connected to breaker in the substation at the site. The installation of the incoming cabling and its connection to the first electric pole in the site will be the responsibility of the Government of Cape Verde, shown in Figure2.2 2-11.

(b) Standby Generator

A standby generator will be installed to secure the function of ice supply to the fishing boats during electric power failure. A capacity of the standby generator is determined to cover the cooling system of ice storage room, the automatic conveyance system for supply of ice to the fishing boats and seawater intake pump. Therefore, the standby generator of 50KVA Capacity will be installed in the ice making facility building.

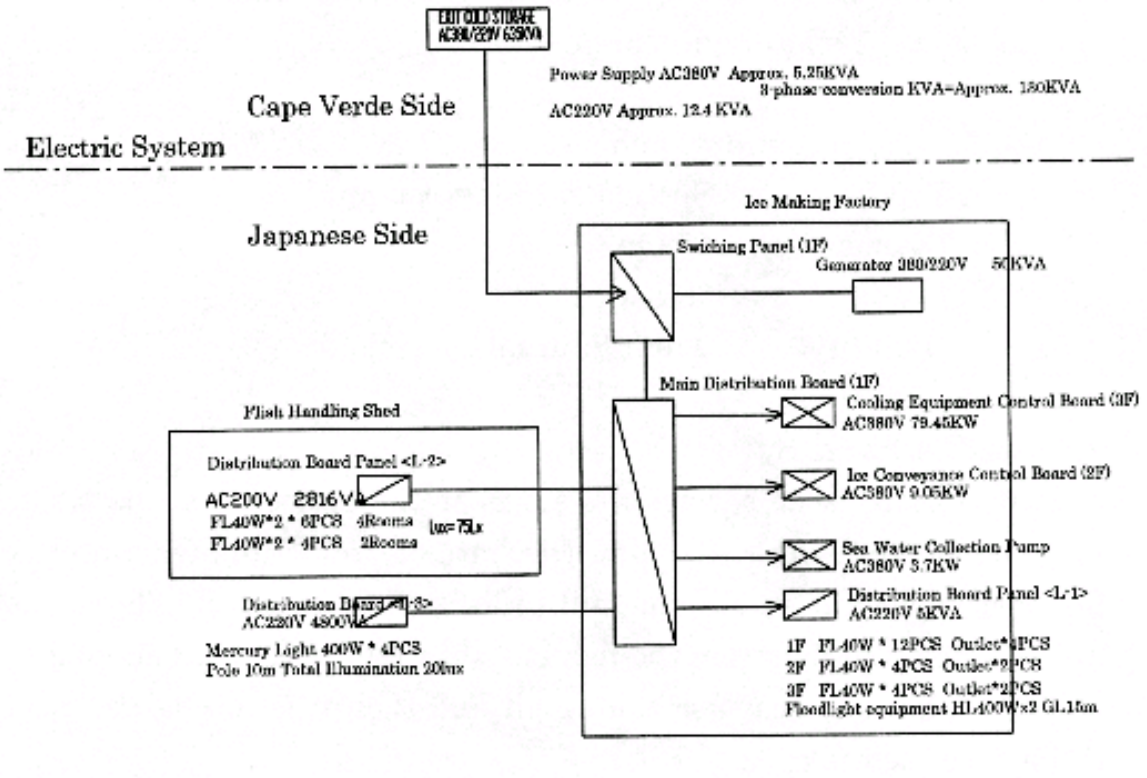


Figure2.2.2-11 Scope of Electricity Work by both Side

(c) Lighting Fixture

In order to ensure the safe and smooth arrival/departure of fishing boats and preparation for fishing trips and also for the security purpose, four electric poles (luminosity = 400W/lamp) will be erected on the apron. Also for the security purpose, the two lamps (luminosity = 400W/lamp) will be set on the wall of ice making facility building. (Shown in Figure2.2.2-12)

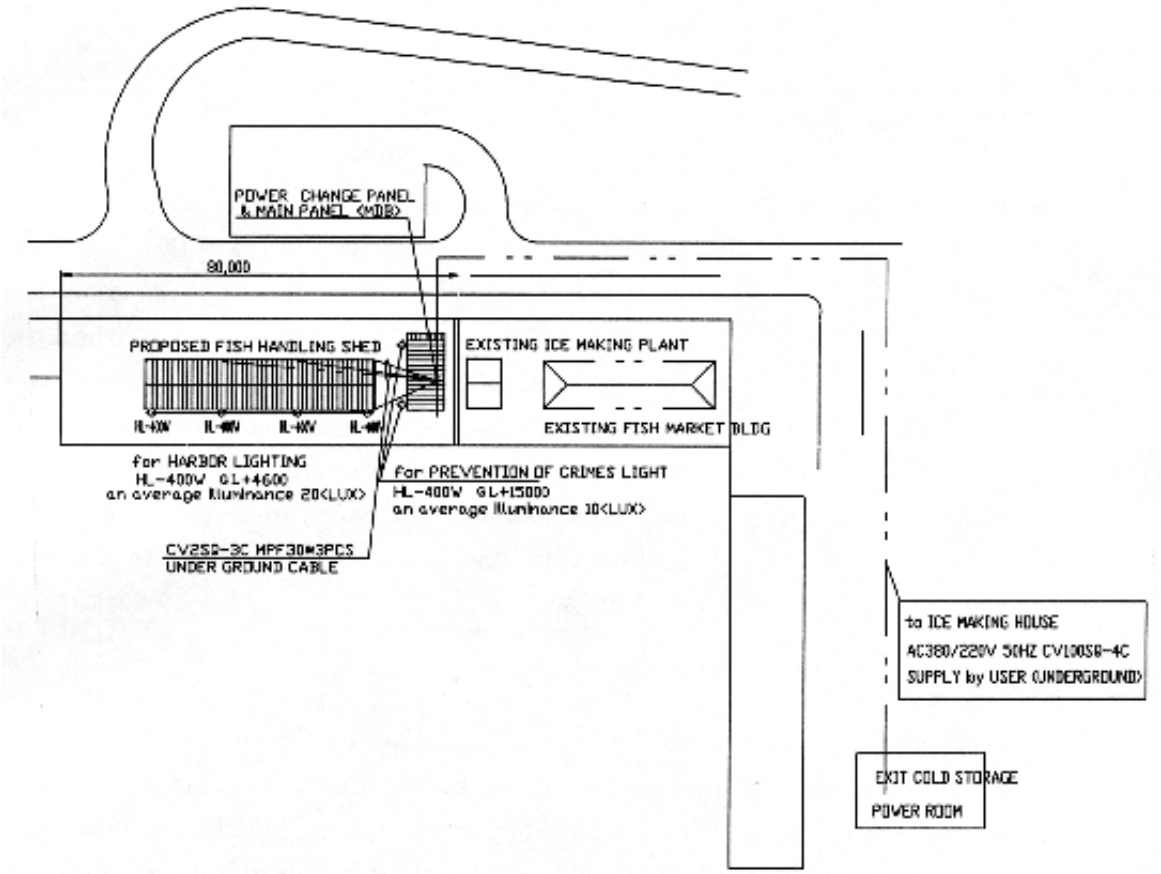


Figure2.2.2-12 Lighting Fixture in the Port

(3) Basic Design of Land Facilities

1) Design Conditions

The natural and other design conditions are as follows:

Outdoor air temperature : 21-32℃

Humidity :60-80%

Wind force, wind speed : Prevailing wind direction: NE
Mean wind speed: 6 m/s
Maximum wind speed: 16 m/s
Design wind speed: 60 m/s

Rainfall : 120 mm/year

Mains power supply : 380 V, 3-phase, 50 Hz
220 V, single-phase, 50 Hz

Standards applied :Japan Industrial Standards (JIS), Japan Electric Industry Association Standards (JEM), Japan Architectural Work Standard Specification (JASS). The Japan Architectural Standards Law, its Enforcement Ordinance, etc. apply in the absence of a corresponding local law. It should be noted that measures against damage by a briny atmosphere and measures against rust are included in the standard specification for the buildings.

2) Fish Market

A fish market with a shed will be constructed at the rear of the landing wharf for sorting, washing and primary processing of the catches landed from the fishing boats. The purpose of providing such a facility is move the buying and selling of the fish away from the wharf apron in order to mitigate the congestion there and make it possible to buy and sell the fish under more sanitary conditions.

(a) Design Concepts in Planning of the Fish Market

The following are the basic design concepts in planning the fish market:

① It should be a facility that does not impose major changes in the commercial practices presently observed in buying and selling on the wharf apron so that it will be readily acceptable to both the fishermen

and the fish venders.

②It should be provided with equipment and apparatus that will maintain a good state of sanitation. However, such apparatus should be of the type amenable to change in layout for convenience of use, fixed type sales stands, etc. being avoided.

(b) Steps Involved in Buying and Selling of Fish at Fish Market

The lines of movement of the fish from the wharf to the fish market and the steps involved is buying and selling them will be as follows in order to reflect present conditions:

①The fishermen are to take their catches directly to the fish market and not engage in any selling thereof on board or on the wharf apron. The methods of landing the catches and taking them to the market are to be as follows:

a. In landing the catch, the fish are to be put into plastic fish containers with a capacity of 30 kg.
b. 2-wheel carts are to be used as the means of taking the fish containers to the fish market.

②The small fish that have been landed are first to be weighed by platform scale and then taken to the fish market and put in fish cases for sale.
In order to cover the buying and selling presently taking place on the wharf the dimensions of the fish cases should be as follows:

External dimensions: 1 m width × 1 m depth × 0.5 meter height

③The fish landed in the evening need to be temporarily stored on the wharf apron in cold-insulation cases for sale the next day.
External dimensions: 1 m width × 1 m depth × 1.2 m height

④As for large fish, considering sanitary conditions, they are to be sold on plastic pallets instead of being laid out on the concrete floor for sale. Use is to be made of 4-wheel handcart for moving the large fish from place to place.

⑤For the sake of eliminating congestion on the wharf it will be put off-limits to general fish vendors.

⑥There will be provision of facilities for the fish vendors to wash and process the fish. Seawater will be used for that purpose. Sinks with faucets furnishing seawater will be installed for that purpose.

⑦A place for removing the entrails of large fish and disposing of them as garbage will be provided near the place for sale of large fish. (It will be obligatory for the persons who remove the entrails to dispose of them in a responsible fashion by discarding them at the garbage collection point.)

(c) Required Area for the Fish Market

Presently some 300 to 400 fish vendors buy the fish and process it on the wharf apron and on the road from the entrance of the fishing port to the wharf. That being the case, as a minimum, an area equivalent to that of the wharf apron and that of the road must be provided at the fish market in order to elimination the congestion at the fishing port.

That area is as follows:

Apron area: 43.5 m × 7.5 m = 326.25 m^2
(not including the artisanal fishing boats part of the wharf)
Road area: 8.0 m × 6.0 m = 48.0 m^2
Total: 374.25 m^2

Furthermore, the buying and selling of the fish will take place simultaneously with landing of the catches over a period of 5 hours from 8 o'clock in the morning to 1 o'clock in the afternoon. Since the buying and selling of fish depends on the landed catches, the market depends on the number of fishing boats bringing in their catches. That being the case, we have determined the number of places at the fish market for sale of fish on the basis of the number of fishing boats landing their catches each day and the volume of those catches and have calculated the necessary area at the fish market as follows on that basis.

For the volume sold at one place in the fish market we have used the average value of one catch. As for the amount of time it takes to sell the fish, we have assumed in the case of small fish that it takes 2.7 hours to sell 1,000 kg in view of the locally measured value of approximately 4 hours to sell 1,500 kg. According to what was observed during the field survey, 1 to 2 fishing boats a day land catches of large fish. That being the case, for our calculations we have assumed that one larger industrial fishing boat and one artisanal fishing boat each land a catch of large fish each day.

Area at the fish market for sale of small fish
* Number of places for sale of the catches of industrial fishing boats
: Obtained from the number of landing and volume of catches.

Number of place at the fish market = (2.7 hours × 917 kg ÷ 1000 kg) × (8 −1) boats ÷ 5 hours

= 3.47 4 (rounded off)

Volume of catch of industrial fishing boat: 917 kg of small fish (average value for one fishing trip)

Since the volume of a fish case used for sale of the fish is 0.5 m^3 (1.0 × 1.0 × 0.5 m), the quantity of fish that can be accommodated in a case is approximately 250 to 300 kg (with use of water and ice for protection against damage and keeping the fish fresh). That being the case, the number of such cases needed is calculated as follows:

917 kg ÷ (250~300 kg) = 3.7~3.1 cases 4 (rounded off)

Therefore the required area to accommodate that number of fish cases is 1.0 m^2 × 4 = 4 m^2, or a square space 2 m on a side.

If one also takes into account the space for the fish vendors themselves, the space requirement becomes 4 × 4 m^2 = 16 m^2. That means that for each place in the fish market for sale of small fish an area of 16 m^2 is needed, the number of such places being four in all.

* Number of places in the fish market for sale of fish from artisanal fishing boats

: Obtained from the number of catches landed and the volume of each catch.

Number of places in the fish market = (2.7 hours × 166 kg/1000 kg) × (9 −1) boats ÷ 5 hours

= 0.7 1 (rounded off)

Volume of catch of artisanal fishing boats: 166 kg of small fish (average value for one fishing trip)

Since the volume of a fish case used for sale of the fish is 0.5 m^3 (1.0 × 1.0 × 0.5 m), the quantity of fish that can be accommodated in a case is approximately 250 to 300 kg (with use of water and ice for protection against damage and keeping the fish fresh). That being the case, the number of such cases needed is calculated as follows:

166 kg ÷ (250~300 kg) = 0.7~0.6 cases 1 case (rounded off)

Therefore the area needed for placement of the cold-insulation fish cases is 1.0 $m^2 \times 1 = 1\ m^2$, i.e. a square space 1 meter on a side. If one also takes into account the space for the fish venders themselves, the space requirement becomes $3 \times 3\ m^2 = 9\ m^2$. That means that an area of 9 m^2 is needed for each place in the fish market for sale of small fish from artisanal fishing boats. Considering, in addition to that, the fact that during the field survey we observed 2 to 3 artisanal fishing boats a day that returned to port in the evening with fish that were landed and put into plastic fish containers to keep for sale the next day, it has been decided to provide three such places at the fish market for sale of the catches of artisanal fishing boats.

Area for Sale of Large Fish

We have taken the required area for sale of large fish (tuna) as the space needed for laying out the fish themselves. Assuming large fish catches each day from one artisanal fishing boat and one industrial fishing boat, the volume of catch is as follows as the average per fishing trip:

Volume of large-fish catch = 536 kg per larger industrial-type boat sortie +
125 kg per small artisanal fishing boat sortie
= 661 kg

Applying the calculation of the area for the fish handling shed, the required area for the place in the fish market for sale of large fish is obtained by the following formula:

$S = N \div (R \times \alpha \times P)$

Where: N is the planned quantity handled per day (661 kg)
P is the quantity handled per unit area (bulk: 27 kg/m^2)
R is the turnover (2 times)
α is the occupancy rate (0.6)
(from Fishing Port Planning Guide)

$S = 661\ kg \div (2 \times 0.6 \times 27\ kg) = 20.4$ 20 m^2

With provision of a 2.0 m passage between the different sales places in the fish market and with a layout of the fish market as indicated in Figure 2.3.3-13, the area of the market including fish processing facility area (1m width) will be 8 m×42.7 m = 341.6 m^2.

(d) Structural Description

The perimeter of the buildings will be opened, only processing area will consist of 1.2 m CB waist-high walls with sink.

Foundation:	Isolated foundation
Structural Skeleton:	RC structure
Roof:	Slate covering on steel-frame structure
Floors:	Concrete with trowel finis

(e) Other Facilities

Electrical equipment: Installation of 75 lux lighting fixtures for the work.

(f) Equipment Planning

a) Water Supply

Supply of seawater for washing the fish in processing from an overhead water tank installed on the roof of the ice-making machine building.

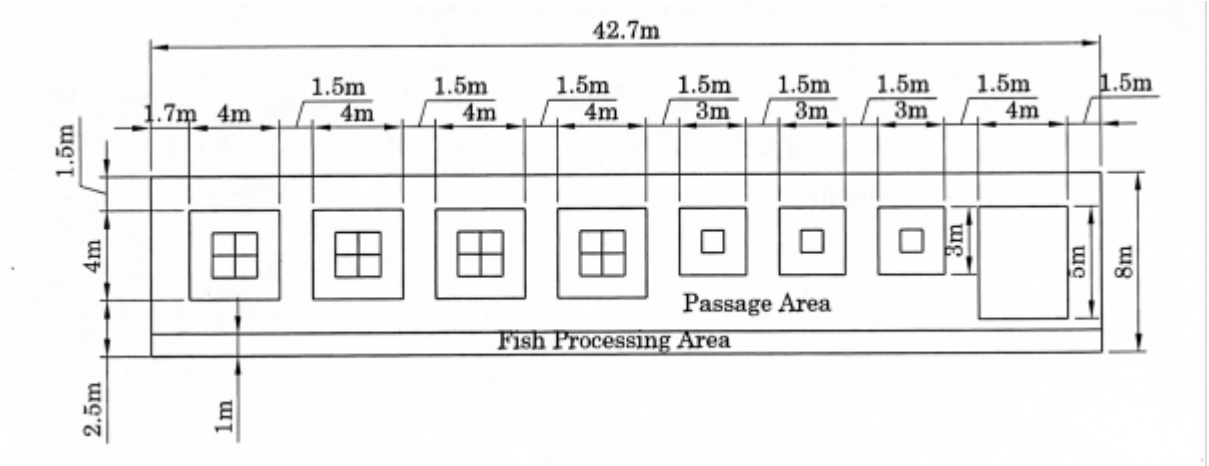


Figure2.2.2-13 Layout Plan of Fish Market

3) Ice-Making Facility Building

The building for accommodation of the ice-making machine and ice storage facility with a total floor space of approximate 315 m^2 will be located at the rear of the wharf.

It will be a 3-storey steel-frame building. The seawater intake pump will be installed on the ground floor, the ice storage facility and ice conveyance system on the second floor, and the ice-making machine, refrigerating machine and apparatus control panel, water storage tank for making ice, condenser and FRP elevated tank for seawater on the third floor.

From the ice-making machine, refrigerating machine, control panel and other equipment layouts, the building area will be as follows:

Ground floor:	105m^2	
Second floor:	105m^2	
Third floor:	105m^2	(Machine Room : 41.25m^2, Roof : 63.75m^2)
Total:	315m^2	

The structural skeleton will be as follows:

Foundation:	Isolated foundation
Body structure:	Reinforced Concrete Structure
Roof:	Deck-plate concrete-laid, asphalt waterproofing
Walls:	Partly block, mortar and paint finish, folded plate

4) Fishing Gear Lockers

In the previous project 25 lockers each measuring 1.7 m × 2.2 m = 3.74 m^2 were provided for accommodation of outboard engines of artisanal fishing boat and fishing gear. Presently all 25 of them are in use, 15 of them by industrial fishing boats and the other 10 by artisanal fishing boats. Besides fishing gear, the lockers of industrial fishing boats also accommodate fishing boat spare parts. Not only fishing gear but also cold-insulation fish cases, outboard engines, etc. are stored in the lockers of artisanal fishing boats. The lockers of both categories of fishing boats are all full most of the time.

(a) The Number of New Lockers provided

In the interviews in our local survey many of the fishing boat owners who do not yet have a fishing gear locker expressed the strong desire to be able to use one. The present 25 lockers mean that only 32% of the total of 77 fishing boats presently using Praia Fishing Port are able to use such lockers.

The only available place for construction of new fishing gear lockers is the existing fish handling shed, a part of which could be converted to that purpose. It would be possible to provide 22 fishing gear lockers there.

It has therefore been decided to do that and thereby raise the rate of provision of lockers to 61% (61% of the fishing boats then having one).

(b) Necessary Area Per Locker

Judging from the situation regarding how the existing lockers are being used, the new lockers will be given the same size as them, 3.74 m^2. The total necessary area will therefore be 3.74 m^2 × 22 lockers = 82.28 m^2.

(c) Construction Site of Lockers

The lay-by wharf will be located on the No. 3 wharf side, and in terms of lines of movement, too, it is desirable that the new lockers be constructed on the lay-by wharf side. Furthermore, since it would be difficult to provide an area for that purpose at the extension part of the wharf, it has been decided to provide the new lockers using a part of the existing fish handling shed. The layout of the new fishing gear lockers will be as indicated in Figure 2.2.2-14.

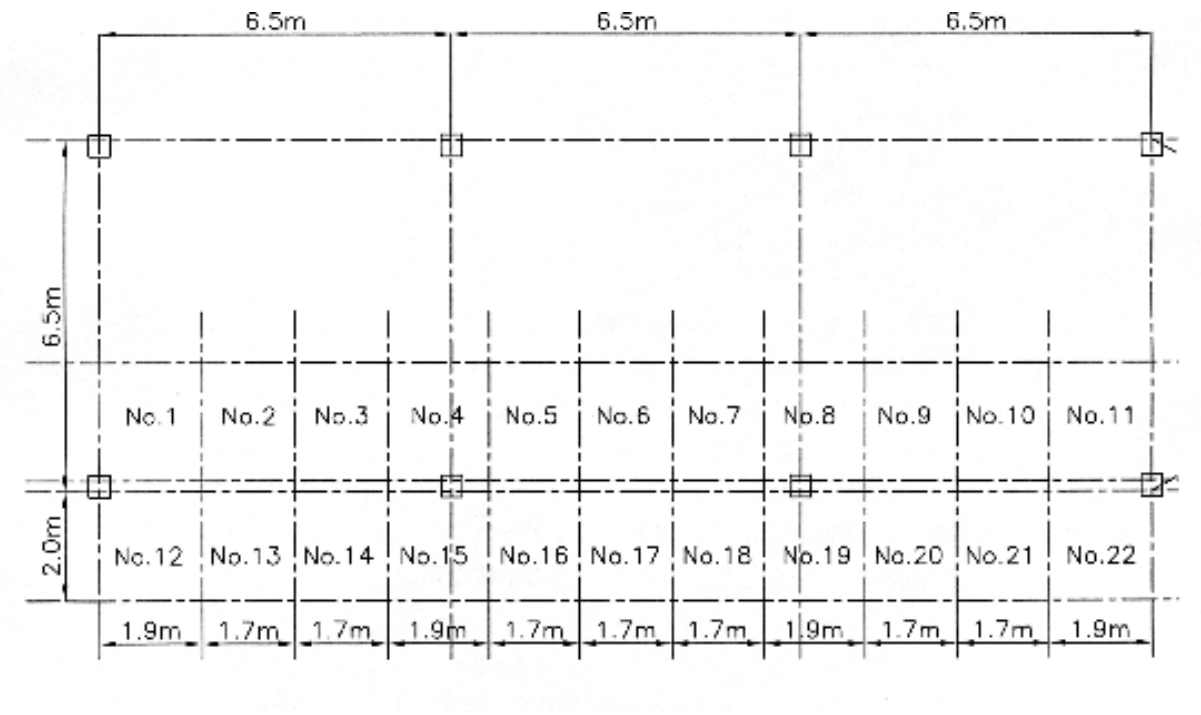


Figure 2.2.2-14 Layout of the New Fishing Gear Lockers

(4) Related Equipment

The following related equipment will be provided for landing of catches at the wharf and for use at the fish market:

1) Fish containers for Landing the Catches

The containers will be used not only for landing the catches from the fishing boats but also for keeping the fish at the fish market.

The numbers and dimension are as follows.

Dimension: 560×390×283mmH
Capacity: Approximately 40 liters
Material: Plastic
Quantity: 72 units

2) Fish Cases for Sale at the Fish Market

Dimension: 1 m × 1 m × 0.5 mH
Capacity: 0.5 m^3
Material: plastic
Quantity: 19 units

3) Cold-Insulation Fish Cases for Initial Storage

To be used for keeping the fish of the catches landed in the evening till the next day.

Dimension: 1 m × 1 m × 1 mH
Capacity: 1.0 m^3
Material: Plastic
Quantity: 5 units

4) 2-Wheel Carts for Conveyance of Small Fish

Load capacity: 150 kg
Material: Pneumatic tire wheels
Quantity: 7 units

5) Push Hand Carts for Conveyance of Large Fish

Material: stainless-steel load platform

Quantity: 2 units

6) Pallets for Sale of Large Fish at the Fish Market

Dimensions: 1 m × 1 m × 14 cm H

Material: resin

Quantity: 20 units (20 m^2)

7) Scales for Weighing Catches

Weighing capacity: 100 kg

Material: stainless steel

Quantity: 4 units

8) Labor Hose for Cleaning

25mmφ×20m 2pcs

(5) Summary of the Project

A summary of the facilities to be constructed in the project is given in Tables 2.2.2-23 and 2.2.2-24.

Table 2.2.2-23 Summary of Planned Facilities (1)

Designation of facility	Scale	Out line
Land reclamation	Approx.1800m2	
Breakwater (with one light beacon)	70 m	Block-type vertical structure
Wharf (water depth of −3.0 m)	80 m	Cellular block type

Table 2.2.2-24 Summary of Planned Facilities (2)

Designation of facility	Planned scale	Planned content
Fish market	341.6 m2	8m × 42.7 m
Ice-making facility building	315.0 m2	7.5 m × 14.0m (3-storey building)
Ice-making equipment	Ice-making machine Ice storage facility Emergency generator	5 t/day × 2 units 30 t × 1 unit 50 KVA × 1 unit
Concrete paving	Wharf apron 400 m2	Concrete paving
Road inside fishing port	Approx. 930 m2	Concrete paving
Parking area	210 m2	Concrete paving
Lighting within the fishing port	HL-400W, 4 points HL-400W × 2, 1 point FL-40W × 2-32points FL-40W-18points IL-60W-10points	Outdoor lamps Security lamp Lamps for fish-market Lamps for Ice-Making Facility Building Lamps for Ice-Stocker

A summary of the related equipment is given in Table 2.2.2-25 below:

Table 2.2.2.25 Summary of Related Equipment to be Provided

Designation of the equipment	Specification	Quantity
Fish container	Capacity: approx. 40 liters	72
Fish case	Capacity: 0.5 m^3	19
Cold-insulation fish case	Capacity: 1.0 m^3	5
2-wheel cart	Load capacity: 100 kg	7
Push hand cart	Load capacity: 500 kg	2
Pallets for sale of large fish	Dimensions: 1 m × 1 m × 14 cm (height)	20
Scales	Weighing capacity: 100 kg	4
Laver hose	25mmφ×20m	2

2.2.3 Basic Design Drawings

The following is a list of the basic design drawings:

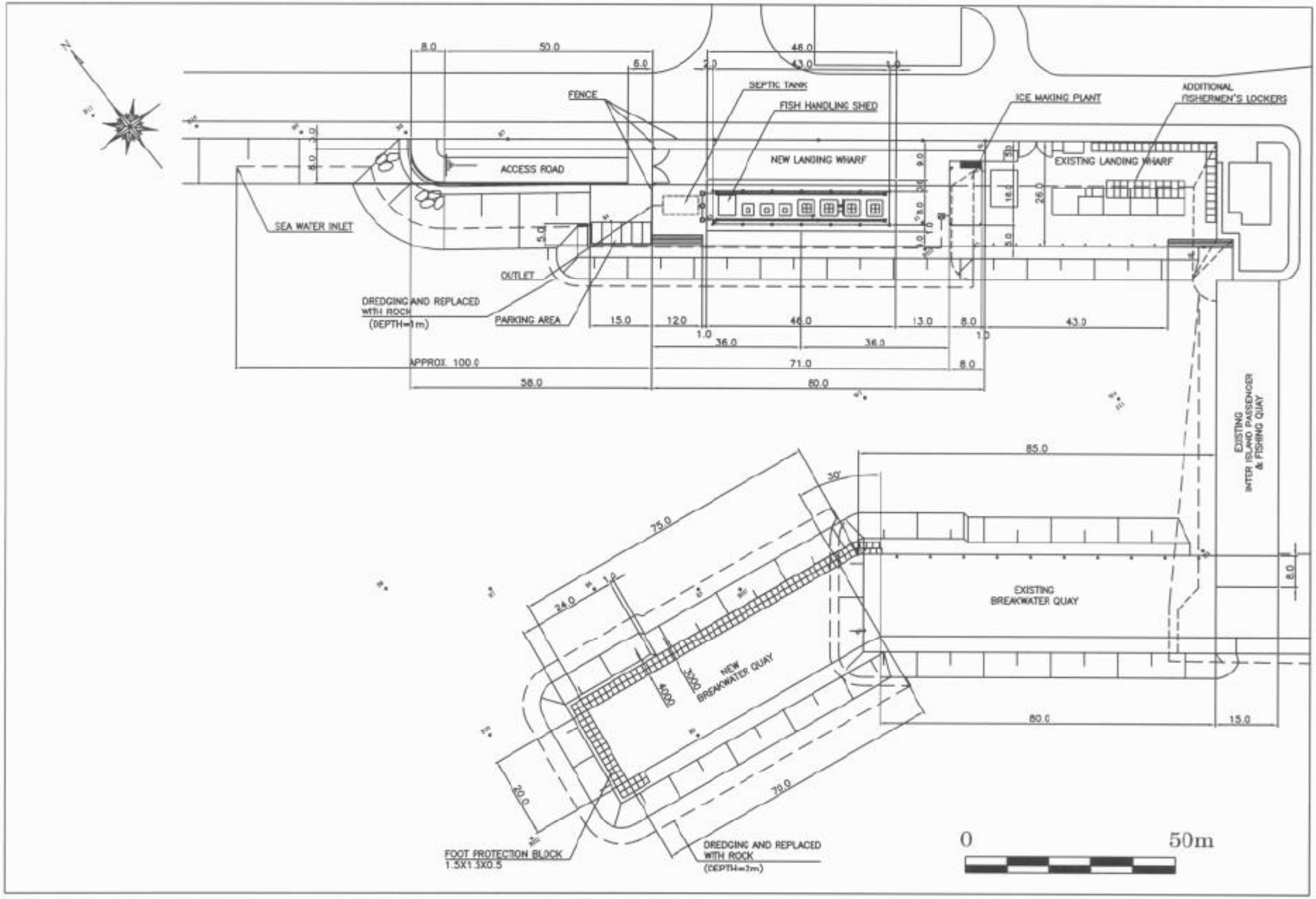


Figure 2.2.3-1 Overall Project Ground Plan

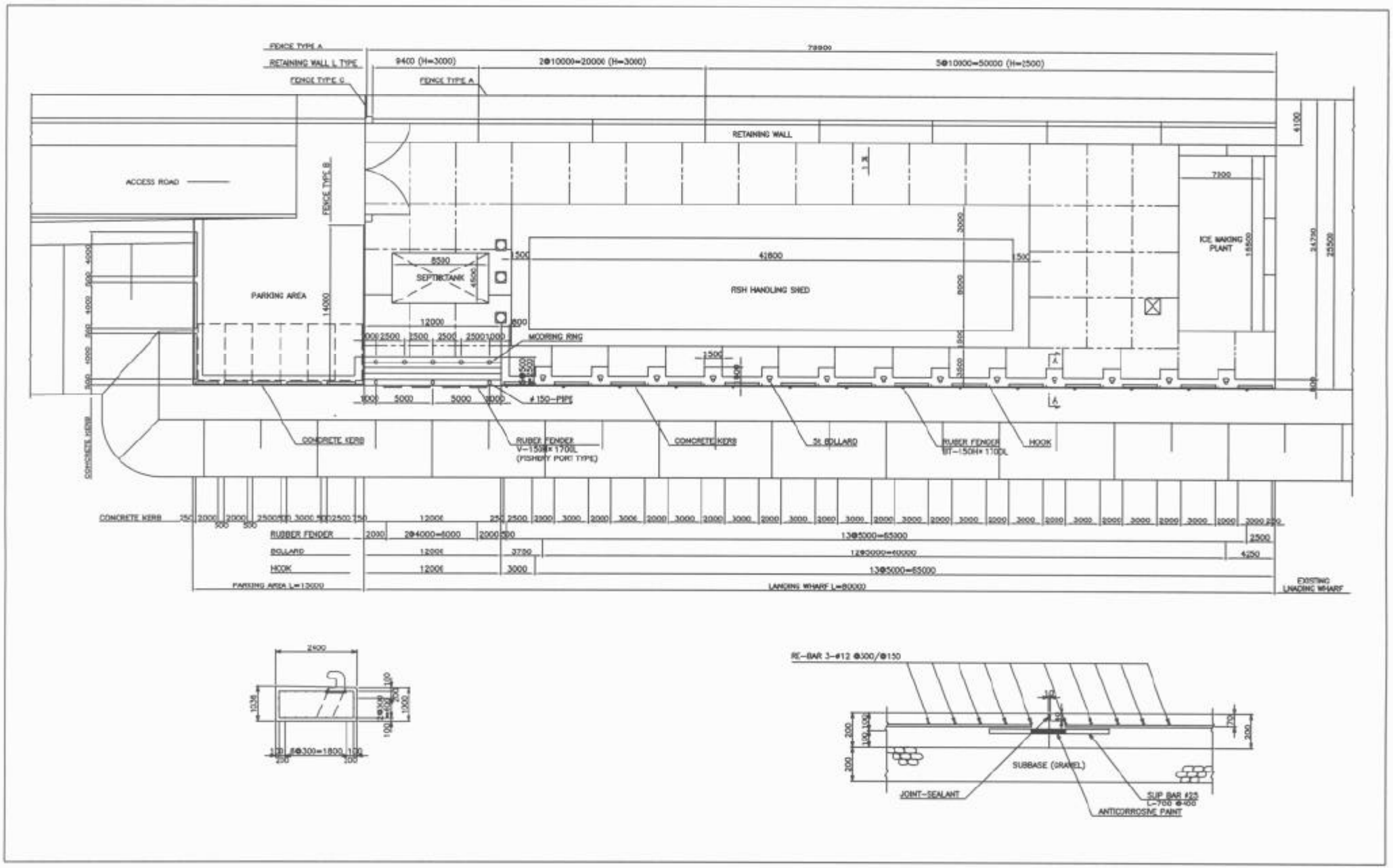


Figure 2.2.3-2 Facility Layout Ground Plan

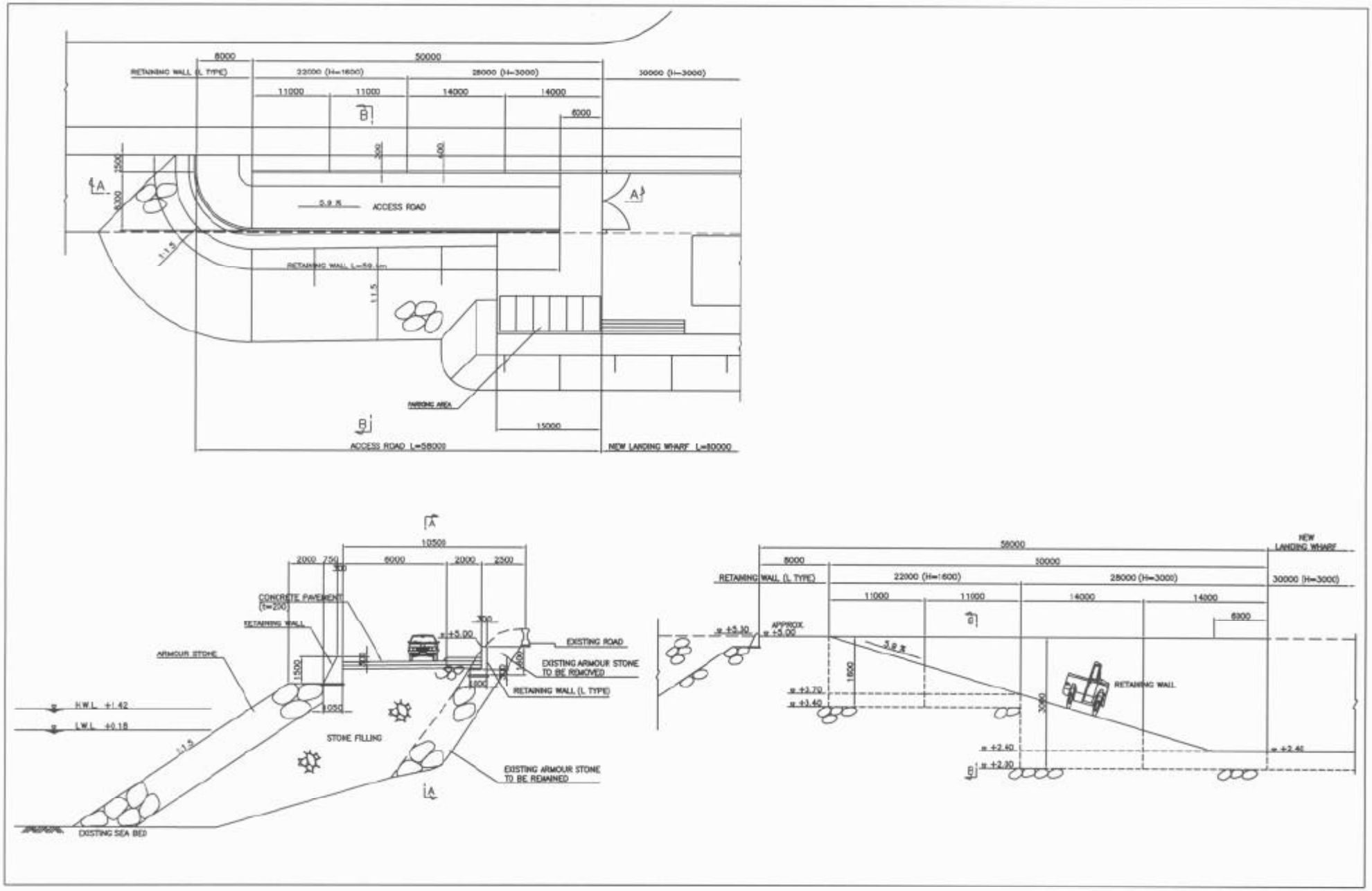


Figure 2.2.3-3 Cross Section of Revetment

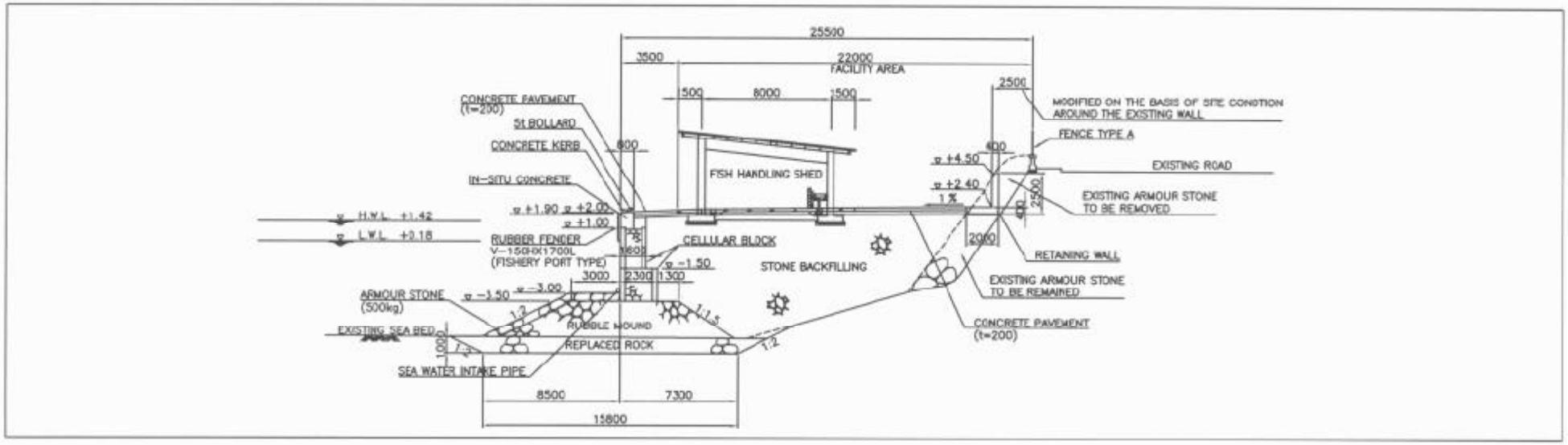


Figure 2.3.3-4 Cross Section of Wharf

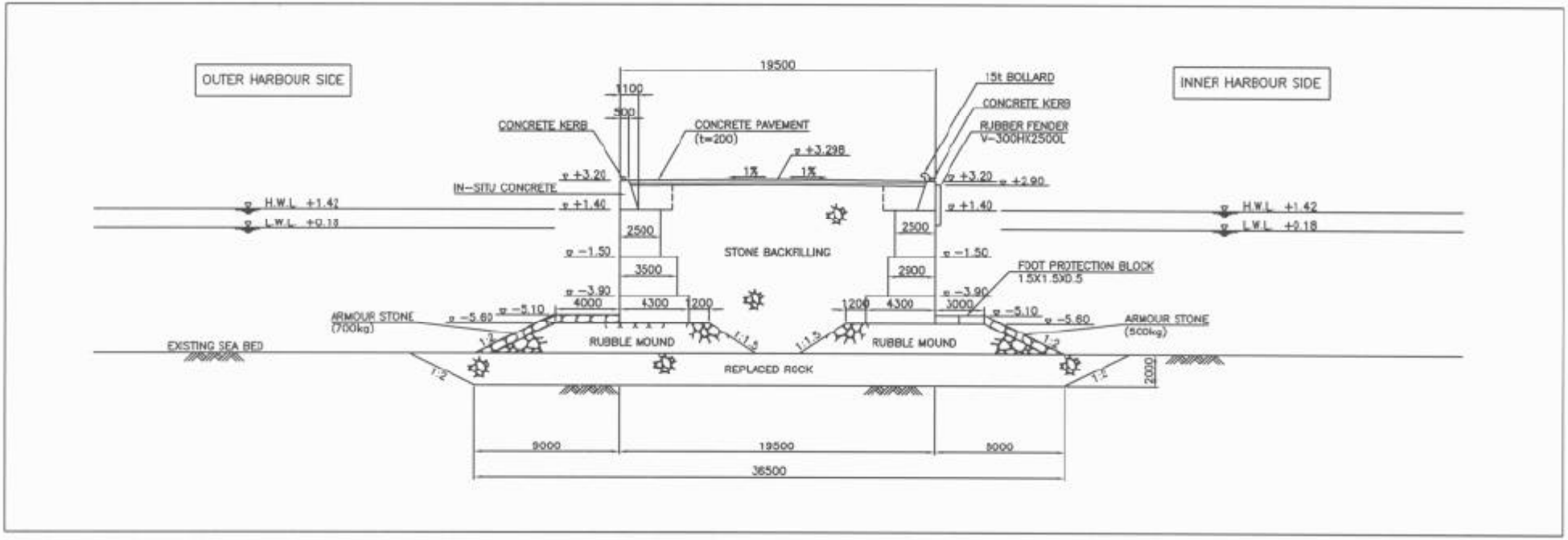


Figure 2.3.3-5 Cross Section of Breakwater

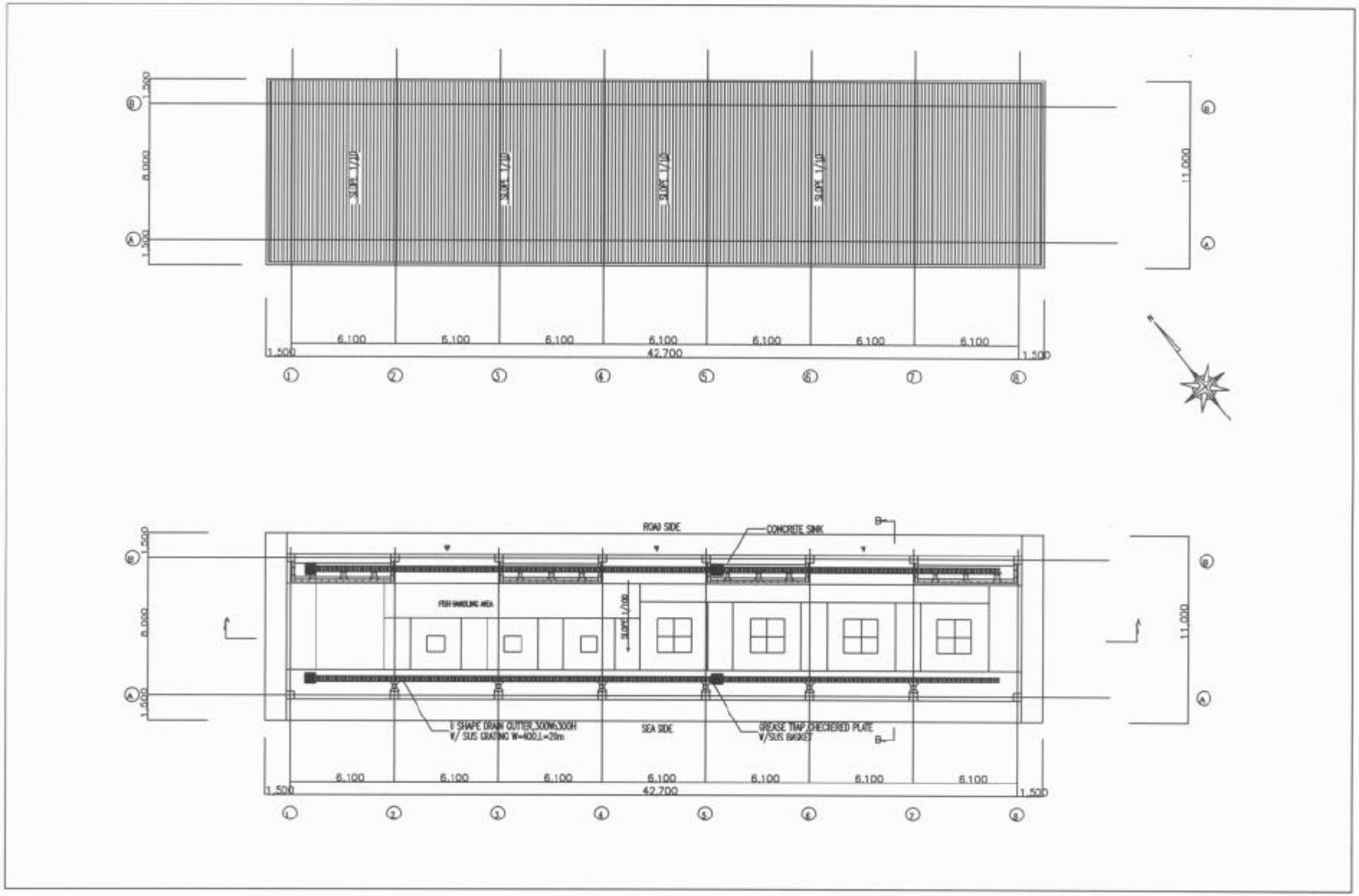


Figure 2.2.3-6 Plan of Fish Market

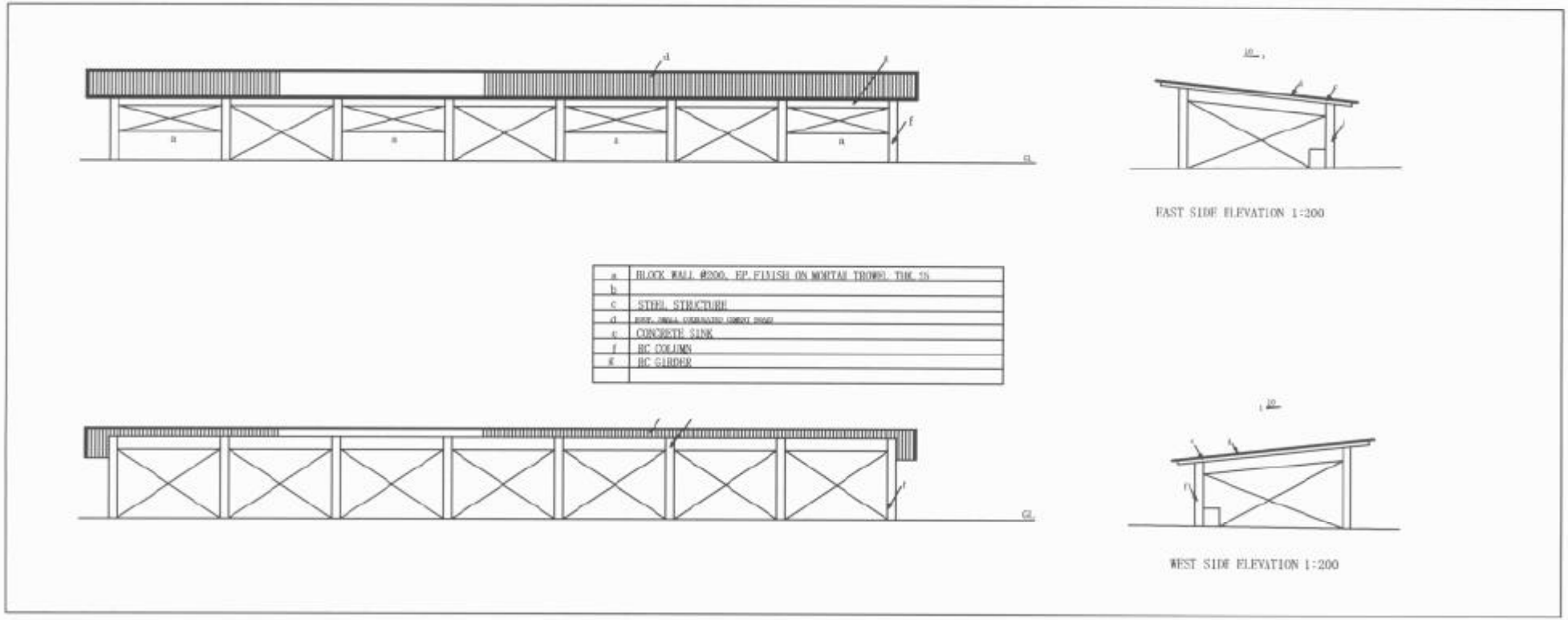


Figure 2.2.3-7 Elevation of Fish Market

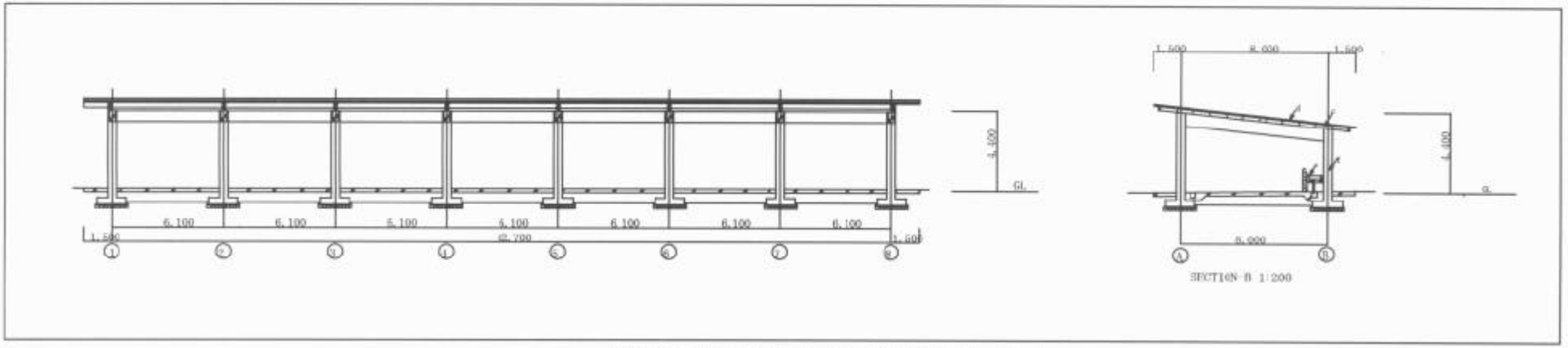


Figure 2.2.3-8 Section of Fish Market

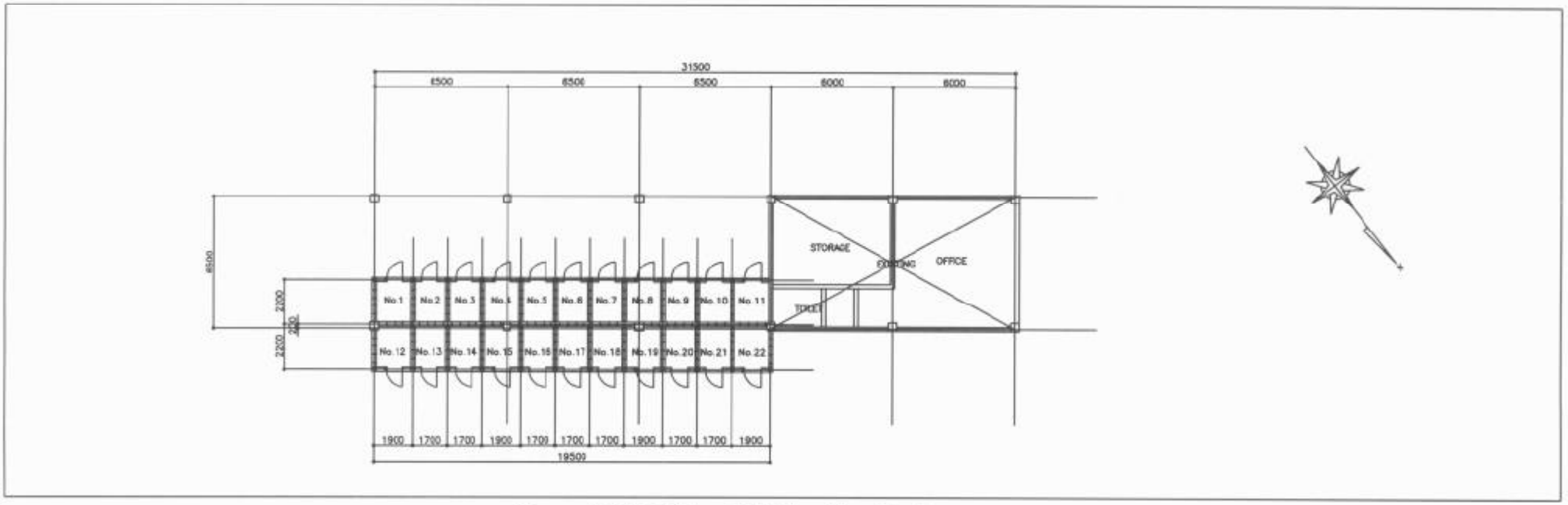


Figure 2.2.3-9 Plan of Fishing Gear Lockers

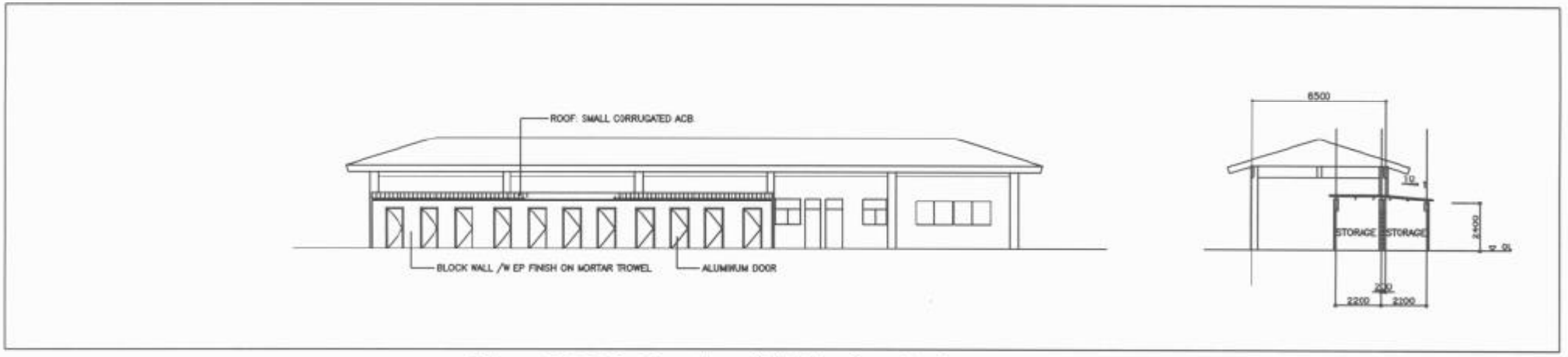


Figure 2.2.3-10 Elevation of Fishing Gear Lockers

EXTERIOR FINISH SCHEDULE	
ROOF	SMALL CORRUGATED CEMENT BOARD
ROOF BALCONY	CONCRETE TROWEL
WALL	MORTAR TROWEL /W EP
SKIRTING	MORTAR TROWEL
STAIR	STEEL /W CP

INTERIOR FINISH SCHEDULE

	ROOM NAME	FLOOR	SKIRTING	WALL	CEILING
3F	MACHINE ROOM	CONCRETE TROWEL	MORTAR TROWEL	EXPOSED BLOCK WALL	EXPOSED CEMENT BOARD
2F	ICE STORAGE	CONCRETE TROWEL	——	INSULATION PANEL	INSULATION PANEL
1F	MACHINE ROOM	CONCRETE TROWEL	——	EXPOSED BLOCK WALL	FAIR FACED CONCRETE

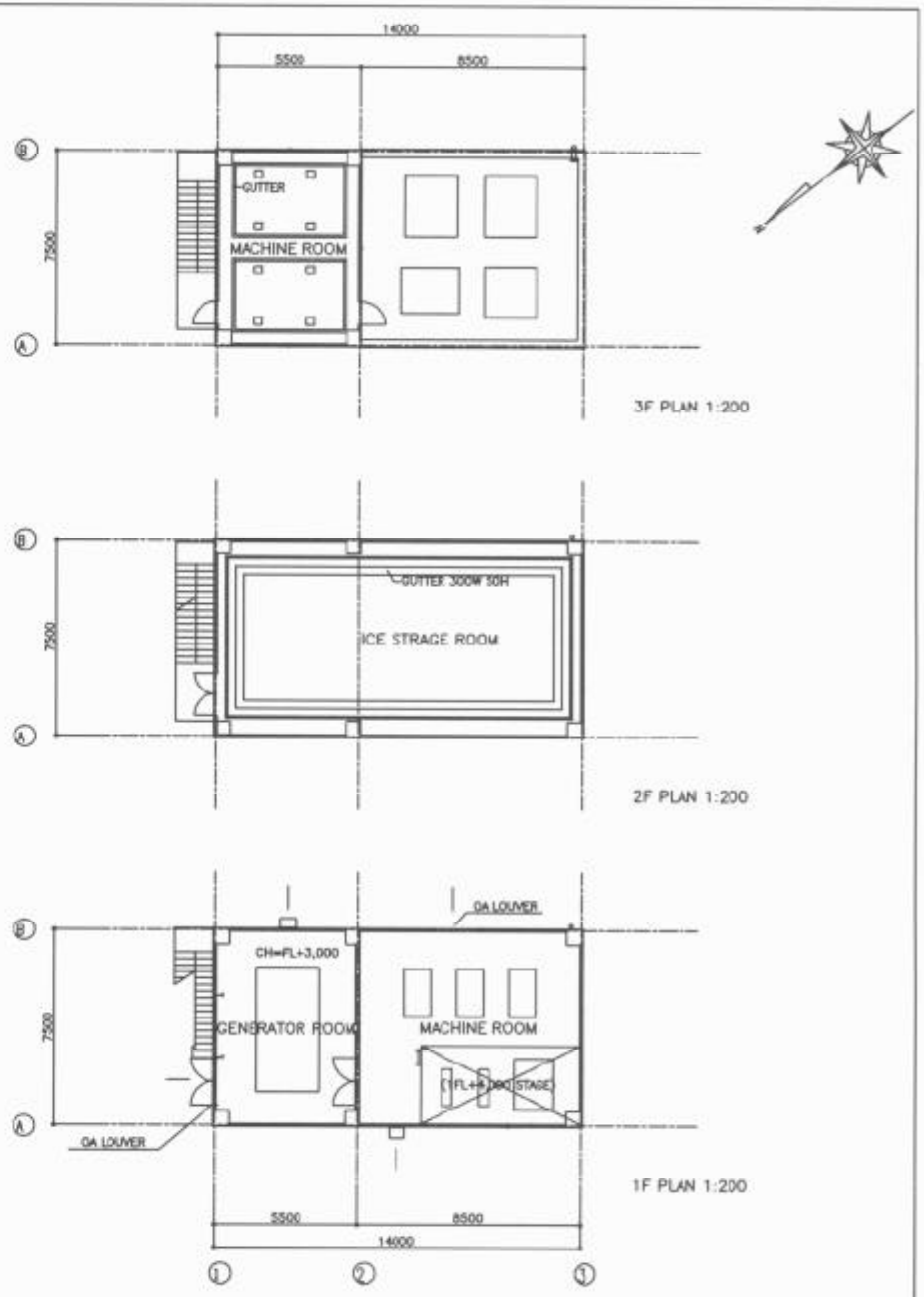


Figure 2.2.3-11 Plan of Ice-Making Facility Building

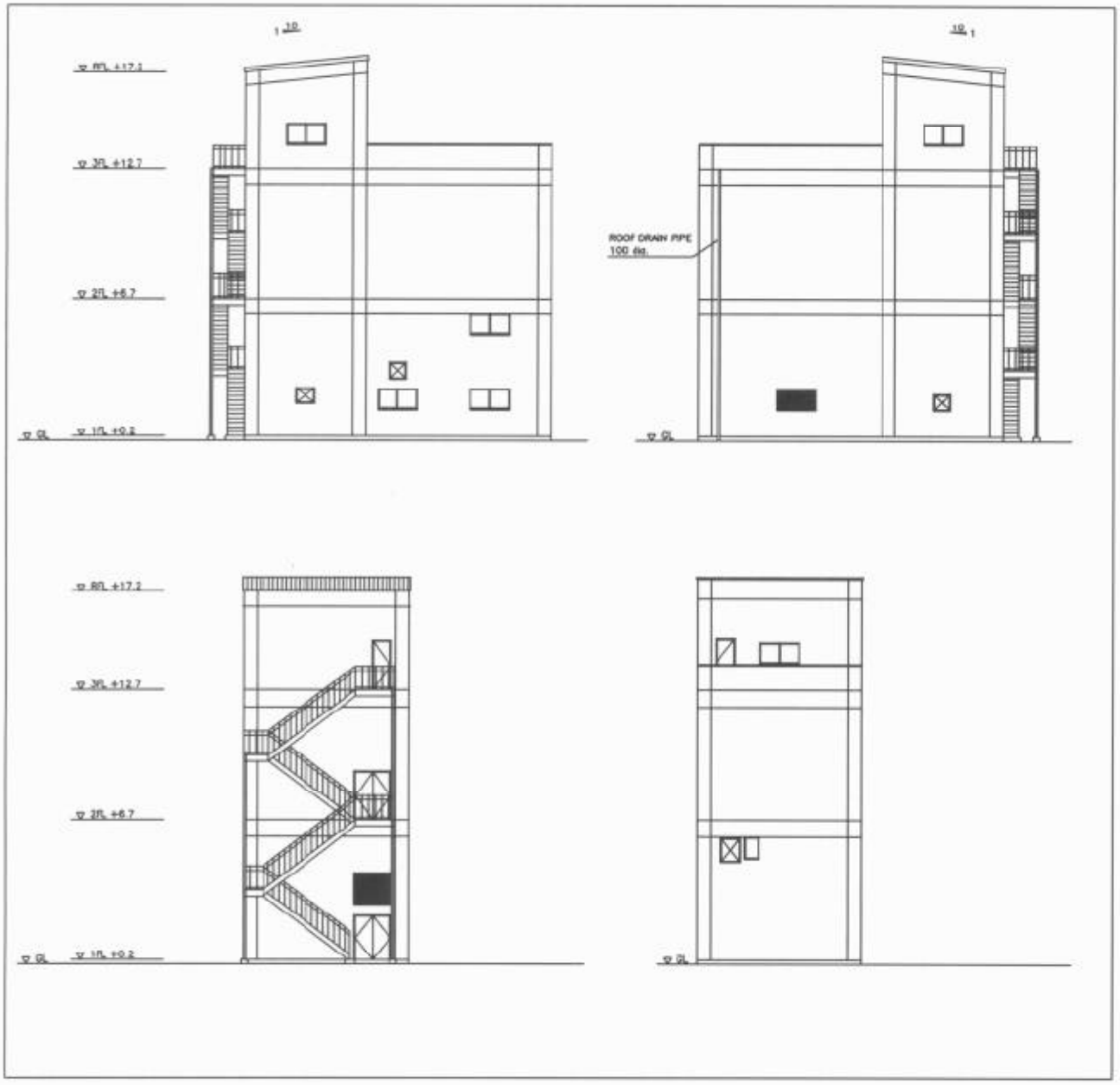


Figure 2.2.3-12 Elevation of Ice-Making Facility Building

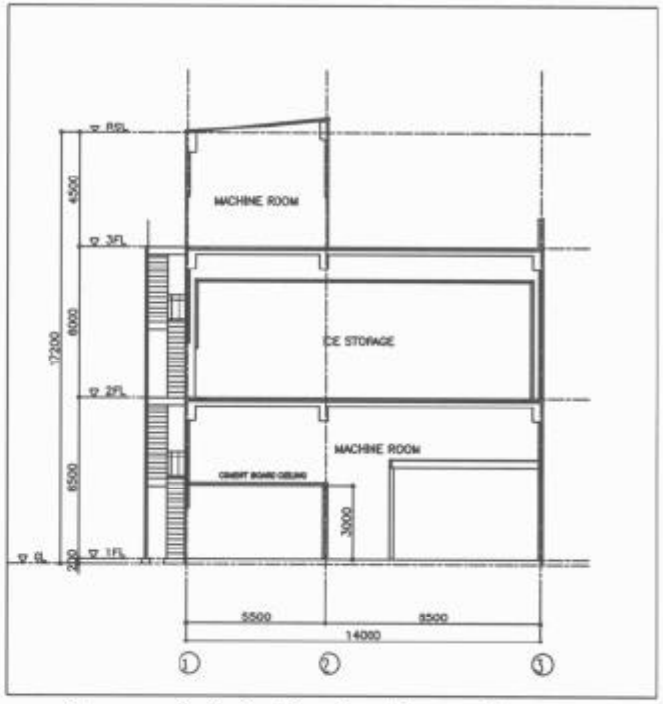


Figure 2.2.3-13 Section of Ice-Making Facility Building

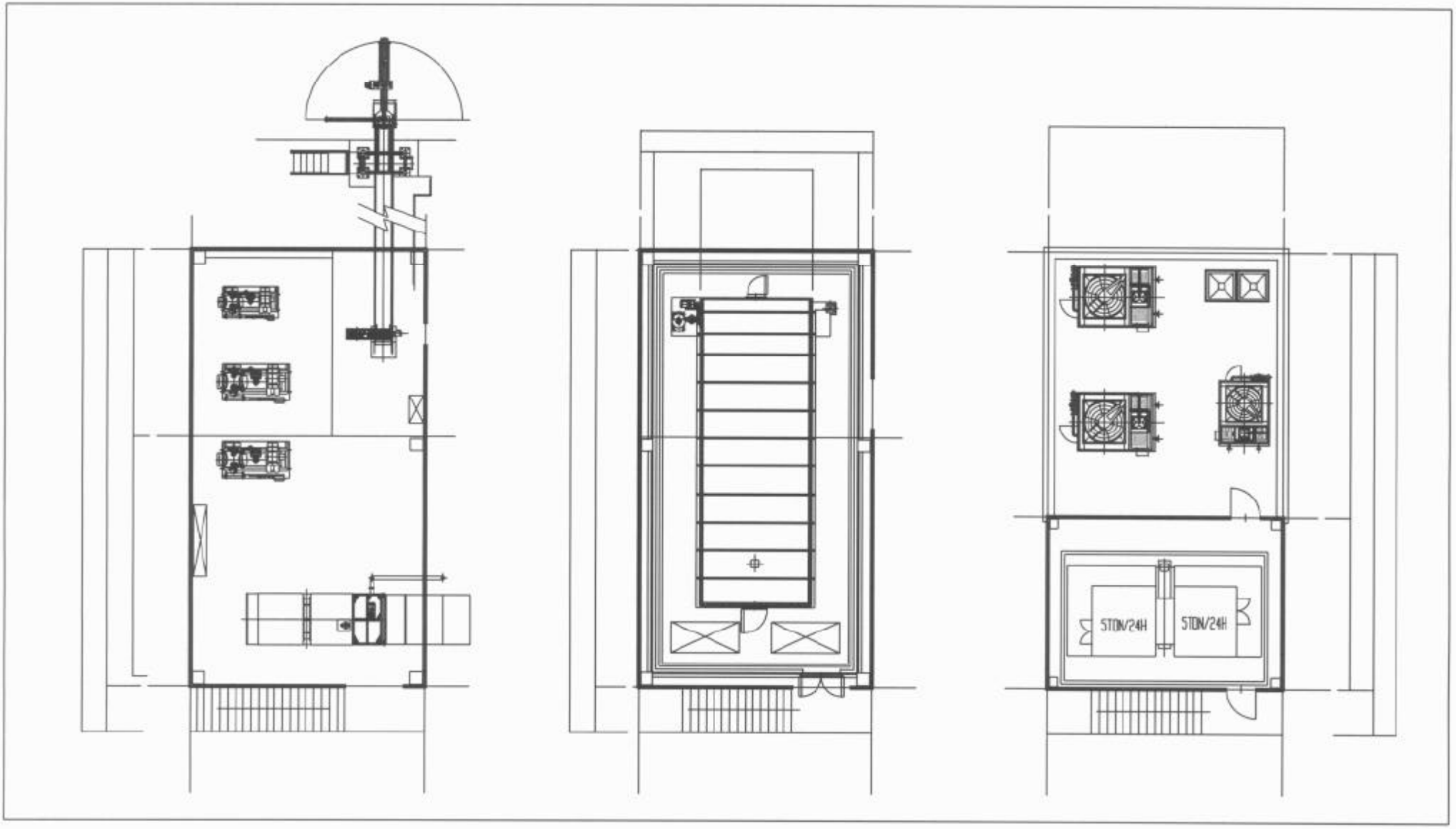


Figure 2.2.2-14 Planning Diagram of Ice-Making Apparatus

2.2.4 Implementation Plan

(1) Implementation Concept

1) Basic Concept

① For the implementation of the Project for Extension of Praia Fishing Port, after the Exchange of Notes (E/N) is signed between the Government of Japan and the Government of Cape Verde, a contract for undertaking consulting services will be concluded between the Government of Cape Verde and the Japanese Consulting Firm.

② The Consulting Firm will prepare all the documents required for the tender and concluding the contract such as the drawings of the complex facilities, technical specifications, cost estimations and so forth. After the approval of these documents by the Government of Cape Verde, the contractor for this Project will be selected from among Japanese construction companies by examining their pre-qualifications and tender procedures.

③ The construction work will be performed by the selected construction company in accordance with the construction contract concluded between the Government of Cape Verde and the Construction Company.

④ The construction period is expected to last for phase-1, 12 (twelve) months, and phase-2, 8 (eight) months, totally 20 (twenty) months taking into considerations the scale and complexities of the Project as well as the site conditions.

2) Implementation Concept

① The Praia Fishing Port to be built by the Project is a fishing port to be built on the reclaimed land in the waterfront. The construction of wharf and breakwater/quay will form the major components of the Project in the port. Utmost efforts will be made to minimize the cost and shorten the construction period. Though a sand layer is presented in the seabed layer, good quality reclamation material will be used and adequately compacted for measures against land subsidence on the reclaimed area.

② Since construction companies in Cape Verde have hardly had any experience in undertaking large scale projects, particularly on marine construction, a Japanese company will be responsible for construction work by providing skilled engineers and the relevant machinery. However, some works such as the pavement of roads, the installation of furniture, electrical wiring, water supply and laying sewage pipelines will be undertaken by local firms as much as possible.

③ Since Cape Verde has limited experience in the field of site investigation, some of the works such as sounding surveys for environmental monitoring will be consigned to local firms, as was already done during the basic design study. Such work will be carried out under the instruction of the Japanese consultant firm.

④ The ice-making/storage equipment will be procured from Japan and assembled in Cape Verde under the instruction and supervision of Japanese experts.

3) Executing Agency in the Government of Cape Verde

Agencies which will be involved in the Project on the part of the Government of Cape Verde will be as follows.

① Responsible agency: Ministry of Agriculture and Fisheries (MOAF)
② Responsible agency for Project implementation: Ditto
③ Responsible agency for the supervision of construction work:
National Institute of Fisheries Development
④ Management authority of the Fishing Port:
National Institute of Fisheries Development

(2) Implementation Conditions

1) Conditions for Construction

(a) Construction Company

Construction companies of Cape Verde may be assigned as sub-contractors under the supervision of the Japanese construction company.

(b) Construction Machinery

Construction machinery such as backhoes, tire shovels, bulldozers, dump trucks, etc. will be available in Cape Verde. But the number of machinery is limited. The equipment which cannot be made available in the Cape Verde will be procured from Europe.

(c) Labor

Skilled experts will be required for the construction of ice-making plants. Japanese experts will be dispatched to Cape Verde to undertake this responsibility. Operation of working boats and placing work of the cellular blocks and concrete blocks will be required Japanese experts. Common skilled labor will be employed in Praia, and Foreman for each construction work will be employed from Portuguese.

(d) Goods and Materials to be Imported

Aggregate materials for road and concrete and blocks for construction are made available in Cape Verde, while other materials such as cement, sand and iron bars will be imported from Europe. However ice-making machines and ice storage equipment will be imported from Japan. The quality and durability of such equipment and materials will be carefully examined when importers are selected. There might be other materials and equipment that will be procured from local factories, agents and shops, although the stocks of these goods may not be always available and adequate. Therefore, a stock control will be carefully carried out in close consultation with local agents to ensure their stable procurement.

(e) Safety Control

This Project will construct and extend the existing fishing port. For the extension of breakwater and wharf it is necessary to clearly mark the construction area and the site with buoys and other signs to secure the safe navigation of fishing boats and commercial vessels. For the construction of land facilities, the roads and routes which will be used for the transport of materials and equipment should be clearly indicated to avoid to give any nuisance to the city residents.

2) Care for Construction Work

① An appropriate construction plan will be prepared taking into account

the natural conditions at the sites, especially sea conditions.

② Dispatch of the Japanese experts will be planned carefully in respect of the number of persons, the timing and duration in accordance with the progress of work.

③ Local equipment and material will be used as much as possible to minimize the cost for the procurement of such material and equipment from foreign countries.

④ The Project will involve a long term construction work and therefore special attention will be paid to fishing boats navigating in the construction sites.

(3) Scope of Works

Scope of work to be undertaken by the Government of Japan and the Republic of Cape Verde are divided as follows.

1) Scope of Work to be Undertaken by the Government of Japan

① Phase-1

Extension of breakwater/ quay
Extension of landing wharf
Construction of access road and parking area

② Phase-2

Construction of concrete pavement (Apron)
Construction of fish market
Construction of ice-making/storage facility
Construction of fishing gear lockers
Construction of lighting systems for security purpose

③ Equipment (Phase-2)

Ice-making /storage machines
Equipment for fish market and landing wharf
Generator (50KVA)

④ Soft Component (Phase-2)

Instruction of fishing port operation

2) Scope of Work to be undertaken by the Government of Cape Verde

Provision of services will be made available which will include utilities, e.g. electricity, water, telephone lines connected to the Project site.

(4) Consultant Supervision

It is the policy of the Government of Japan that a grant aid project will be implemented under the strict supervision of the Consulting Firm is fully aware of technical details of work during the whole period of the Project. The Consulting Firm will supervise the construction work through the close contact and communications with local engineers in regard to the design, inspection and schedule of work.

1) Supervisory Policies

① The time frame of the work will be strictly observed by establishing close contact and communications with the persons and organizations concerned on the part of Cape Verde to prevent any delay of work.

② Provision of prompt and appropriate guidance and advice will be essential for the contractor as to the construction of the facilities in compliance with the drawings and specifications agreed upon.

③ High priority will be accorded to the utilization of local materials and technologies.

④ The Project will ensure to promote the transfer of technology in the course of the construction and engineering work.

⑤ The Project will ensure to provide adequate advice and guidance regarding the maintenance of equipment and material delivered for the work.

2) Supervisory Work

(a) Preparation of a Contract

Provision of services will be provided by the Consulting Firm in relation to the selection of a contractor, determining the type of the contract, drafting the contract documents, evaluating the bills, and holding a contract awarding ceremony.

(b) Evaluation and Approval of the Drawings of Retail Shops.

Evaluation will be carried out as to the drawings of a retail shop, materials to be used, and equipment.

(c) Instruction on Construction Work

Reviewing construction plan and schedules, provides constructions to the contractor and reporting the progress of work to the Government of Cape Verde.

(d) Process of Payment

Evaluation and approval of the bills for the payment to the contractor during the work will be carried out taking into account the progress of work and upon completion of work.

(e) Inspection and Witness

The Consulting Firm will inspect, when necessary, the work in progress and give appropriate instructions to the contractor. The Consulting Firm, having confirmed that the work has been completed and the contract fulfilled, will witness the delivery of the Project and confirm the Government's acceptance. The consultant will also report to the Government of Japan about the progress of work, payment procedures and status, and the delivery of facilities completed.

(f) Soft Component

The Consultant will provide an advice and guidance on fishing port operation to the staffs of fishing port administration, fishermen and fish vendors.

(5) Procurement Plan

In the process of procuring materials and equipment necessary for the Project, special attention will be paid to the following.

1) Procurement Policy

Priority should be given to the use of locally available material and equipment if the quality and quantities will meet the need of the Project work. In this way the procurement cost from Japan will be minimized.

(a) Procurement from Japan

A detailed procurement and transport schedule must be prepared well in advance for the material and equipment to be made available from Japan. This normally will take a long period of time before manufacturing, packing

and shipment of goods until to be completed. Construction machinery will have to be procured from Japan or third countries when they are not available in the country.

(b) Local Procurement

Rubble stones and aggregates which can be locally procured should be carefully examined as to the quarry site, quality and transport capacities.

(c) Cost

The cost is an important element to be taken into account in the selection of materials from local sources, neighboring countries and Japan. It should be borne in mind that the prices of procurement from Japan include the charges for packing, transport, insurance, while port charges and taxes are to be exempted. On the basis of the above principles and rules, the following plans will be established for the procurement of construction materials and equipment.

2) Procurement Items

(a) Materials

From local source	:	rubble stones, aggregates, timbers, cement, steel bars, materials for water supply and discharge, material for power supply;
From Japan	:	fenders, navigation light, steel sheet piles, equipment for ice-making and storage plants, and other equipment;
From third countries	:	steel material, material for roof.

(b) Machinery

All machinery except for available in Cape Verde will be procured from third countries.

(6) Quality Control Plan

1) A quality Control of Material

About the material used for this construction, it shall manage according to fishing port construction common specifications (volume on national fishing port association), and shall be used by receiving prior manufacture recognition etc.

2) Mix Proportion of Concrete

Mixture of the concrete and mortar which are used for this construction will be decided upon mixture performance test. In the trial mixture, the strength of the concrete, mixture time, method of placing will be studied.

Moreover, an examination scorecard, a concrete on-the-strength management table, and management figures (X-R management figure etc.) are created, and maintenance of quality and management are performed.

3) A Road bed, A Quality Control of Subbase Course

The management standard for checking support intensity of a road bed part and subbase course part is set up.

On the basis of this, a prior examination is performed, construction dryness density, moisture content, and the number of times of roll are set up, and it manages as a construction standard.

(7) Implementation Schedule

Japan's grant aid program will follow normal project implementation schedule. After the Exchange of Notes (E/N) is signed between the two countries, a Japanese Consulting Firm will be appointed by the Government of Cape Verde and the consulting contract will be concluded between the Government and the consulting firm.

E/N will give details on the tender procedures, supervising and construction work. The Project will be implemented in accordance with the conditions stated in the E/N.

1) Preparation of Detailed Design Document

After the consulting contract has been concluded between the executing agency of Cape Verde and the Japanese Consulting Firm, the contract will be verified by the Government of Japan and the consultant will draw up detailed designs. In the detailed design the tender documents consisting of design drawings, technical specifications, instruction to tenderers, etc. will be prepared on the basis of the Basic Design Study. In the meantime, consultations will be held with the Government of Cape Verde regarding the details of the fishing port facilities and eventually the tender documents will be approved by the Government of Cape Verde. About 4 (four) months will be required for the preparation of a detailed design for the first and second phase, respectively.

2) Execution of Tender

The contractor (a Japanese construction company) who will be involved in the construction of the Project facilities will be selected through the tender. The tender procedures will be as follows: first invitations will be extended to interested tenders; acceptance of the tenders; examination of the pre-qualifications; evaluation of tender documents, submitting the tender, evaluation of the tender, designation of the contractor and conclusion of a construction contract. The whole procedure will take one and half months for each phase.

3) Execution of Construction Work

Construction work will be started after the conclusion of the contract and verification by the Government of Japan. The construction period is expected to last about 21 months (Phase-1: 12 month, Phase-2: 12months) considering the size of the Project and its complexities, including the problems relating to the local construction conditions, unforeseen situations which might occur in the course of the work.

Figure 3.1.1 shows the implementation schedule covering from the Exchange of Notes to the completion of Project.

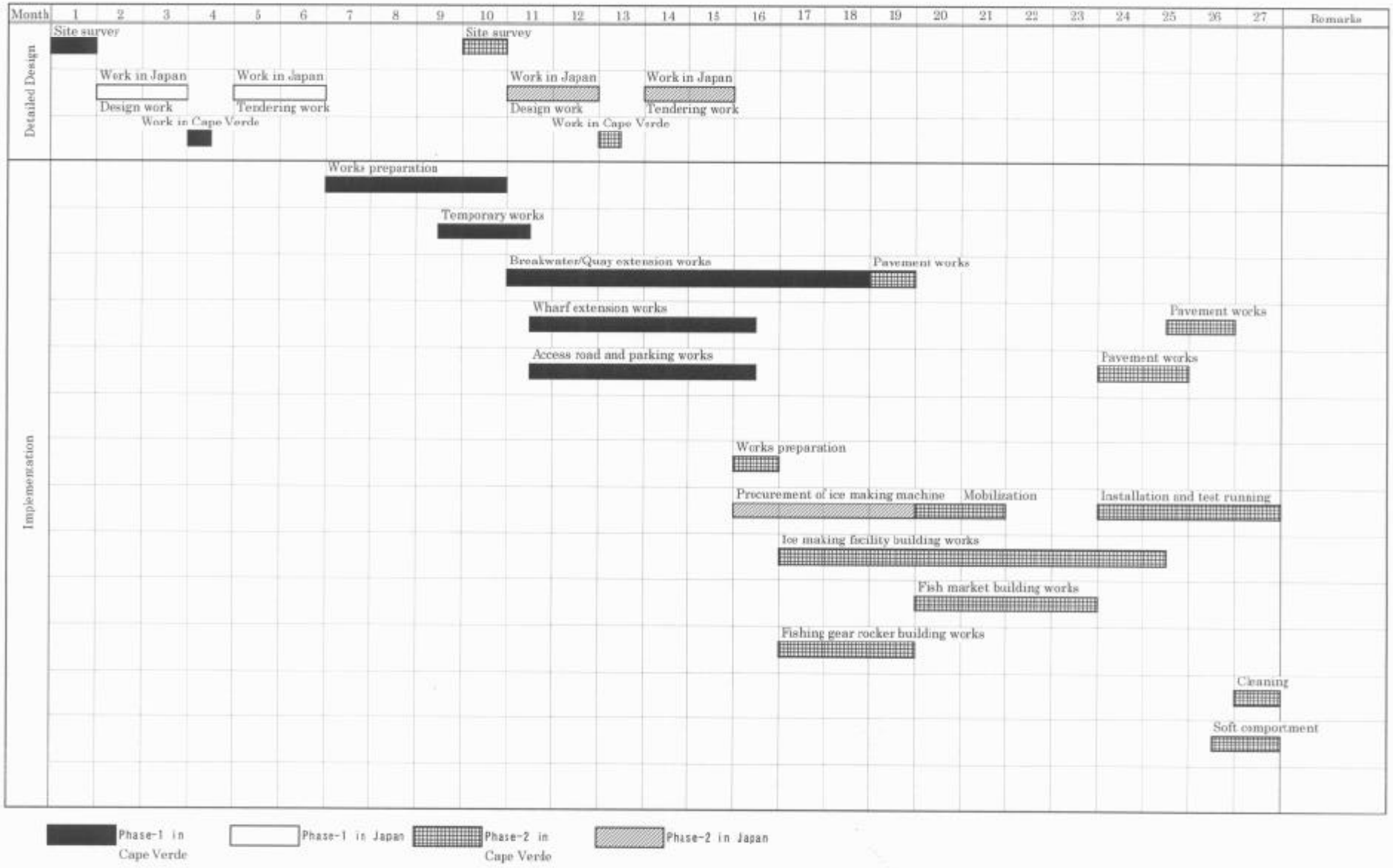


Figure 2.2.4-1 Implementation Schedule

2.3 Obligations of the Recipient Country

The obligations of the Government of the Republic of Cape Verde were confirmed by the Minutes of Discussions during the Basic Design Study implemented in April/August 2001.

① to secure land necessary for the site of the Project prior to commencement of the construction;

② to provide suitable access to the project site;

③ to provide connection works for distribution of electricity, water supply, telephone, drainage and other incidental facilities to the site;

④ to ensure all the expenses and prompt execution for unloading, customs clearance at the ports of disembarkation and internal transportation of the products purchased under the Grant Aid;

⑤ to exempt Japanese nationals from customs duties, internal taxes and fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts;

⑥ to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such as facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their works;

⑦ to bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and other payment commissions;

⑧ to provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary; and,

⑨ to maintain and operate proper and effectively the facilities constructed and the equipment supplied by the project; and,

⑩ to bear all the expenses other than those covered by the Grant Aid, necessary for the Project.

⑪ to allocate appropriate budget and personal timely for proper operation and maintenance of the facilities and equipment to be provided by the Project

⑫ to make a request to the Government of Japan for conversion of the existing fish handling shed into fishing gear lockers to be implemented by the Project

⑬ to take necessary measures including temporary berthing restriction to the existing wharf and breakwater to secure smooth and timely progress of the Project

⑭ to carry out environmental impact assessment, if necessary, and consider not to hinder the smooth implementation of the Project

2.4 Operation and Maintenance Costs

2.4.1 Operation and Maintenance Costs

Management Officer of Praia Fishing Port appointed by the Minister of Ministry of Agriculture and Fishery will be responsible for the operation and maintenance of all the fishing port facilities. Costs and benefits of Praia Fishing Port including Fish Marketing Facilities (Cold Storage and Ice Making Facilities) can be estimated as follows.

There will be a surplus of 18,600Ecv. Therefore, the Fishing Port Facilities will be able to operate on a self-paying basis. It is to be desired that the amount of surplus will be kept and spend for maintenance of facilities.

Table 2.4.1-1 Cost and Benefit of Praia Fishing Port

(Unit：Ecv)

		Remarks
Expenditure(Ecv)	**20,752,400**	
Fishing port Facilities		For Wharf and Fish Market
Personnel	2,328,000	13 persons
Water	30,000	
Electricity	218,400	
Garbage Collect Fee	168,000	
Expendable	698,000	
Sub-total	3,442,400	
Cold Storage and Ice Making Facilities		
Personnel	6,600,000	Result of SEFI for 2000
Water	2,600,000	Result of SEFI for 2000 and New Ice Making Plant (1,207,000Ecv)
Electricity	5,600,000	New Ice Making Plant+ Result of SEFI for 2000 × 1/2(Cold Storage)
Fuel and Oil	690,000	Result of SEFI for Average of 1996-2000
Maintenance	860,000	Ditto
Others	960,000	Ditto
Sub-total	17,310,000	
Income (Ecv)	**20,771,000**	
Fishing port Facilities		For Wharf and Fish Market
Mooring Fee	630,000	
Rental Fee of Gear Locker	564,000	
Entrance Fee	1,627,000	
Sub-total	2,821,000	
Cold Storage and Ice Making Facilities		
Sales of Ice	13,500,000	New Ice Making Plant
Store Fee of Cold Storage	4,000,000	Result of SEFI for 2000
Freezing Fee	300,000	Result of SEFI for 2000
Other Services	150,000	Result of SEFI for 2000
Sub-total	17,950,000	
Balance (Ecv)	**18,600**	

2.5 Other Relevant Issues

2.5.1 Soft Compornent

(1) Definition of Role of Soft Component

In this project a wharf layout plan that avoids overlapping of lines of movement of fishing boats and lines of movement of fish, persons, vehicles, ice, etc. has been devised. Furthermore, the plans call for provision of ice-making machines for keeping the catches fresh and a fish market for efficient and sanitary handling of the catches.

However, only if the fishermen and fish venders who actually make use of those facilities and equipment understand their purposes and the basic ideas behind them and use them effectively can they have the full positive impact expected of them. That being the case, an important task from the viewpoint of enhancing the effect of the project is that of achieving thorough application of management of lines of movement and of methods of handling the fish in an efficient and sanitary manner, and besides that, this presents a good opportunity to help application of the rules of the new Sanitation Law concerning sanitary handling of catches take hold. Instruction and guidance for that purpose will therefore be given the fishing port managers and the fishermen and fish venders using the port.

(2) Need for Inclusion of Soft Component

In view of the fact that the fishing port managers that will be the operating entity after implementation of the project and the fishermen and fish venders making use of the port have little basic knowledge concerning things like management of lines of movement and the concept of sanitation in handling catches, there is risk of the project not attaining its initial goals and the facilities not being effectively used. The task of furnishing the users of the fishing port with instruction and guidance concerning the concept of sanitation is particularly urgent in view of the illegality of handling of fish in an unsanitary manner since promulgation of the new Sanitation Law with its strict provisions concerning that.

Instruction and guidance concerning fishing port operation, mainly management of lines of movement in the different kinds of work and handling of catches, the two most important items in management of the fishing port, will be provided in an effort to achieve improvement of the knowledge needed for efficient management and efficient use of the port by its managers and users.

(3) Work Content of the Soft Component

1) Goals

- Raising of the efficiency of the different kinds of work at the wharf by the fishing boats making use of Praia Fishing Port and particularly the catch landing work.
- Taking root of the rules concerning use of the wharf, fish market, etc. and of efficient use methods for facilitation of landing of catches and sale of the fish.
- Enabling supply of high-quality fish to consumers by keeping them fresh thanks to learning by the users of the fishing port of efficient, sanitary methods of handling catches.

2) Expected Fruits

The following are the fruits expected of implementation of the soft component:

- Understanding of the basic ideas of the project by the port managers and the users of the port (fishermen and fish venders).
- Enhancement of the management capacity of the fishing port managers by having them fully understand the zoning and lines of movement of the different kinds of work on the wharf and at the land facilities.
- Understanding by the users of the fishing port of the plans concerning zoning and lines of movement on the wharf and at the land facilities and thorough familiarity on their part with the use rules and guidelines and following thereof by them.
- Learning by the users of the fishing port of the efficient and sanitary methods of handling the fish indicated in the work standards.

3) Activities and Direct Effects Thereof

The following work will be done jointly with the counterparts, drawing on the opinions of the users of the fishing port when necessary:

- Confirmation of the basic concept of the project.
  Determination of how the facilities and equipment to be provided this time relate to the project goals of elimination of congestion and

improvement of work efficiency at the fishing port.

- Confirmation of the zoning plan of Praia Fishing Port and drawing up of a diagram of ideal lines of movement for efficient accomplishment of the different kinds of work

  Achievement of concrete understanding of how the work efficiency of the different kinds of work will be improved by separation of the areas in which they take place and ensuring that the lines of movement do not overlap one another. Carrying out such work will also enhance consciousness for control of lines of movement.
- Establishment of rules concerning use of the facilities of Praia Fishing Port

  Concrete means of control of lines of movement will be obtained.
- Preparation of work norms for the different kinds of work taking into consideration the views of the users of the fishing port and establishing them as guidelines

  Besides establishment of efficient work methods with integration of everyone's theoretical knowledge and experience, it will be ensured that the users of the fishing port will be thoroughly familiarized with them.
- Preparation of plans for instruction and guidance of fishing port users (fishermen and fish venders)

  Through systematically planned instruction and guidance the above-mentioned rules and work norms will be thoroughly learned, and common awareness on the part of fishing port users will be obtained. Furthermore, newcomers will also become thoroughly familiarized with them through regular implementation of such instruction and guidance.
- Preparation of a handbook for the fishing port users that sets forth the above soft component fruits and holding of meetings of fishing port users to explain it as well as setting up signs concerning use of the fishing port.

  That will have the effect of achieving greater familiarization with the rules concerning use of the fishing port and the work norms as well as curbing rule violations and restraining departures from the work norms.

Physical Fruits

The following physical fruits will result from the soft component work:

- Diagram of fishing port zoning and lines of movement (A)
- Rules and guidelines for use of the wharf (work norms) (B)

- Fishing port use handbook (content: A and B above)
- Signs (content: summarization of A and B above)
- Instruction and guidance plans
- Forms of logs of implementation of the instruction and guidance and meetings and so on

4) Detailed Input Plan

This project is to be implemented over the 2-year period fiscal 2002-2003 and is scheduled to be completed in March 2003, the E/N deadline. This soft component will be implemented over a period of one and a half months starting in February 2003, when construction of the fishing port facilities and provision of the machine and equipment will have been just about completed.

(a) Activity Implementation Methods

For this soft component a Japanese consultant who has handled planning of the fishing port will be sent to Cape Verde for joint implementation of the prescribed work with the counterparts, the fishing port managers.

The above-mentioned fishing port users handbook, signs and other fruits of the work be prepared in Portuguese, and the fishermen meetings and instruction will also be in that language. The period of stay for the soft component will be as follows:

- Person who is expert of fishing port operation (Japanese consultant) : 1.5 man-months

(b) Activity Implementation Plan (draft)

The draft activity implementation plan will be as indicated below:

i) Consultation with the Counterparts and Preparation of the User Handbook (draft) (0.5 months)

- In consultations with the counterparts there will be confirmation of the basic concept of the project and the zoning plans and working out of the lines-of-movement plan (draft) for use of the fishing port.
- Preparation of draft rules concerning fishing port use and draft work

standards for the different kinds of work on the basis of consultations with the counterparts and the results of interviewing of fishing port users.

- Preparation of draft user handbook on the basis of sorting out of the above fruits of the soft component work.

ii) Holding of fishing port meetings and discussion and revision of the draft user handbook (0.5 months)

- Holding of about four meetings with the fishing port users (fishermen and fish venders) on the basis of the above-mentioned draft user handbook (about two with the fishermen and two with the fish venders).
- Revision of the draft user handbook in consultations with the counterparts on the basis of the results of those meetings and the interviews with fishing port users.

iii) Preparation and Setting up of the Signs and Drawing up of the Instruction and Guidance Plan (0.5 months)

- Finalization of the results of the consultations and completion of the user handbook, followed by reflection of those results in easily understood signs and setting them up on the fishing port grounds.
- Consultations with the counterparts for the purpose of drawing up fishing port user instruction and guidance plans as well as preparation of forms for keeping a record of implementation of such instruction and guidance and meetings, etc.
- Sorting out and evaluation of the results of implementation of this soft component.