REPORT ON BASIC DESIGN FOR APIA FISH PORT COMPLEX PROJECT IN WESTERN SAMOA

FEBRUARY, 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

It is with great pleasure that I present this report entitled BASIC DESIGN FOR APIA FISH PORT COMPLEX PROJECT to the Government of Western Samoa.

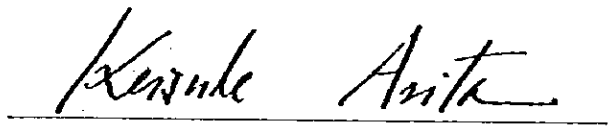
This report embodies the result of a basic design survey which was carried out in Western Samoa from November 14 to November 30, 1980 by the Japanese survey team commissioned by the Japan International Cooperation Agency following the request of the Government of Western Samoa.

The survey team, headed by Mr. Kiyohide Nemoto had a series of close discussions with the officials concerned of the Government of Western Samoa and conducted a wide scope of field survey and data analyses.

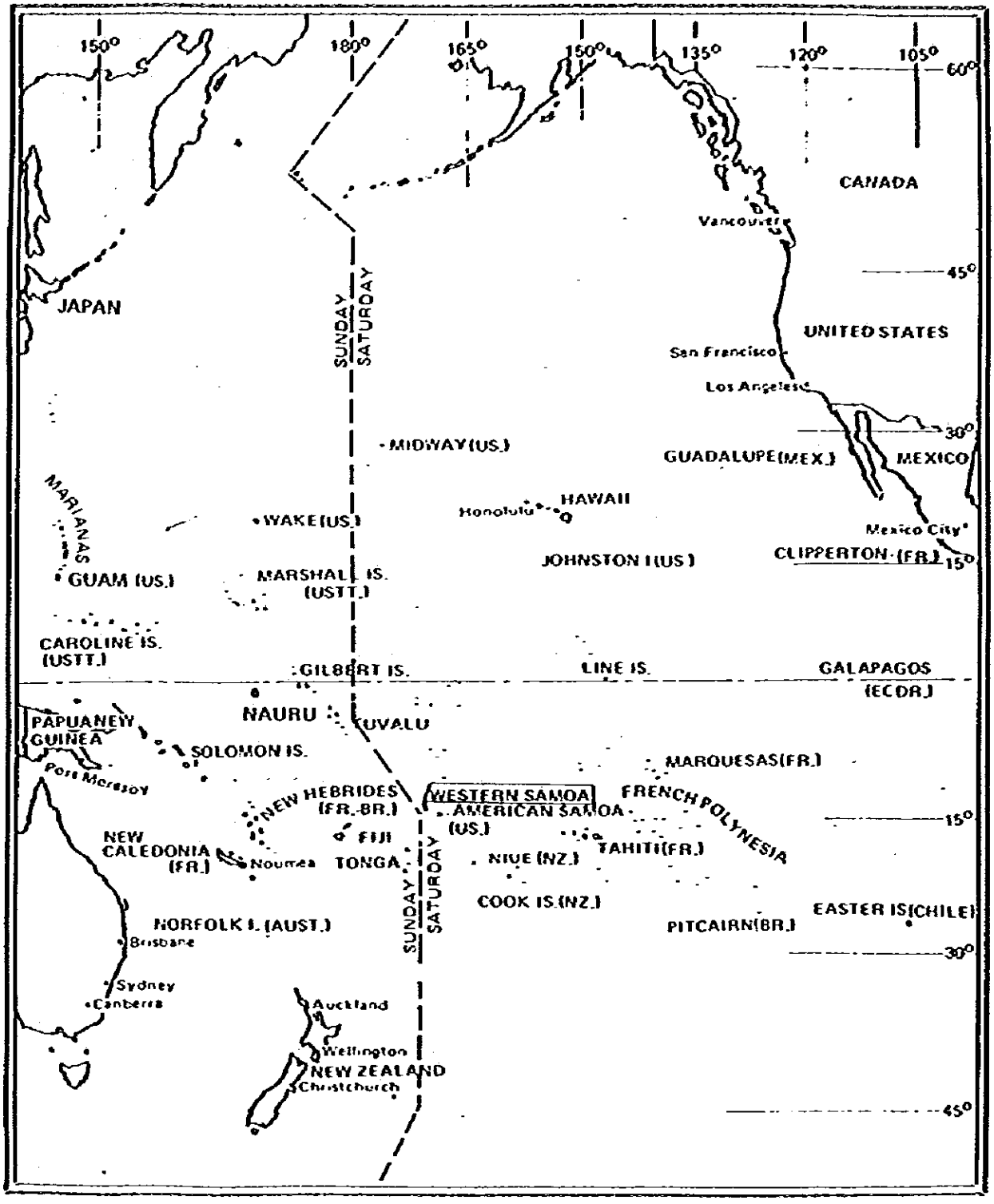
I sincerely hope that this report will be useful as a basic reference for development of the project.

I wish to express my deep appreciation to the officials concerned of the Government of Western Samoa for their close cooperation extended to the Japanese team.

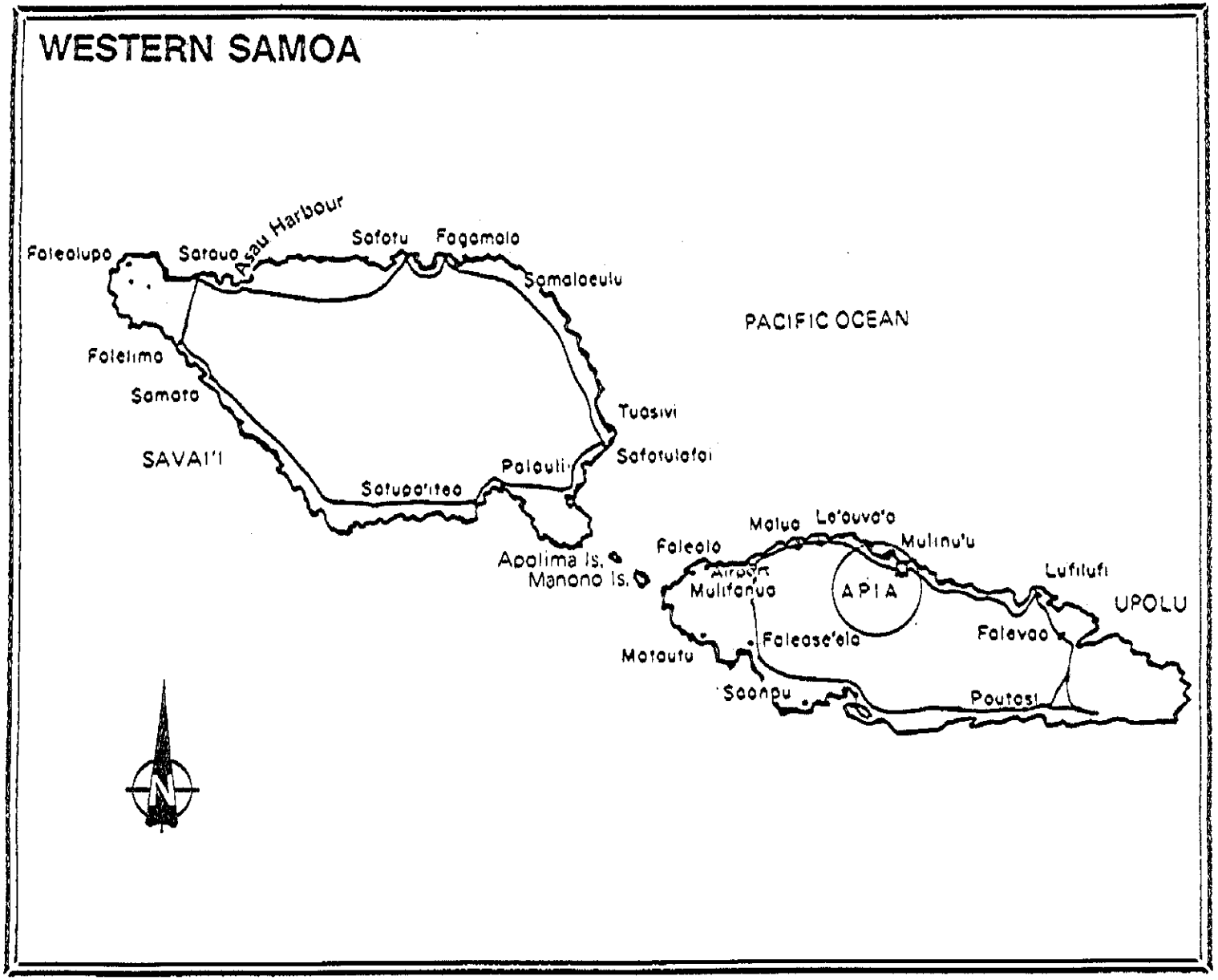
February, 1981



Keisuke Arita
President
Japan International Cooperation Agency



Location of Western Samoa



Planned Site for Apia Fish Port

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SUMMARY

The Government of Western Samoa has set up the National Development Plan under the motto "to improve the welfare of all Samoans through a more effective use of the nation's natural resources", and strived to expand the local agricultural economy without disturbing the traditional social structure of Western Samoa.

With the goals of 1) improvement of nutritional standards, 2) saving foreign currencies, 3) expanding the employment opportunity and 4) increasing the cash income in the fishing field, the Government implemented motorization of fishing boats, modernization of fishing tools and methods and development of fishing outside the reefs in order to increase the fish catch.

It is concentrating its efforts in diffusing Alia-type motor boats all over the country, and is planning to increase the number of such boats from 250 to 400 by 1984 as well as to continue the traditional skipjack-pole & line fishing method by the Tau Tai Samoa so that the traditional self-sustaining fisheries can be grown into the full scale fishing industry.

As a link to such a plan, the Government has noted the importance of promoting the modernized and economical preservation, distribution and sales of fish in Apia, the major consumption area.

The Government of Western Samoa has prepared Fish Port Improvement and Expansion Plan in Apia as a part of the reorganization of distribution structure to meet the expansion in both production and consumption. The Government of Western Samoa has requested the Government of Japan for the technical and financial assistance. In response to the request from the Western Samoan Government, the Japanese Government dicided to conduct a basic design survey for formulating the improvement of Apia Fish Port and commissioned the work to be performed by Japan International Cooperation Agency (JICA).

JICA dispatched a basic design survey team headed by Mr. Kiyohide

Nemoto, the advisor of All Japan Fishing Port Association, from November 14 to November 30, 1980 to Western Samoa in order to confirm the basic plan of the Western Samoan Covernment as well as to conduct a site survey and to collect available data.

This report presents the results of the survey. The Apia Fish Port Complex Plan to be conducted under the grant from the Japanese Government includes the following items.

Apia Fish Port Complex Plan

- Facility Items

Basic Facilities

1) Berthing facilities — Total length 200 m
   - Discharging wharf (-1.5 m) — 70 m
   - Idle berthing wharf (-1.5 m) — 80 m
   - Wharf for Tau Tai Samoa (-3.0 m) — 50 m

2) Breakwater — length 77 m

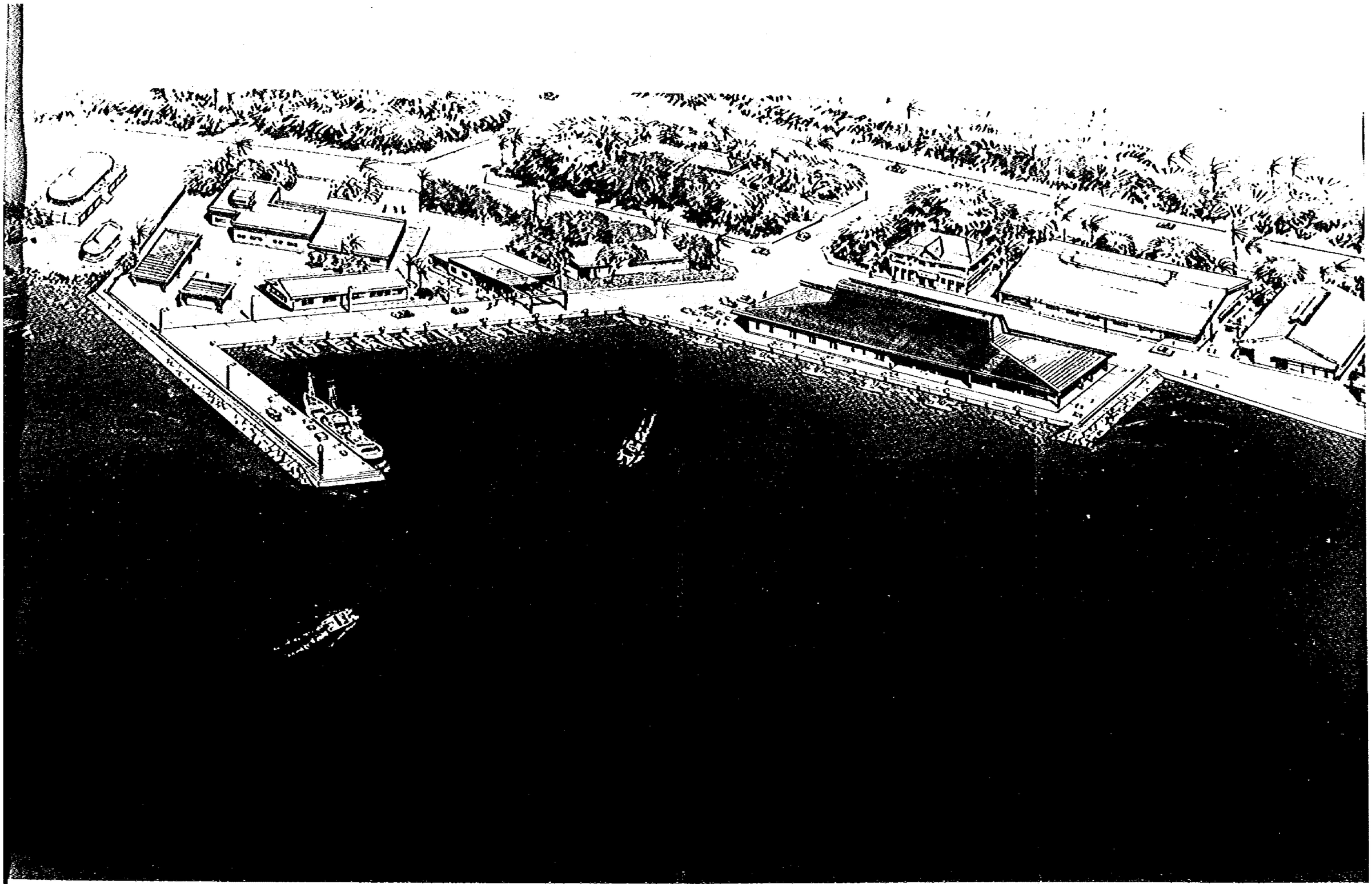
3) Annex facilities — one unit
   fenders, mooring posts, light buoy, light beacon, illumination, water pipes, intake pipes, etc.

Functional Facilities

1) Fish market — Total area 1,000 m^2
   - Market for selling — 500 m^2
   - Management/administration facilities — 500 m^2

2) Annex facilities
   - Freezer — capacity 50 tons — 1 unit
   - Ice maker — capacity 1 ton/day — 1 unit
   - Back up generator
   - Refrigerated trucks, other equipments

The plan is shown in Figs. 01 to 10 of the Basic Design Drawing.



SURVEY OBJECTIVES, BACKGROUND AND METHODOLOGY

Chapter 1: Survey Objectives, Background and Methodology

1-1: Survey Objectives

The Government of Western Samoa has requested grant-aid for a Fish Port Complex to promote fisheries activities in Western Samoa.

The basic design survey team was to confirm justification of this grant-aid program and to develop a basic plan for permitting the effective implementation of the program, through the medium of a field survey in Western Samoa and discussions with Western Samoa's government personnel concerned.

1-2: Background of the Survey

Fish has been an important source of animal protein traditionally in Western Samoa, but due to increase of population and overfishing by the explosives in the reef, the fish catch has not been sufficient enough to satisfy the demand, and recently they have to rely on the canned fish which are imported every year spending their precious foreign currency.

The Government of Western Samoa has been promoting fishery development under the Second Five Year Development Plan (1971 - 1975) and the Third Five Year Development Plan (1975 - 1979), and has requested the Japanese Government for cooperation for the development of fisheries. In response to the requests, such assistance as providing a fishing training vessel and refrigeration/distribution facilities network in 1977, and construction of the Fisheries Center in 1978 were made, and fisheries specialists from Japan International Cooperation Agency and Japan Overseas Cooperation Volunteers were sent as technical assistance to Western Samoa. Therefore, their expectation for Japanese aids in the fisheries field is great.

Western Samoa's fishery has developed steadily depending on efforts of Fisheries Division of the Government of Western Samoa under the auspices foreign countries including Japan, and international organizations. The lack of the fish port to land catches of the fishing training vessel, catches made by catamaran ships built in Western Samoa, such as idle berthing wharf, breakwaters, freezers, fish market, etc. appeared as actual impediment against the development of coastal fishery. Though Western Samoa Government prepared Apia Fish Port Complex Plan, realization of the plan was hard by herself due to the financial difficulties prevailing in the country. Thus, request for the grant was made to Japan and the basic design survey team was sent in response to this request.

1-3: Members of Survey Team

The Survey Team headed by Kiyohide NEMOTO, Advisor of All Japan Fishing Port Association, is composed of the following members.

In Charge	Name	Organization
Head of the Team	Kiyohide NEMOTO	Advisor of All Japan Fishing Port Association
Cooperation Planning	Teruo SUGAWARA	Disaster Prevention & Coastal Protection Div., Fishing Port Dept., Fisheries Agency
Coordinator	Hiroshi SAITO	Fisheries Technical Cooperation Division, Japan International Cooperation Agency
Civil Engineering Design (Fishing port construction)	Koichi IGARI	Nippon Tetrapod Co., Ltd.
Architect (Production & Distribution Facilities)	Toshiya OGASAWARA	Nippon Tetrapod Co., Ltd.
Structural Engineering (Fishing port facilities)	Masafumi ITO	Nippon Tetrapod Co., Ltd.
Equipment & Cost Estimate	Kuniaki TAKAHASHI	Nippon Tetrapod Co., Ltd.

Dr. Taiji Endo representing the consultant accompanied the survey team.

1-4: Itinerary of Survey Team

The survey was conducted for seventeen days from November 14, 1980 to November 30, 1980. The log of major movements of the survey team is shown in Table-1.1.

Table-1.1: Itinerary of Survey Team

Nobember		
15	Sat.	Departed Auckland at 8:40 by NZ #449 for Wellington, and arrived at Wellington at 9:35. Paid a visit to the Embassy of Japan at Wellington, met Mr. Kawanoto, second secretary, to whom the team explained the outline of the survey and who in turn explained to the team the local situations.
16	Sun.	Departed Wellington at 15:45 by NZ #462 for Auckland, and arrived at Auckland at 16:40.
17	Mon.	Departed Auckland at 8:05 by TE #072 for Apia. (Crossing the international date line).
16	Sun.	Arrived at Apia at 11:45.
17	Mon.	Paid a visit to Economic Development Dep., Ministry of Economic Affairs, Public Works Dep. Discussed the survey schedule at the Fisheries Division. Confirmation of the request for facilitation of work was made. Request for submission of materials made. On the site survey (Apia Commercial Port, Fishing Port, Market) Collected data by Observatory, Lands and Survey.
18	Tue.	Consultation and discussion with Mr. Philipp, the Chief Fisheries Officer. Topographical survey and levelling on the land area. Consultation and discussion with Electric Power Corp., and paid the second visit to Observatory.
19	Wed.	Set the basic point on the land, and conducted the Topographical survey. Consultation and discussion with P.W.D. Paid a visit to Apia Concrete Product.

20	Thu.	Conducted sounding. Consultation and discussion with S.P.D.C. Consultation and discussion with the Chief Fisheries Officer.
21	Fri.	Sorted and classified the materials collected. Organized the results of the survey. Consultation and discussion with the Chief Fisheries Officer. Paid visits to the aggregate plant at P.W.D. and the Boat Craft.
22	Sat.	Prepared the design cross sections, and estimated the construction costs.
23	Sun.	Reviewed the design cross sections, and prepared the construction cost estimate. Based on these results, the survey team had the final discussions on the proposal to be submitted.
24	Mon.	At the Ministry of Economic Affairs, met Mr. Philipp, the Chief Fisheries Officer, to present and discuss the proposal and the basic design. Minutes of Discussions are confirmed and signed between Hon. Letiu Tamatoa and Mr. Kiyohide Nemoto. Survey of the facilities of the breakwater for the commercial port made.
25	Tue.	Sorted and classified the materials. Final discussion with the Chief Fisheries Officer. (Yard and details of facilities and machineries). Preparation to leave from Wester Samoa
26	Wed.	Departed Apia at 14:15 by TE #071 for Auckland. (Crossing the international date line).
27	Thu.	Arrived at Auckland at 18:30.
28	Fri.	Departed Auckland at 8:30 by NZ #449 for Wellington. Arrived at Wellington at 9:30. Paid a visit to the Embassy of Japan in New Zealand. Explanation made to Mr. Ohe, Second Secretary, on the result of the survey. Paid a courtesy visit to the office of the High Commissioner of Western Samoa.

28 (Cont'd.)	Fri.	Departed Wellington at 16:20 by TE #474 for Sydney. Arrived Sydney at 18:10.
29	Sat.	Departed Sydney at 22:30 by JL #772 for Tokyo.
30	Sun.	Arrived Tokyo at 6:05.

1-5: Discussants

In an effort to gain an understanding of local conditions, the survey team has had as many consultations with as many people related to the subject matter as possible during the survey period, and those they met included the government personnel of Western Samoa, and officials of the Embassy of Japan, the members of Japan Overseas Cooperation Volunteers, the private companies. The list of discussants of Western Samoa Government personal is following.

List of Discussants

* Minister of Economic Affairs .....Hon. Letiu Tamotoa
* Director of Economic Development .....Mr. Hans Kruse
* Deputy Director of Economic Development..Mr. Epa Tuioti
* Director of Works .....Mr. Luaiufi Tone
* Chief Fisheries Officer .....Mr. Alfonso L. Philipp
* Director of Meteorological Observation...Mr. Philip Muller
* Director of Lands & Survey .....Mr. Joseph Soon
* Chief Civil Engineer .....Mr. Drenth
* Market Manager .....Mr. Luatoa T. Vesi
* Special Project Development Corporation (SPDC)
  Manager .....Mr. Simon
* High Commissioner of Western Samoa .....Hon. Fepulea'i
* Deputy High Commissioner of Western Samoa.Mr. Toliafoa
* Assistant Manager of Electric Power Company ..... Mr. G. Coxon

1-6: Outline of the Survey

1-6-1: Confirmation of Basic Items

After the team arrived in Western Samoa, the team visited the government personnel to pay respect, and explained the purpose, the itinerary, the details of the survey requesting their cooperation. The following basic items were discussed and confirmed.

(1) Background of the Project
(2) Relation with National Development Plan.
(3) Content and scope of the Project
(4) Proposed site for facilities and construction yard
(5) Administrative plan after the implementation of the project
(6) Executing Agency

1-6-2: Survey

Along with the discussions with the government officials, survey of the area on the planned site for the fishing port was conducted from November 18th to November 21st.

Surveyed area and amounts are listed below:

(1)	Levelling	course of traverse length	850 m
(2)	Topographical surveying	survey length	600 m
(3)	Sounding	course of traverse length	2,160 m
		survey area	16,300 m^2
		sounding points	201 points

1-6-3: Data Collection

Following data and materials were collected within a scope required for the basic design from government organizations and private companies.

(1) Natural Conditions

1) Meteorological conditions

a) Wind

Maximum wind speed

Wind direction

b) Hurricane

Lowest atmospheric pressure

Maximum wind speed

c) Rainfall

Maximum rainfall

Annual average rainfall

Monthly average rainfall

d) Temperature

Daily maximum temperature

Average temperature

Daily minimum temperature

e) Relative humidity

2) Sea conditions

a) Wave

Wave height

Wave direction

Wave period

b) Current

Current direction

Current velocity

c) Sea level

H.W.L.

M.W.L.

L.W.L.

Anomalous sea level

3) Geophysical conditions

a) Topographical map

b) Soil conditions

(2) Investigations of Socio-economical Conditions

1) National Development Plan
   The Fourth Five Year Development Plan (1980 - 1984)
2) Population statistics
3) Trade statistics
4) Gross domestic production

(3) Construction Conditions

1) Materials locally available
2) Amount of supply available
3) Cost
4) Labor cost
5) Labor conditions
6) Workmanship
7) Experiences of similar constructions
8) Private construction companies
9) Legal regulations, specification, standard, etc. referring to construction and management
10) Transportation
11) Water supply, sewerage and electricity system

(4) Present Status of Fishery Production and Distribution

1) Records of fish sales of the market
2) Number of Alias by villages
3) Fish catch statistics data (1978)
4) Design plan for Alia
5) Related facilities
   Apia Commercial Port
   Boat Craft
   Fish Market

(5) Construction-related Survey

Information and data on construction supply materials and construction equipment were obtained from P.W.D., Special Project Development Corporation (S.P.D.C.), Private aggregate supplier and construction companies.

It was found that the supply of construction materials such as stones, aggregate, sand, concrete, etc. is sufficiently insured since no large scale project is presently expected for the year 1981.

On construction machineries, though we obtained a prospect of securing transportation vehicles such as dump truck, it is difficult to use small number of cranes etc. for a long term. Therefore, transporting them from Japan should be considered.

On labor cost, information on minimum wage was obtained from P.W.D., and available number of skilled workers, cost and work conditions were obtained from private companies.

(6) Investigation on Fishery Production, Present Status of Distribution and Fishery-related Facilities

The team observed the existing fish market and the boat craft, obtained information from respective managers, and data on fish sales records, market sales records, Alia (small catamaran type fishing boat) availability in each district were collected.

From the Chief Fishery Officer, the catch statistics data was obtained. It was learned that under the present conditions, the limited market area and lack of the freezer capacity are restricting fishery products distribution. The need for provision of discharge wharf, idle berthing wharf and breakwater was confirmed.

1-7: The Minutes of Discussions

Through reviews on the survey results and discussions with Western Samoa Government personal concerned, decision on the outline of facilities and equipment to be offered was decided, priorities and responsibilities of Western Samoa were confirmed and, future implementation procedures were explained. Then, following Minutes of Discussions was prepared and signed between Hon. Tamatoa, Minister of Econonic Affairs and Mr. Nemoto, the survey team leader.

Hon. Letiu Tamatoa, Minister of Economic Affairs (Left) and Mr. Nemoto, Head of Survey Team (Right)

MINUTES OF DISCUSSIONS

ON

THE BASIC DESIGN STUDY FOR THE FISHPORT COMPLEX PROJECT IN WESTERN SAMOA

In response to the request of the Government of the Western Samoa, the Government of Japan, acting through Japan International Cooperation Agency (JICA), has decided to send a survey team headed by Mr. Kiyohide Nemoto (hereinafter refered to as "the Team") to Western Samoa from November 14 to November 30, 1980 in order to conduct a basic design study for the Fishport Complex Project (hereinafter refered to as "the Project"). During the above mentioned period, the Team held a series of discussions and exchanged views with the authorities of Western Samoa concerned and conducted a field survey for the basic design of the Project.

As a result of the survey and discussions, the Team and the Ministry of Economic Development (hereinafter refered to as "the Ministry") have agreed to recommend to their respective Governments to take desirable measures towards the successful implementation of the Project as stated in the Minutes of Discussions attached herewith.

November 24th 1980

Apia, Western Samoa

Mr. Kiyohide Nemoto
Head of the Japanese
Basic Design Study Team

Hon. Letiu Tamatoa
Minister of Economic Affairs

MINUTES OF DISCUSSIONS

1. The Project covers the following fisheries development areas;

   (1) To promote fisheries activities in Western Samoa by expanding fishing port facilities;

   (2) To modernize fish landing and marketing activities by providing new market facilities.

2. The Fisheries Division of the Ministry will be responsible for the administration of the Project and will be the executing agency for the Project.

3. The Team will convey the desire of the Government of Western Samoa to the Government of Japan that the latter will take necessary measures within the limit of Japanese grant aid to provide the facilities and equipment for the Project as shown on Annex I.

4. The Ministry confirmed that the items listed in Annex I are in the order of priority and that the item of low priority may be deleted or its plan and quantity may be adjusted according to the budget allocated by the Government of Japan.

5. The Government of Western Samoa will take, at its own expense, necessary measures:

   (1) to ensure that the facilities and equipment be maintained and used properly and effectively for the execution of the Project;

   (2) to provide all expenses necessary for the operation and maintenance of the facilities and equipment;

(3) to secure land necessary for the execution of the Project;

(4) to ensure that the sea area necessary for the construction of the facilities be freely accessible;

(5) to provide electricity, water supply, drainage and any other incidental facilities necessary for the construction and the operation;

(6) to ensure prompt unloading and customs clearance at the port of entry in Western Samoa and internal transportation of materials, machineries and equipment to the site;

(7) to exempt Japanese personnel concerned from any taxes, duties, fees, levies and other imposts which may be imposed under the laws and regulations in effect in Western Samoa on the personnel and any equipment, machineries, materials and supplies entered or brought into Western Samoa for the purpose of carrying out the services in connection with construction and installation of the facilities and equipment.

6. JICA will submit twenty (20) copies of Basic Design Study Report to the Government of Western Samoa.

ANNEX I

LIST OF EQUIPMENT AND FACILITIES

Equipment and Facilities requested by the Government of Western Samoa to be provided by the Government of Japan for the Project.

(1) Fish Market with equipment

(2) Wharf

(3) Breakwater

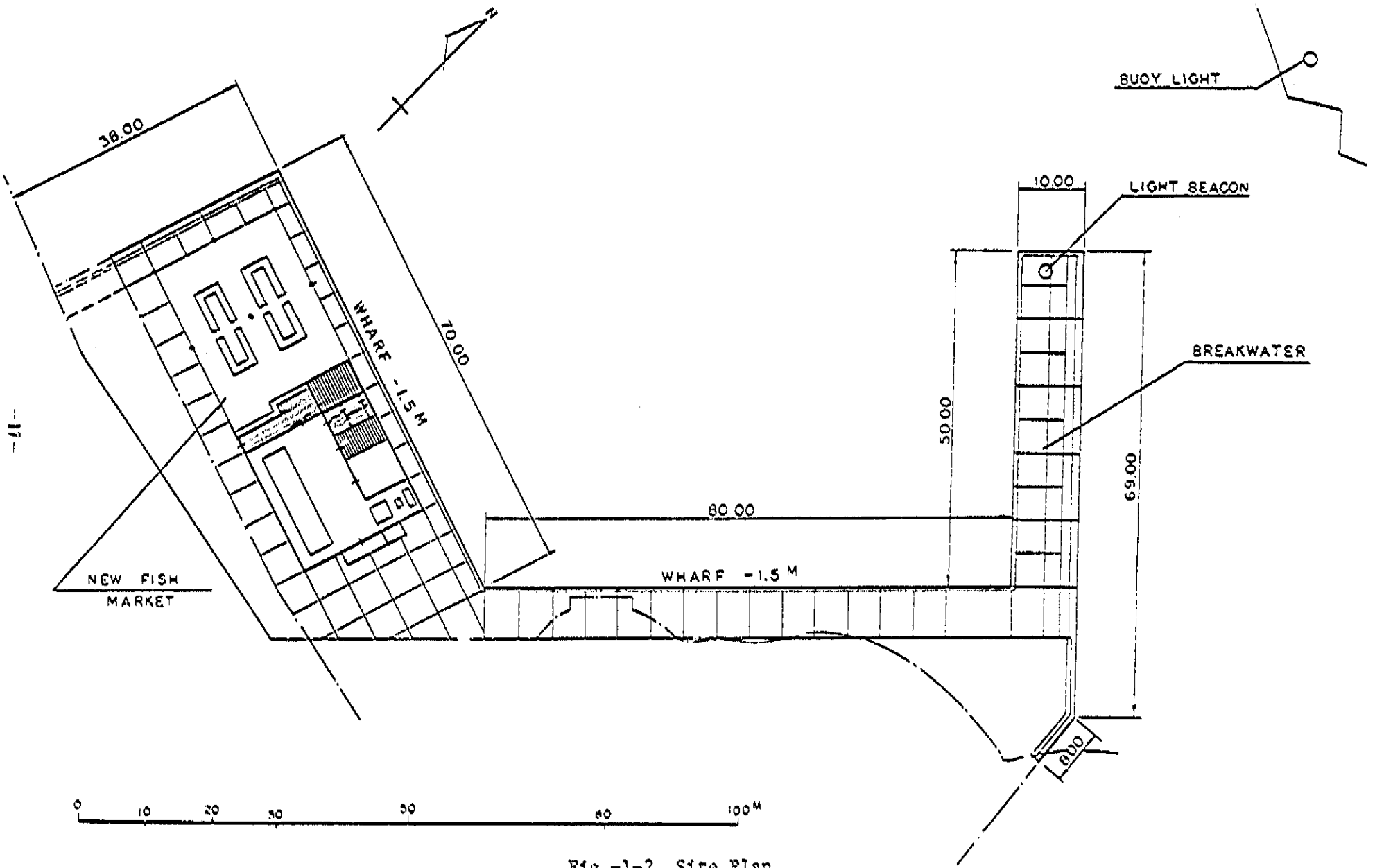


Fig.-1-2 Site Plan

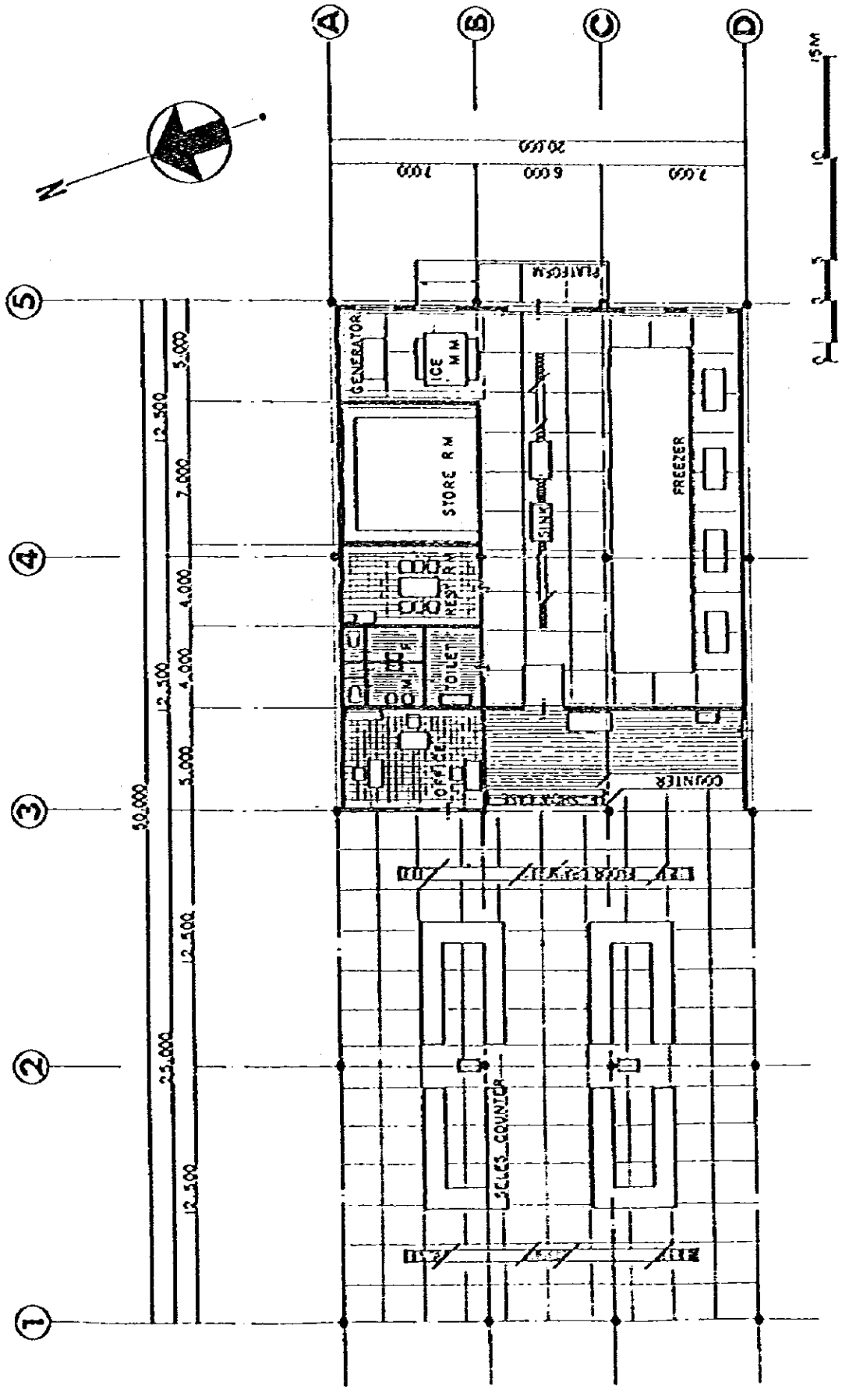


Fig.-1-1 New Fish Market Floor Plan

Chapter 2: Basic Design for Apia Fish Port

2-1: Basic Concept for the Plan

It has been said popularly in Western Samoa that there exists no fisheries as an industry. The form of fishing prevalent here is small scale fisheries for self-sustain and any excess is distributed at the landing place.

In recent years, the increased demand for animal proteins triggered by the population increase caused the foreign currency drainage for the importation of foodstuff to a degree which was not to be disregarded. As a countermeasure for this problem, there have been formulated the Fisheries Development Plans under the Third (1975 - 1979) and the Fourth (1980 - 1984) Five Year Development Plan.
According to these Fisheries Development Plans, there are plans for

1) construction of "Alia" type catamaran boat,
2) opening of waterway for Alia type boats for villages,
3) improvement plan for fish distribution network,
4) developing the fishing grounds

and the positive development and promotion of the fisheries industry are envisaged.

Although it cannot be said that all the plans are proceeding as planned, there are certainly evidences that the fisheries is growing as an industry as a result of such efforts. The amount of fish handled through the fish market at Apia which is the large scale consumption area is increasing gradually, and it was found through the results of the present survey that the existing fish market is about to reach its limit in handling the volume of the fish.

In view of the above facts, the Government of Western Samoa has prepared the improvement and extension plan for Apia Fish Port and to promote improvement of the distribution system in Apia to cope with the increased production and consumption.

2-2: Basic Policy

In formulating construction plan for Apia Fish Port, the following basic policy will be followed based on the actual situation concerning the production and distribution of fish catches in Apia, the prevailing conditions of the market, and the Fisheries Development Plan;

(1) The plan shall be such that it will not only obviate the shortage of the existing facilities but also be able to meet the increases expected in the near future, and shall be able to cope with the expanding of the fisheries.

(2) The port shall be a fully improved fish port which will be able to function as a center for development of fisheries in Western Samoa.

(3) The plan shall be based on the discussions with Western Samoa and the result of the survey in the Basic Design Survey.

(4) The facilities shall be those adapted to the climate of the country, shall be in harmony with the existing facilities, and shall be designed to facilitate an efficient management and maintenance in the future.

(5) The construction situation prevailing locally shall be taken into account in making the construction plan, and construction materials and labor available locally shall be utilized as much as possible.

(6) Plans were made for allocation, structural and construction materials and the work schedule having investigated and reviewed construction situation at the site or related laws, regulations and standards, etc.

(7) The design standards are to be in accordance with the Japanese Laws and Standards concerning architecture, civil engineering designs and facilities with some modifications suited to the actual situations at sites.

2-3: Selection of Planned Site

2-3-1: Topographical Conditions

Apia is located at 13°48'S and 171°46'E, and is at the approximate center of the northern coast of Upolu Island. Upolu Island is a volcanic island and is surrounded by coral reefs.

Attached is a chart near Apia. There is a bay formed between Matautu and Mulinuú Peninsula, and the East Reef and the West Reef extend to the east and the west, and there is a narrow inlet at the center. The principal axis of the inlet is in the approximately NNE direction, and the depth is above 10 m. The eastern side at the end of the inlet accommodate a commercial port, while at the end of the western side lies the anchorage area for the fishing boats. There is a wharf at one portion of the fish market.

The reef at the innermost end of the inlet has been reclaimed, and the portion of the reclaimed land is used by the Fisheries Division. Prior to the construction of the commercial port, the discharging operation of cargoes from the ships anchoring off the port was conducted using barges, and the place before the market used to serve the barges.

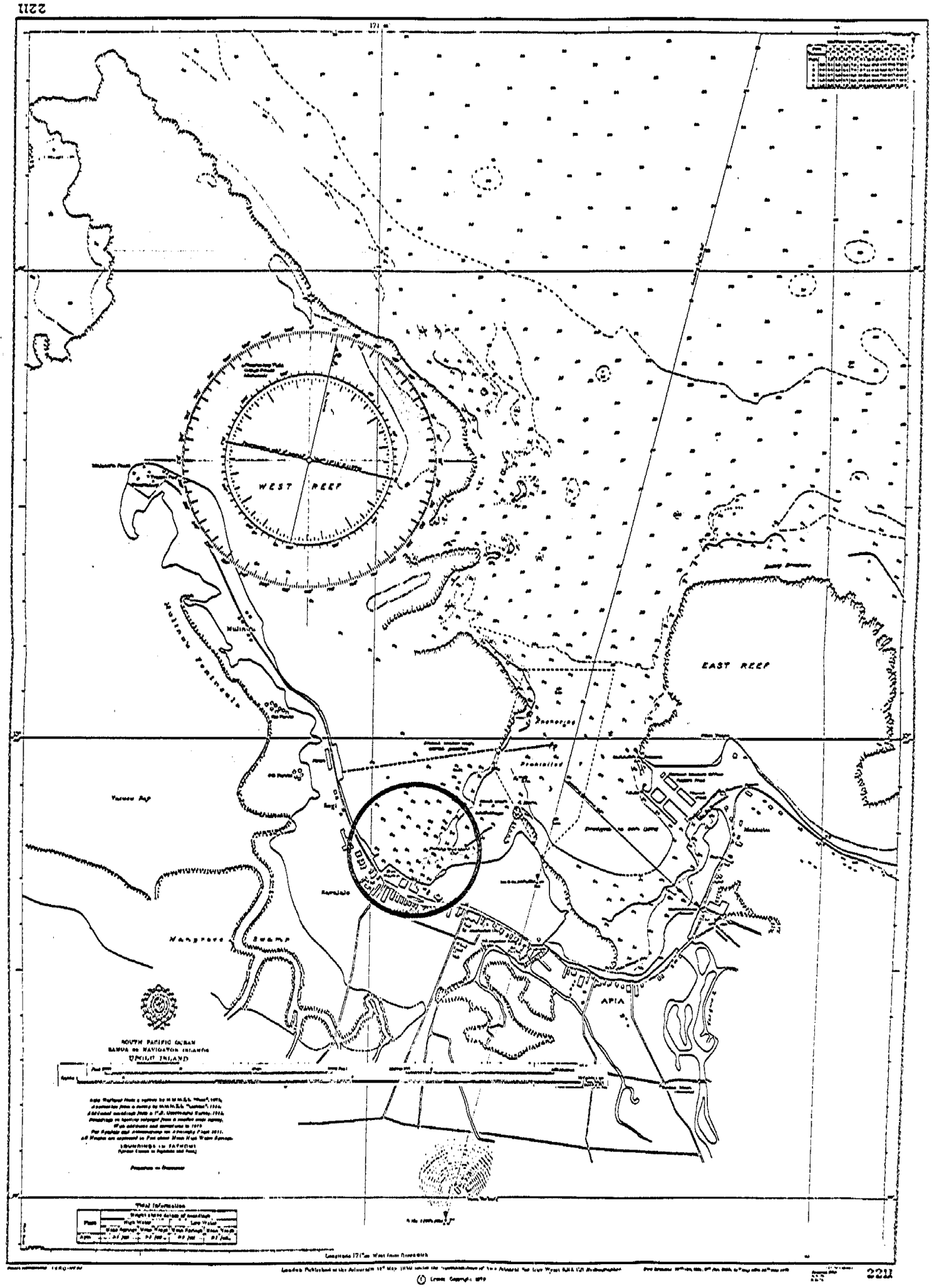


Fig.-2-1 Chart of Apia Harbour

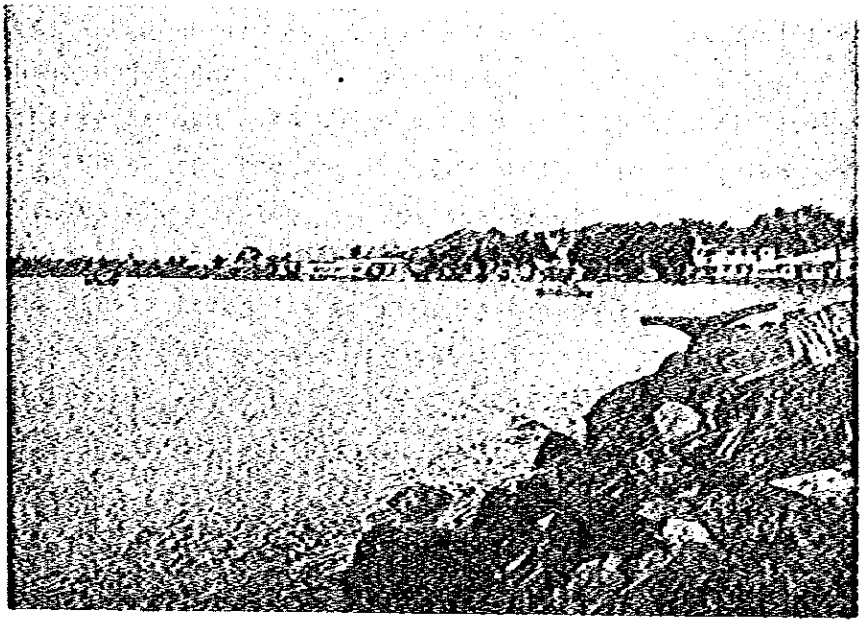


Photo -1 General View of Planned Site

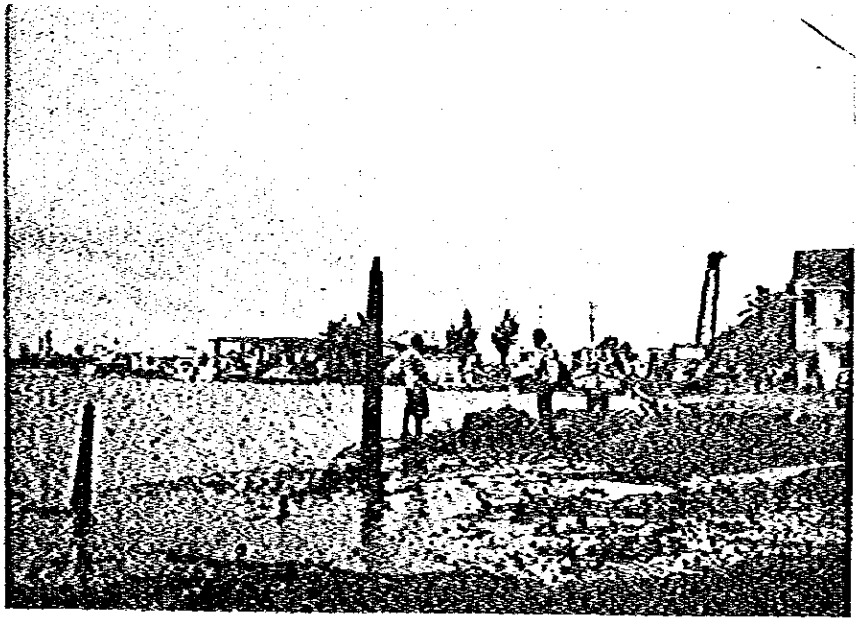


Photo -2 Water Area in front of Fisheries Division

2-3-2: Selection of Planned Site

The site proposed for construction of fishing port facilities for which the Government of Western Samoa requested is the water area in front of the reclaimed land which is now used by the Fisheries Division. As shown in the chart, the water depth at this point is rather deep and therefore there are no problems for the incoming and outgoing ships and boats. It is also close to the market and there is a road behind, thus creating no difficulties for access. Although the water area on the eastern side will be subjected to the influence of waves, a calm area may be secured by providing a suitable breakwater. Accordingly, the site proposed for construction is favored with the very good geographical conditions. As shown in the Fig. -2-2, there is a plan presently for constructing a by-pass road in the area to be reclaimed from the sea in front of the market with an aim to obviate the traffic congestions near the market and for extending the market area. The plan shown in the figure is not yet finalized, but these plans must be taken into consideration in construction of the fishing port facilities.

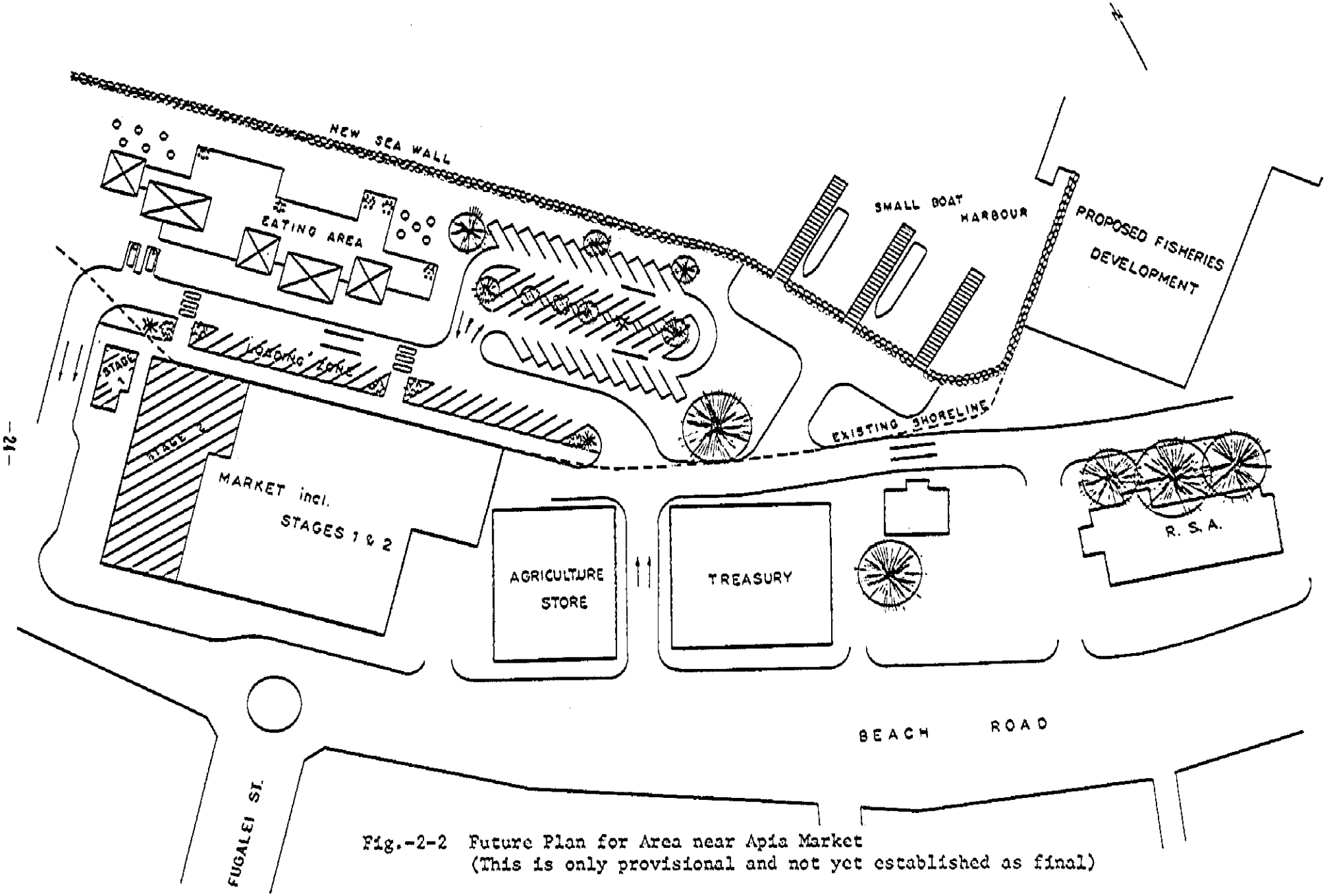


Fig.-2-2 Future Plan for Area near Apia Market
(This is only provisional and not yet established as final)

2-4: Conditions of the Site

2-4-1 Topography

Fig.-2-3 is a bathymetric chart based on the result of the site survey. The water area in front of the Fisheries Division is relatively deep, with the maximum depth reaching -7.0 m. Thus, this is sufficiently deep for anchorage area. The depth of the area near the market is less than -2.0 m and suitable for reclamation and construction of a new market.

2-4-2 Soil Conditions

There is no site boring data available. The boring data of the adjacent area is shown in Fig.-2-4. According to the boring log, the bottom material consists of coral and silt, and is not suitable for the foundation. The structural design was however based provisionally on the sand since there are coral rocks in the part of the planned site.

2-4-3 Marine Conditions

(1) Tidal level

H.W.L. + 1.00 m

M.W.L. + 0.49 m

L.W.L. $\pm$ 0.00 m

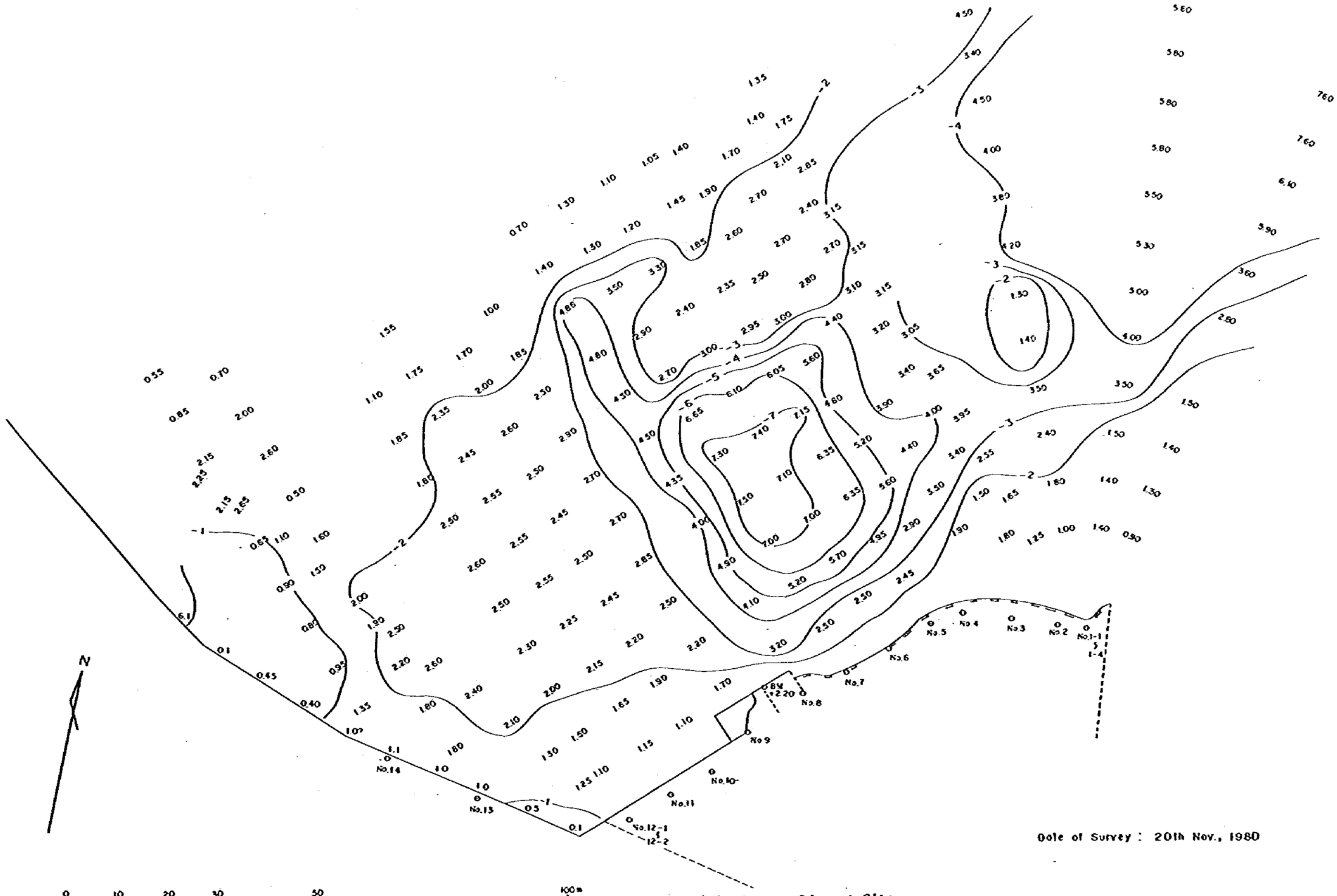
(2) Waves

As shown in Fig.-2-1, the planned site for Apia Fish Port is surrounded by the reef and the calm water.

The waves influencing the fish port area are the wind waves generating inside the creek and the swells from the ocean.

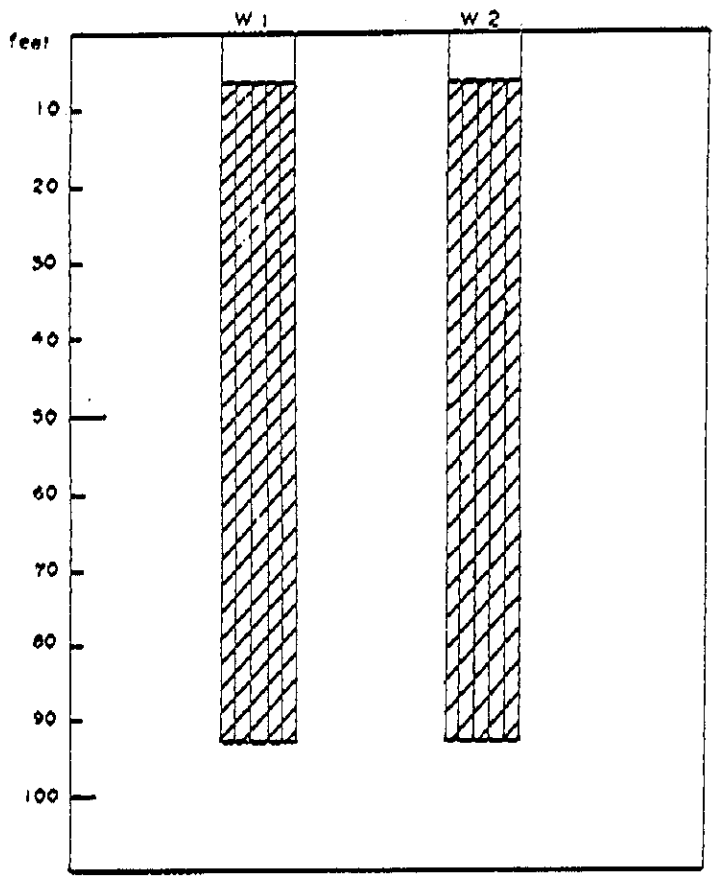
Since the fetch from the planned site to the East Reef of the opposite shore is about 1.5 km, the wind wave is expected to be H = 1.4 m and T = 3.0 sec. even with the maximum wind speed of 40 m/sec.

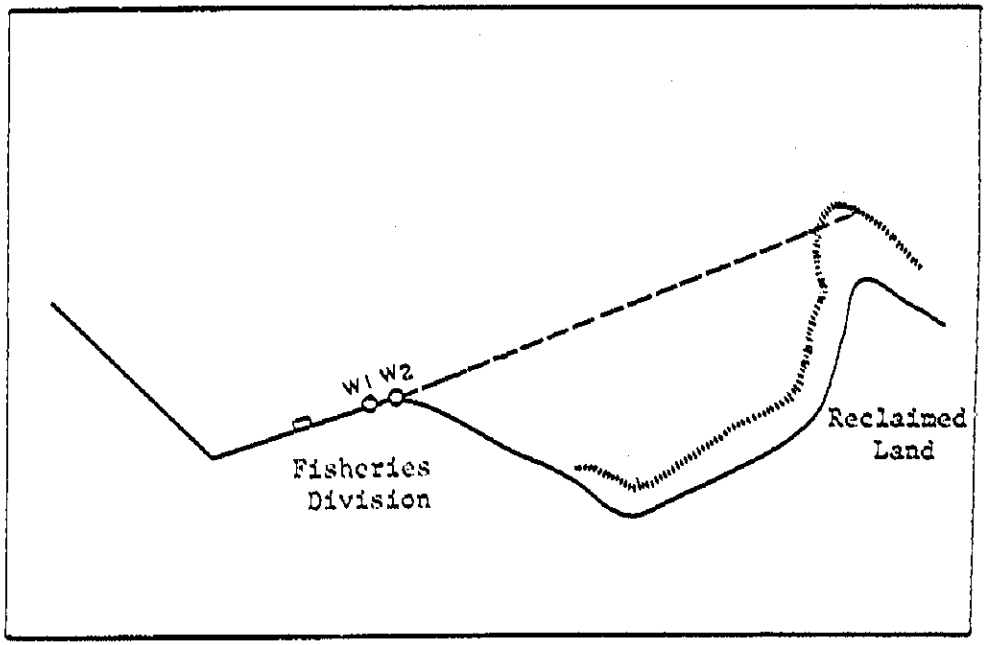
On the other hand, the ocean waves which are the period of 10 - 15 seconds and the height of 7 - 8 m reach at the entrance of the creek and are deformed by refraction and go to the innermost part of the creek as their energy is attenuated through refraction, defraction and by the reef.



Date of Survey : 20th Nov., 1980

Fig.-2-3 Contour Line at Site





Plan of Boring Site

Coral and Silt

Fig.-2-4 Borehole Section and Plan

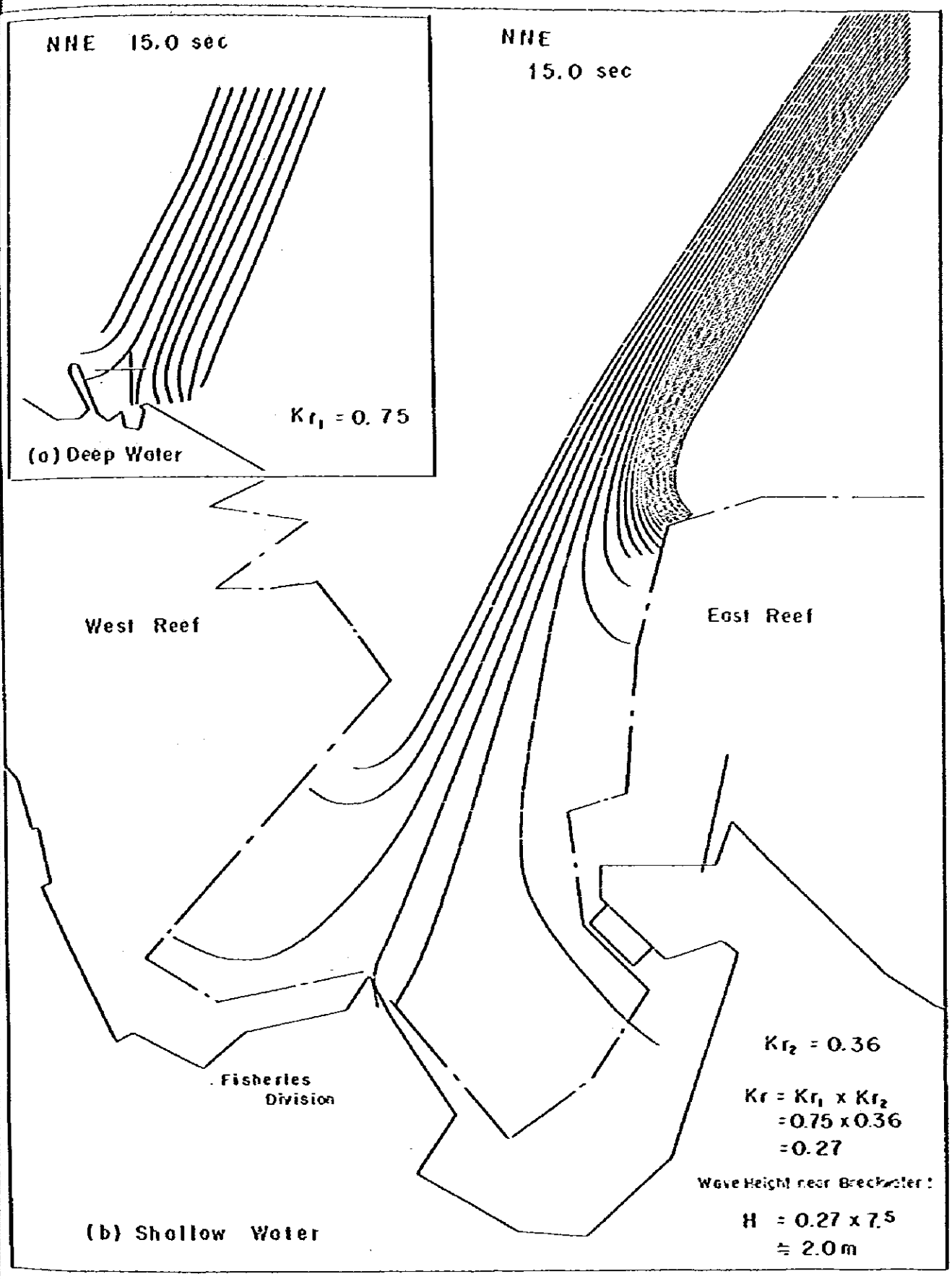


Fig.-2-5 Wave Refraction Diagram

When the most severe direction of the deepwater wave is set to be NNE, the wave reaches the planned site having been attenuated as shown in Fig.-2-5.

Therefore, the maximum wave at the planned site is expected to be H = 2.0 m, and T = 10 - 15 sec.

2-4-4: Conditions of Infrastructures

(1) Electricity

The voltage supplied is 3 phase, 4 line, 400/230 V, 50 Hz, and the Electric Power Corporation controls the power generation and transmission. The power supply in Apia is not necessarily satisfactory, and advance coordination is considered necessary for construction of facilities which is expected to consume a large quantity of electricity. The following table shows various data concerning the power supply in Upolu Island.

Table -2-1 Power Supply (As of 1980)

	Total	Hydraulic Power Generation	Diesel Power Generation
Capacity	11,099 KW	1,294 KW	9,805 KW
Quantity	31.43 MKWH	6.18 MKWH	25.25 MKWH
Number of Generators	12	3	9
Number of Consumers	6,453		

(2) Water Supply, Sewage System

Although the water supply system has not been established on a nation-wide scale in Samoa, the service is available throughout the city of Apia. There is a waterpipe of 50 mm ϕ within the compound of the Fisheries Division where the construction is being planned. The sewage system is not yet available, and the sewage is processed in the septic tank type digestion tanks and discharged to the ground.

(3) Fuel

No city gas supply is available, and the public is generally dependent on the oil. Although propane gas is beginning to be used for general business purposes, the supply is quite unstable.

(4) Telephone

The telephone service is extensively available for the most part of Apia city and the construction and service lines are controlled by the Ministry of Communications and Works. It is possible to get the required number of circuits.

(5) Road Conditions

As discussed before, the site of the Fisheries Division located on the reclaimed area joins the Main Beach Road which is the main road in Apia District. There is a plan for constructing a by-pass between the existing market and the New Fish Market. There would be, therefore, no problems at present or in the future concerning the access.

2-5: Plans for Basic Facilities

The basic facilities are defined as the facilities to protect the fishing port from the outer forces such as waves, littoral drift, current, etc. that affect the port adversely, the facilities for berthing ships for discharging and idling, and the facilities to secure the water area for the safe departure, return and anchorage of the boats. Since there are no basic facilities at present except for the water area where the fishing boats are anchored in the planned area at Apia, these facilities to fulfil the above purposes are designed.

2-5-1: Items of Facilites

The facilities to be built are as follows:

(1) Berthing Facilities

1) Discharge wharf

There are many "Alia-type" small fishing boats in Apia district at present and the facilities to discharge the catches of these fishing boats and to transport them to the market are designed. The boats will be berthed alongside.

2) Idle berthing wharf

There is no idling facility for berthing the Alia-type fishing boats now in Apia district. Therefore, an idle berthing wharf is designed for those Alia-type small fishing boats. They will be berthed by the stern.

3) The wharf for Tau Tai Samoa

The large tuna fishing boat, Tau Tai Samoa, is anchored offshore presently due to lack of a berthing wharf. Therefore, the wharf that is capable of berthing Tau Tai Samoa or the similar size vessels will be designed.

(2) Breakwater

The planned site is located at the innermost point of the creek surrounded by the reef, but gets the effect of the swells invading from offshore. The breakwater is designed in order to protect the new wharf and to facilitate its use especially free from the effects of the waves on the eastern side.

(3) Fish Port Annex Facilities

Light beacons and light buoys will be provided at the edge of breakwaters and in the waterways in order to secure the departure and return of the fishing boats. Bollards and fenders will be provided at the wharf and water supply pipes and illumination lamps will be also provided.

2-5-2: Plan for Facilities

(1) Berthing facilities

1) Conditions of the plan

(a) Object: Alia type small fishing boats and Tau Tai Samoa

Dimensions of Alia are as follows:

Length overall	8.35 m
Breadth	2.75 m
Draft	0.25 m

Dimensions of Tau Tai Samoa:

Length overall	20.65 m
Breadth	3.60 m
Draft	1.55 m
Gross Tonnage	23.23 t

(b) Alia-type boats after unloading are to be berthed by the mooring area or the idle berthing wharf.

2) Length of the berthing facilities

Expected number of Alia type boats in 1984, the target year of the Fourth Five Year Development Plan, is 90 boats in Apia. 1/3 of these boats will use the wharf of the port.

(a) Discharge wharf

Number of fishing boat: 30

Length required for alongside berthing:

Length of boat + allowance

9 m + 3 m = 12 m

Turnover r = 5

Normally, the following formula stands.

$$r = \frac{\text{Time available for unloading}}{\text{Unloading time per one boat}}$$

However, we have considered a situation where the unloaded fish is sold at the market and then the boat departs to wharf, and therefore the time available for sales at the market is set as 5 hours (from 7 to 12 o'clock) and the time for selling the catch per one boat is set as 1 hour.

The required length for the wharf = 30 boats/5 x 12 m/boat ≒ 70 m

(b) Idle berthing wharf

Number of boats: 30

Required length for the wharf where the boats will be berthed vertically: boat breadth + allowance

2.8 m + 2.0 = 5.0 m

The boats are expected to berth by the stern in two rows.

The required length for the wharf = 30/2 x 5 m ≒ 80 m

(c) Wharf for Tau Tai Samoa

Number of boats: 1

Length of alongside berth: boat length + allowance

20.65 m + 4 m ≒ 25 m

Required length of the wharf = 1 x 25 = 25 m

Provided, however, the length of the wharf shall be 50 m which shall include the approach to the wharf for the Alia-type boats and the approach from the end of the breakwater.

3) Depth of the wharf

(a) Discharge wharf

Draft for Alia-type boat	0.25 m
Allowance	0.5 m

Water depth of the wharf = 0.25 m + 0.5 m ≒ 1.0 m

The allowance shall be made for the small fishing boats other than the Alia-type, and the depth shall be set at -1.5 m.

(b) Idle berthing wharf

The same as the discharge wharf at -1.5 m.

(c) Wharf for Tau Tai Samoa

Draft of Tau Tai Samoa	1.55 m
Allowance	0.5 m

Water depth of the wharf = 1.55 m + 0.5 m = 2.05 m

Therefore the dpeth shall be set at -2.5 m to -3.0 m making an allowance.

4) Crown height of wharf

0.5 - 1.0 m will be added to the high water level.

Height = H.W.L. (+ 1.0 m) + 1.0 = 2.0 m

Accordingly, the crown height of the wharf shall be +2.0 m.

This is equal to the height of the existing reclaimed area (Fisheries Division).

(2) Breakwater

1) Conditions for the Plan

(a) The length and direction which can effectively shield the swells and the wind waves coming in from the off-shore area shall be selected for the plan. The wind waves inside the bay are small, and the swells of about T = 10 - 15 sec. coming in from the outer sea shall be considered.

(b) The plan shall be such that the reflected waves from the breakwater will not hinder the navigation of the ships in the waterway and the harbor entrance.

(c) The plan shall be such that the predetermined waterway width, the width of the harbor entrance and the anchorage area will be secured.

2) Required Length of Breakwater

The breakwater length shall be made as long as possible having secured the sufficient width of the harbor entrance in order not to hinder the safe navigation of the boats. The boat to be served is Tau Tai Samoa.

(a) The depth of the waterway:

Draft	+	Allowance
1.55 m	+	1.0 m

The depth of the waterway = 1.55 m + 1.0 m = 2.55 m

Therefore, the required depth for the waterway and the harbor entrance shall be -2.5 m to -3.0 m.

(b) Width of Waterway and Harbor Entrance

Since the port is located within a creek, the waterway from the outer sea to the inner port shall have the width of 5B - 6 B (B = vessel breadth).

Width of Harbor Entrance = 3.60 m x (5 - 6) = 18 - 21.6 m

The above value is obtained based on the double way channel, while there is only one boat of Tau Tai Samoa which is to be served by this port. Thus, although the width such as above is not actually required, the width of 20 m for the harbor entrance is to be secured in view of the possible increase in use in the future.

(c) Length of Breakwater

According to the bathymetric chart shown in Fig.-2-3, there is a -2.0 m shoal about 50 m off the eastern boundary of the Fisheries Division compound toward the north. The maximum depth between the shoal and the land is 3.5 m, and the predetermined width is not obtainable. The depth beyond the shoal is 3 - 4.5 m, and reaches a part of the West Reef of Apia at 40 to 50 m in the northern side.

Therefore, if the breakwater length was set at about 77 m extending from the reclaimed area of the Fisheries Division compound as shown in Fig.-2-6, it will be possible to secure at least 20 m of width of the harbor entrance with the depth of above -2.5 m.

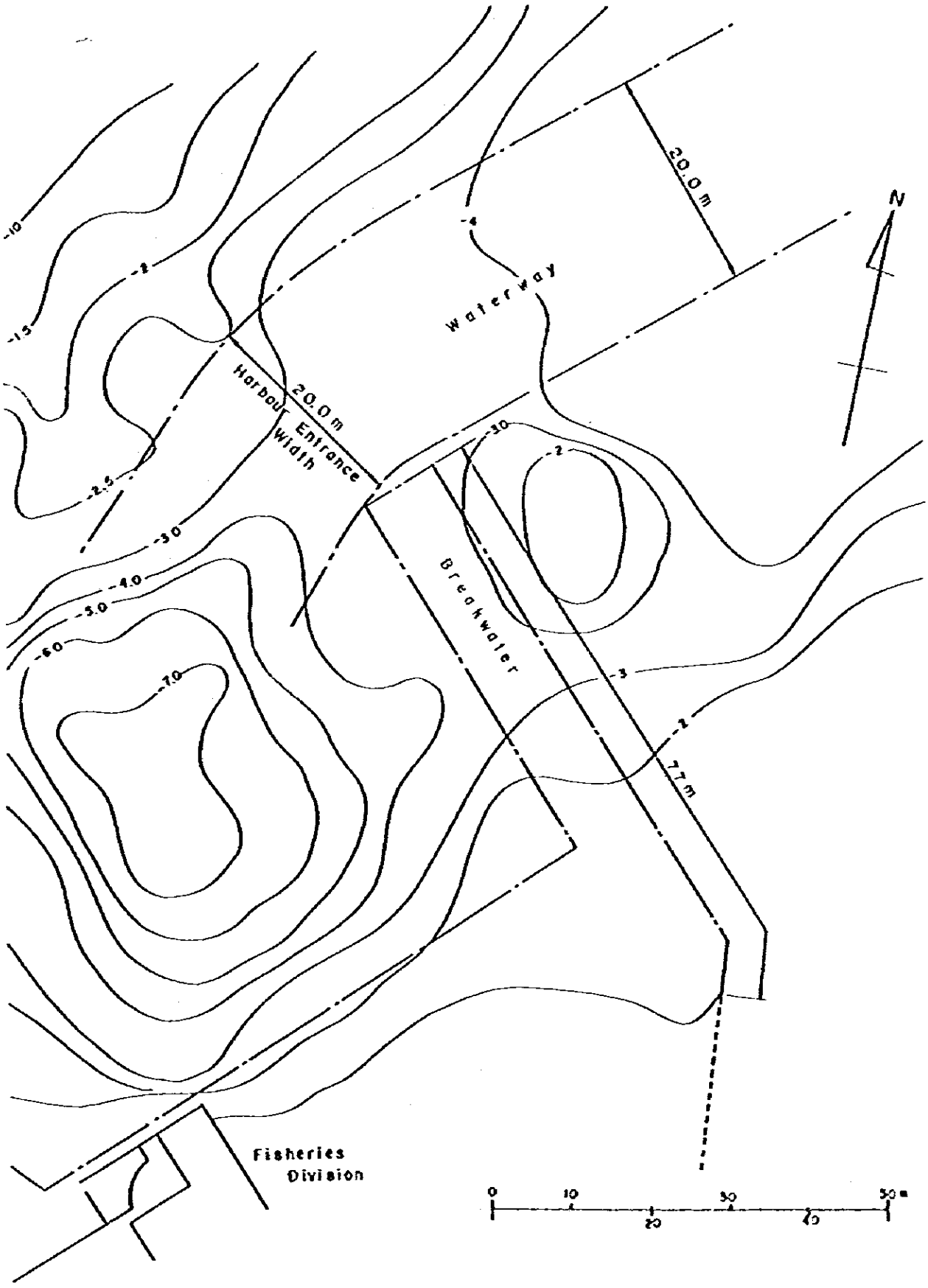


Fig.-2-6 Breakwater Length and Harbour Entrance Width

3) Direction of Center Line of Breakwater

The waves invading from the baymouth surrounded by East Reef and West Reef run up the reef, and further advance into the innermost area of the creek passing through the deepest area and having been attenuated. Most of the waves then enter the commercial port area, while a part of them are defracted and advance into the fishing port area. The deepwater waves enter the fishing port most easily in the direction of NNE, but the waves are defracted in the midway and change the direction to NE - E and reach the fishing port area. Therefore, the center line of the breakwater is preferred to be approximately rectangular to the direction of NE in order to effectively shield the waves from NE direction.

4) Sheltering Effect of Breakwater

The waves which affect the fishing port area most adversely are the swells of T = 10 - 15 sec. and the deepwater direction of NNE. The breakwater should have an efficient sheltering effect for such waves.

Figure-2.7 shows the distribution of waves under the present conditions obtained by computer simulation analysis. The numerical values show the ratio of the wave height as against the wave height of 100 at the point of proposed breakwater head. According to the figure, the wave height ratio under the present conditions prevailing on the side of the mooring basin of the planned site is about 70.

On the other hand, Fig.-2-8 shows the values when the breakwater is provided. According to the figure, -3.0 m wharf and the idle berthing wharf shall be sheltered by the breakwater and the wave height ratio shall be below 20, less than 1/5 of the value before the construction of the breakwater. The unloading wharf, on the other hand, shall have the wave height ratio of 40 to 60 on its eastern side, while the western half thereof shall have about the same value because of the short length of the breakwater. The waves in the direction of NNE in the fishing port area are the highest, although the frequency of its appearance is extremely small. In the directions

of NE and N, the frequency is only 6%. Most of the waves are in the direction of E. Thus, the planned breakwater has a sufficient sheltering effect against the waves. During the storms, the boats will be well sheltered if they seek relief in the sheltered area by the breakwater.

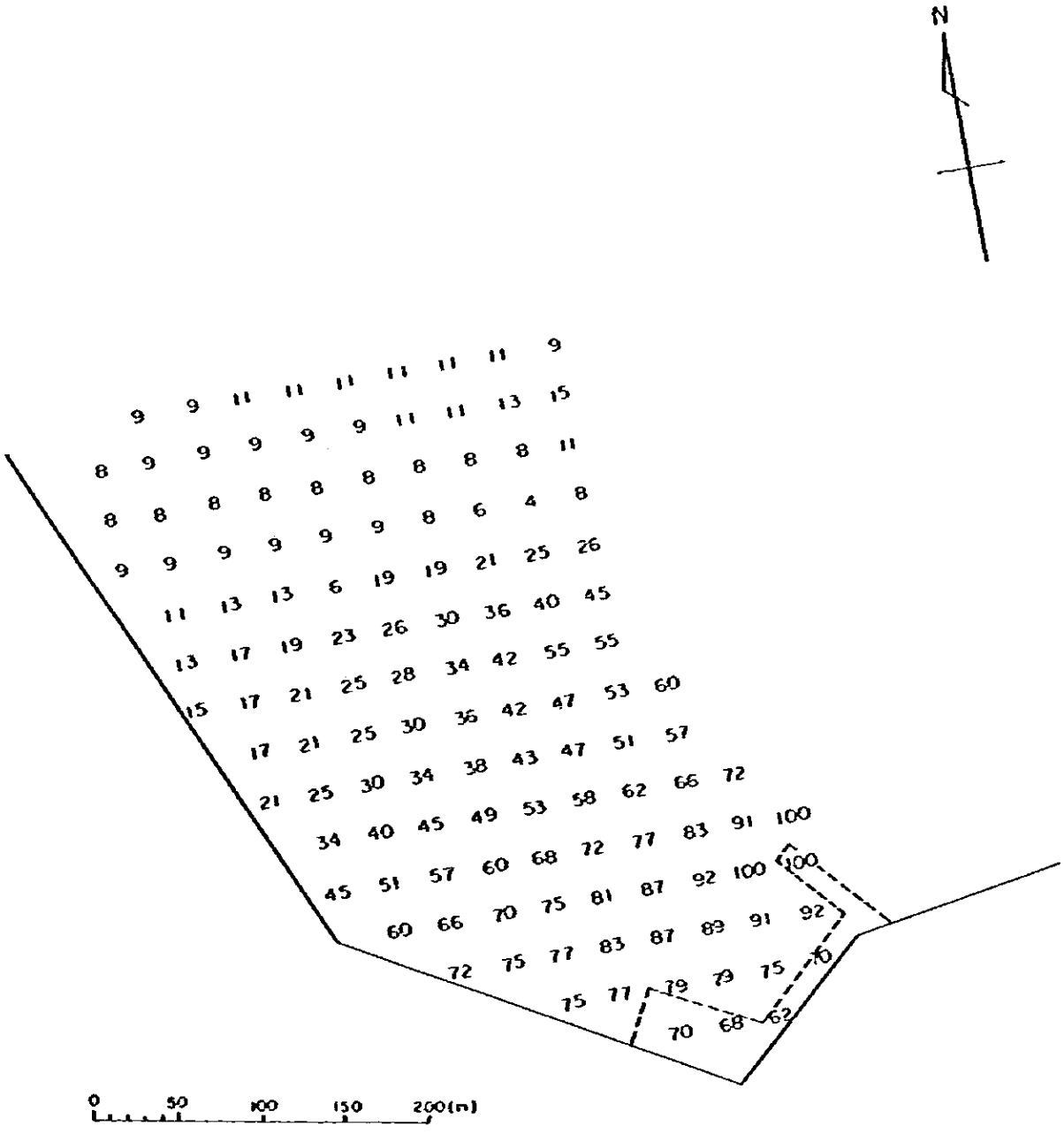


Fig.-2-7 Present Wave Height Distribution

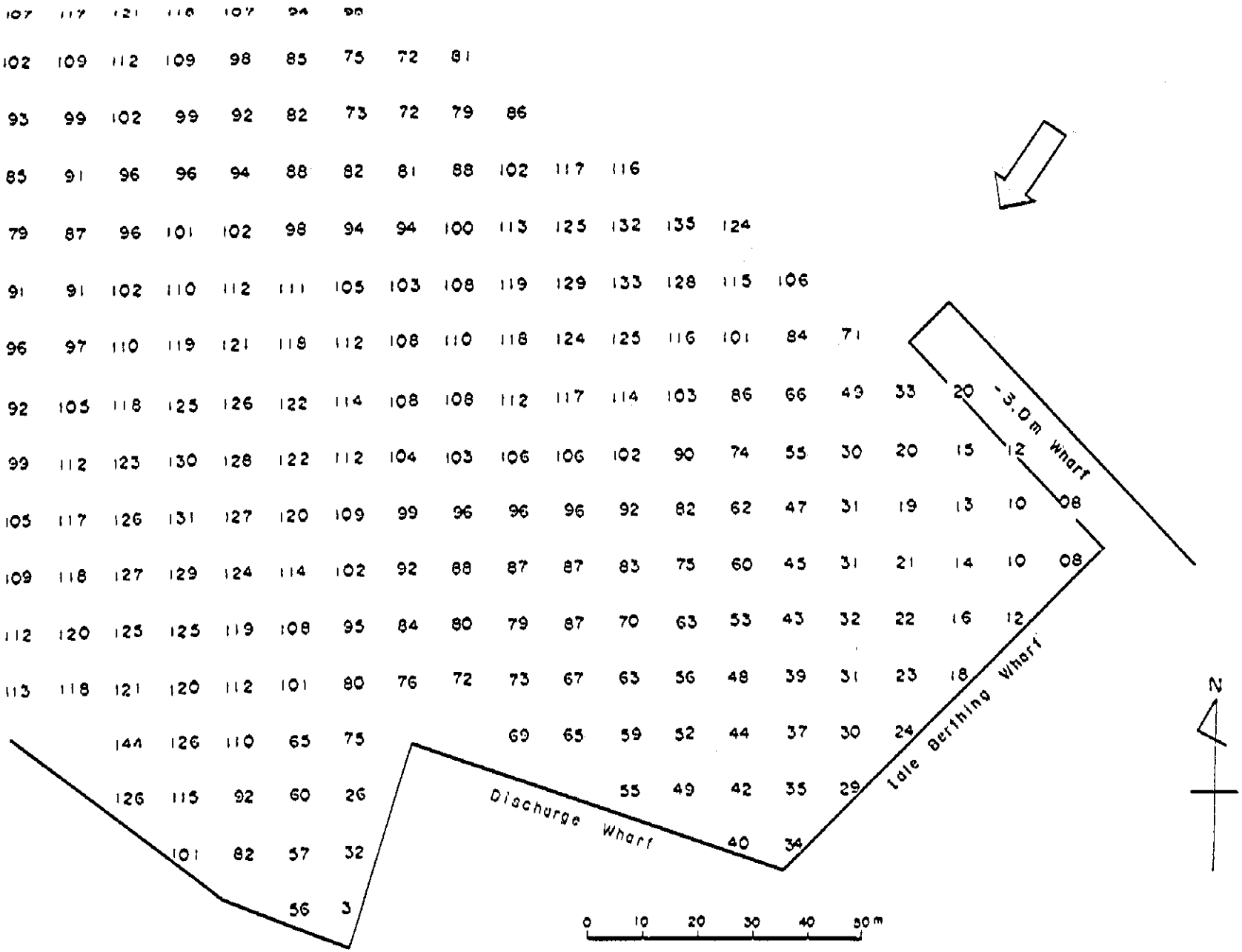


Fig.-2-8 Wave Height Distribution after Breakwater Installation

2-5-3: Allocation Plan

Fig.-2-9 shows the Plan I for the fishing port initially requested by the Government of Western Samoa, and the Plan II, the project approved by the Minutes of Discussion.

Differences between Plan I and Plan II are summarized hereinafter:

(1) There is a plan for constructing a by-pass in front of the existing market which will require the area of about 10 m wide. The new market, therefore, shall be moved to the side of the sea by 10 m.
(2) The faceline of the wharf in front of the new market shall join the faceline of the new road plan, and the eastern side shall be moved to the side of the sea.
(3) The length of the breakwater shall be shortened in order to secure the width of the harbor entrance (about 20 m).

The allocation plan for the basic facilities prepared based on these points is shown in Fig.-2-10.

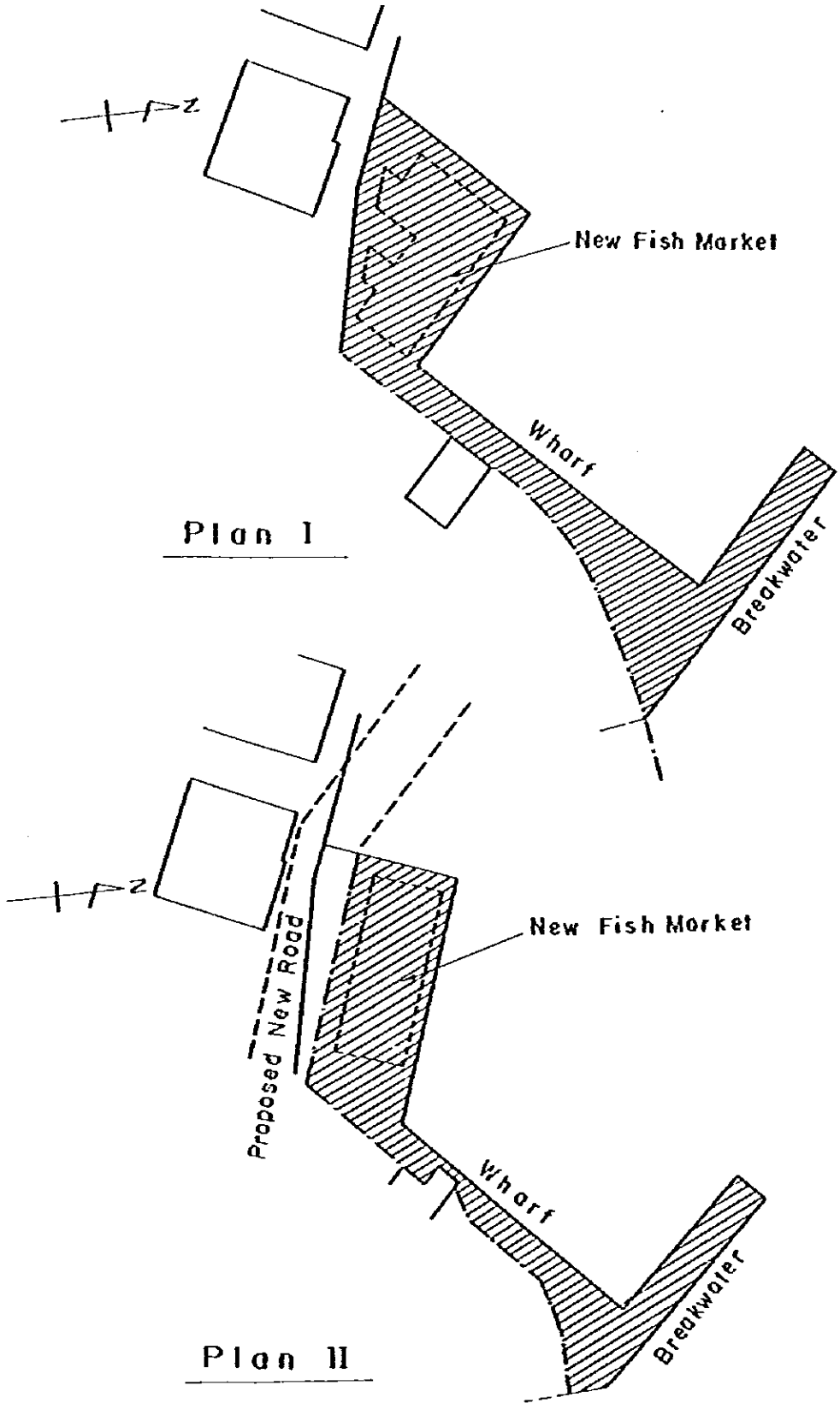


Fig.-2-9 Comparison of Plan

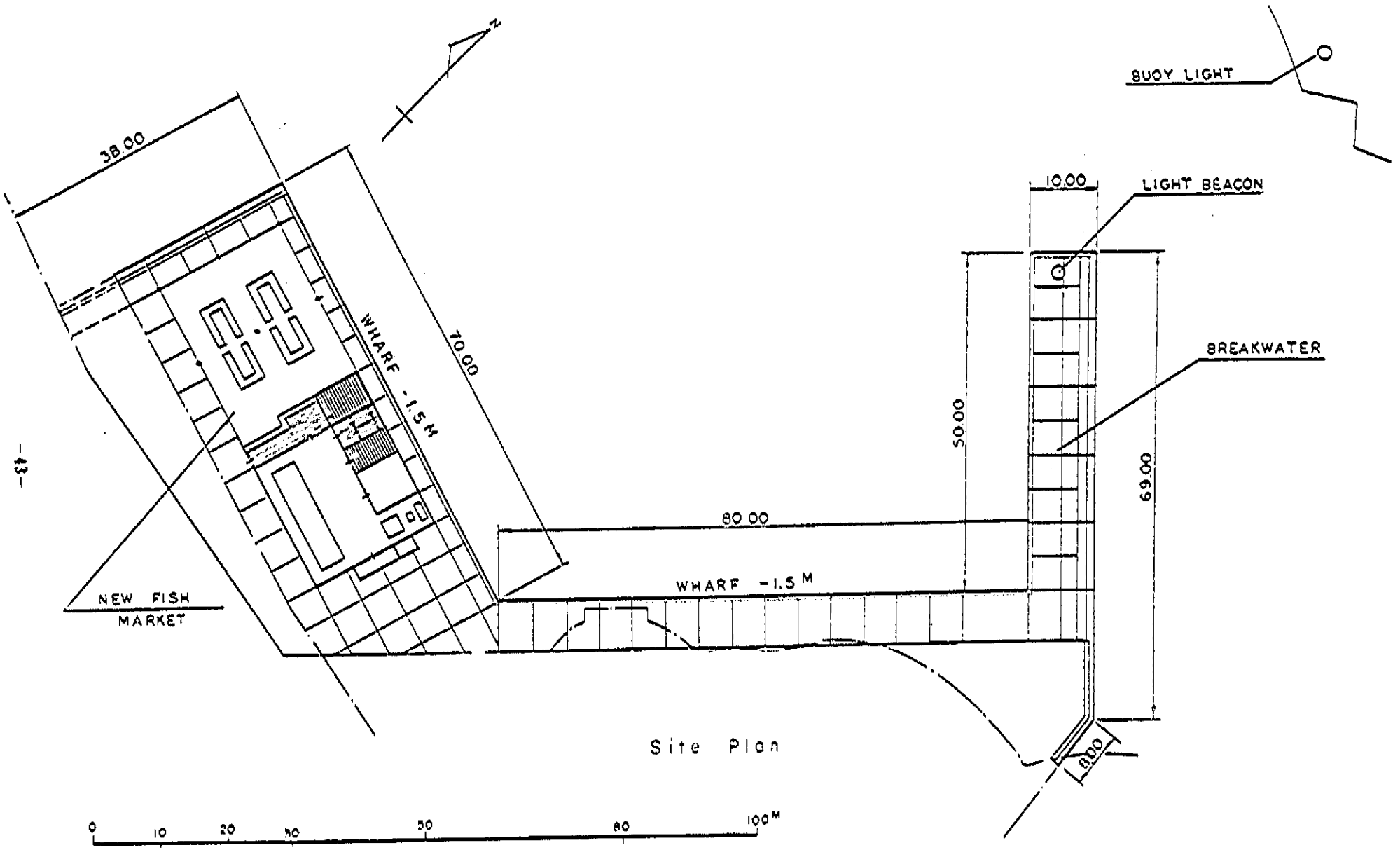


Fig.-2-10 Apia Fish Port Complex

2-5-4: Design of Basic Facilities

(1) Design Conditions

Design conditions for principal fish port facilities are as follows:

1) Boat
   50 GT type fishing boat
2) Surcharge
   $q = 1.0$ t/m2
3) Seismic Force
   $k = 0.0$
4) Tidal Level
   H.W.L. = + 1.00 m
   L.W.L. = ± 0.00 m
5) Residual Water Level
   R.W.L. = + 0.33 m
6) Waves
   Wave Height $H = 2.0$ m
   Wave Period $T = 10 - 15$ sec.
7) Backfilling Materials
   Angle of Internal Friction: $\phi = 35°$
   Angle between Materials and Wall: $\delta = 15°$

(2) Outline of Design

1) Seawall (On the eastern side of market, length 38.00 m)
   Fig. -2-12 shows the standard cross section of seawall. Since the stones of big and small sizes are easily procured locally, the main body of the seawall shall be built of the rubble mound. The armor stones of less than 500 kg shall be used in order to give sufficient stability to the structure against the waves. The ground level of reclamation shall be about the same as the area for the existing Fisheries Center, viz. + 2.00 m.
   The height of the seawall shall be +2.50 m. The waves will be attenuated by the armor stone layer.

2) Breakwater (Length 77 m)

Fig. -2-12 shows the standard cross section of the breakwater. At the breakwater, the maximum wave height is expected as 2.0 m. Therefore, the armor stones of 1 to 2 tons are used. The main body of the breakwater consists of rubble mound. The crown height of the breakwater is planned to be + 3.00 m in order to prevent wave overtopping and to enable use of the back of the breakwater as the wharf. The surface of the breakwater is covered by the armour stone, so that the waves are attenuated and the wave reflection is prevented in order to secure the safe navigation of the boats.

3) -1.5 m Wharf (Length: 150 m)

Fig. -2-13 shows the standard cross section of the wharf. The wharf shall be the gravity type of laying concrete blocks, since it is possible to procure the coarse and fine aggregates for concrete locally, and a wide area for the manufacturing yard for blocks is available. As the ground surface is assumed to be covered with silt, there will be provided the rubble mound by excavation. In the stage of detailed design, boring will be conducted and the cross section shall be amended depending on the results obtained.

4) -3.0 m Wharf (Length: 30 m)

Fig. -2-12 shows the standard cross section of the wharf. Basically, it is the same as the -1.5 m wharf.

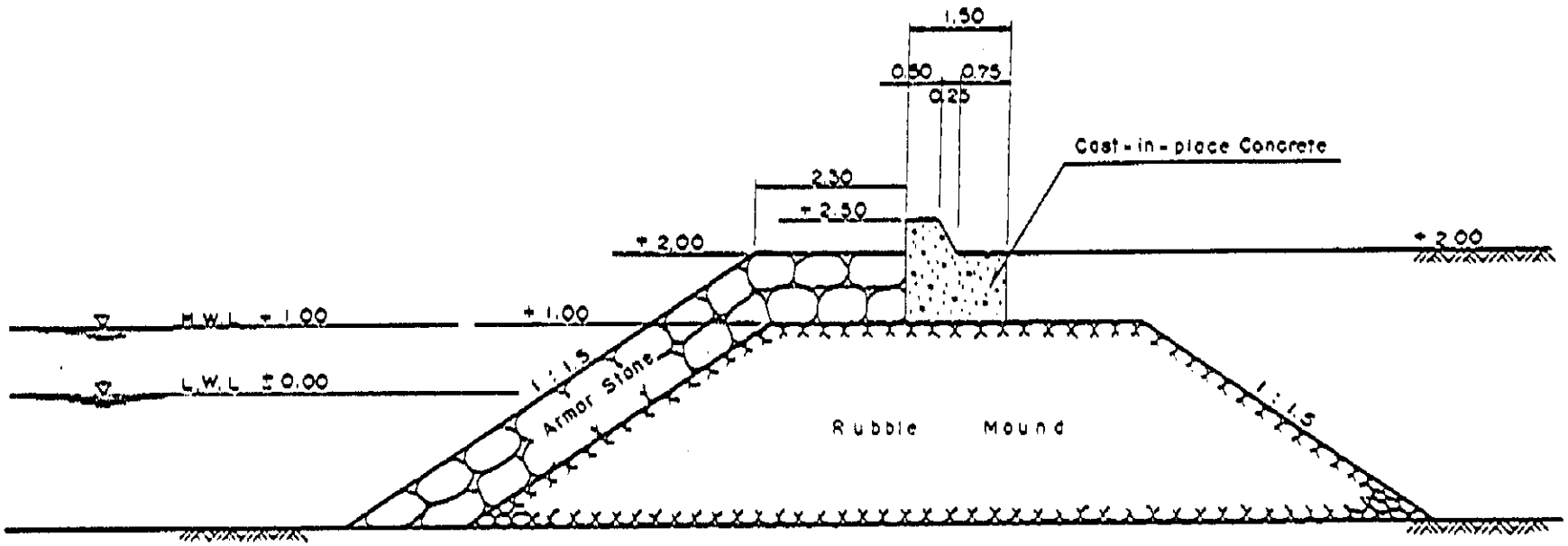


Fig.-2-11 Typical Cross Section of Seawall

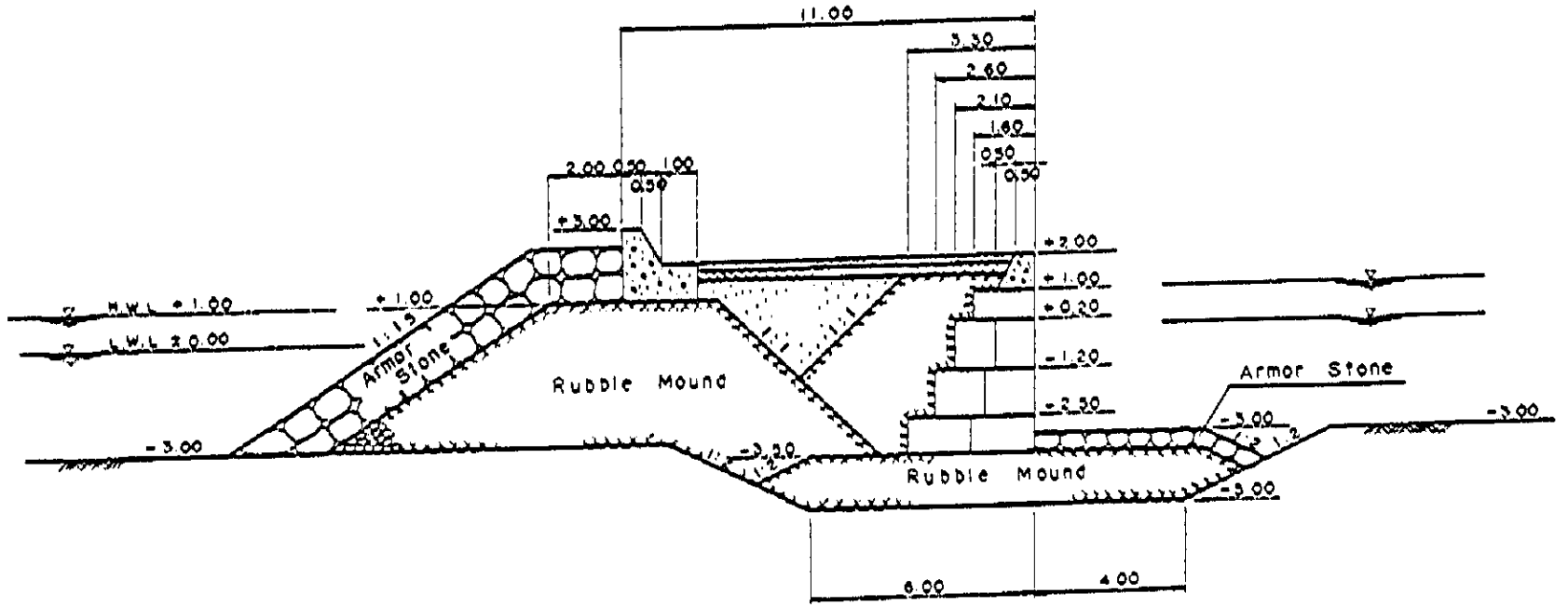


Fig.-2-12 Typical Cross Section of Breakwater and Wharf (- 3.0 m)

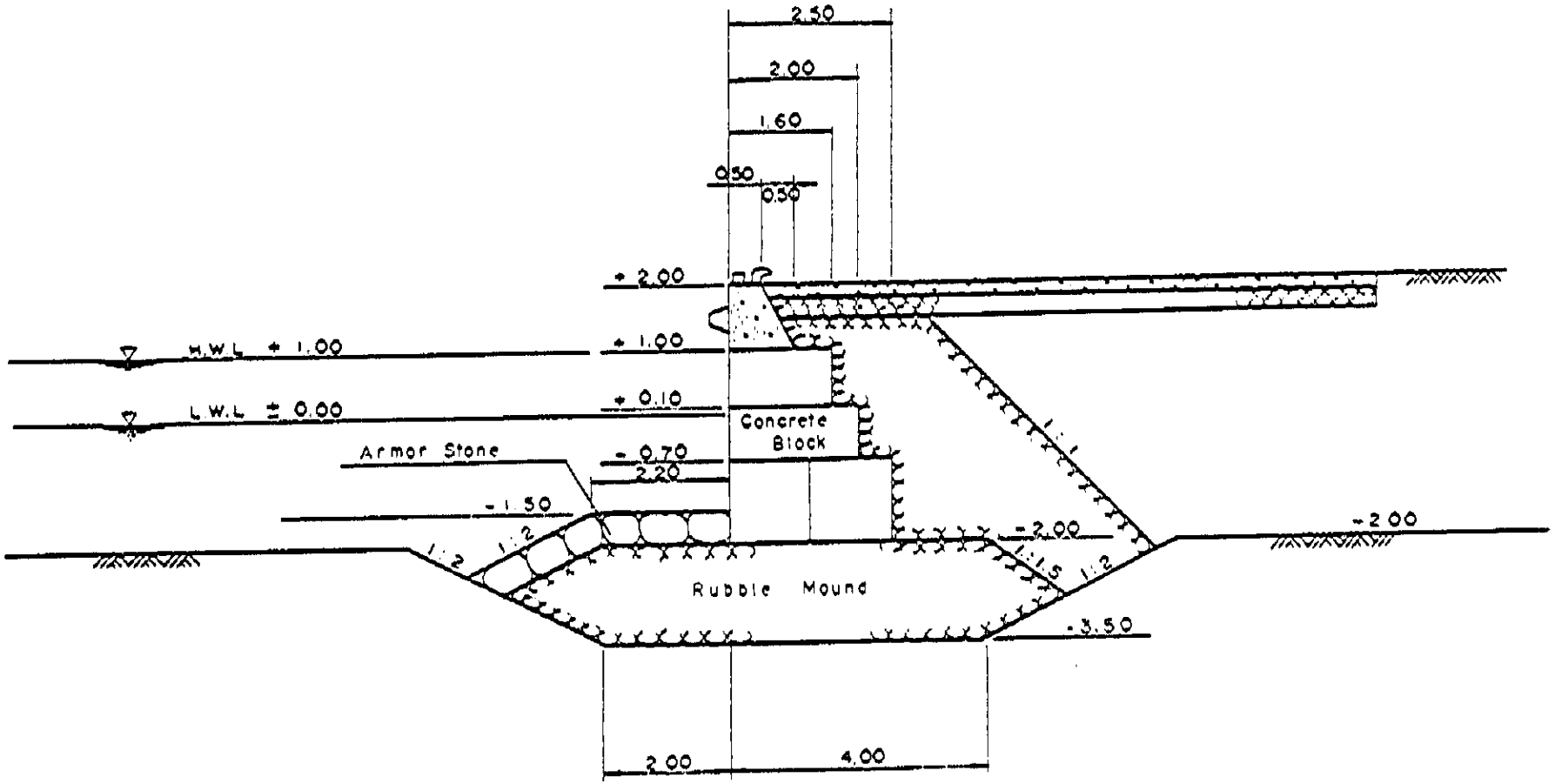


Fig.-2-13 Typical Cross Section of -1.5m Wharf

2-6: Plans for Functional Facilities

Functional facilities are defined as the facilities which complement the basic facilities and which enable more rational performances of various works and services conducted at the fish port. When the fish market, the ice making and the freezing facilities are to be built within the planned area for the fishing port, they will also be counted as one of the facilities which make up the port.

2-6-1: Items of Facilities

1) Fish Market

A new fish market will be built, taking into consideration that the existing fish market has the small floor area and doesn't operate sufficiently.

2) Annex Facilities

Facilities of the new market including a freezer and an ice maker are built and some equipment are provided in order to function as the new one.

2-6-2: Plans for Facilities

For planning the facilities, study should be made for calculating the required floor area of the fish market, required volume of the freezer and required capacity of the ice maker.

(1) Floor Area of Fish Market

It is assumed that the amount of fish handled by the fish market in 1984, which is the target year of the Fourth Five Year Development Plan, would increase by 2 fold compared with that of 1979.

The required floor area of the new fish market was determined to be 1,000 m^2 or about 2.5-fold of the existing fish market, taking into considerations the handled amount which is expected to increase and the limited floor area of the existing market. Fig.-2-14 indicates the existing fish market.

(355.75 m^2 + 42 m^2) x 2.5 = 994.375 m^2 ----- 1,000 m^2
(Existing Fish Market) + (Freezer in a separate building)

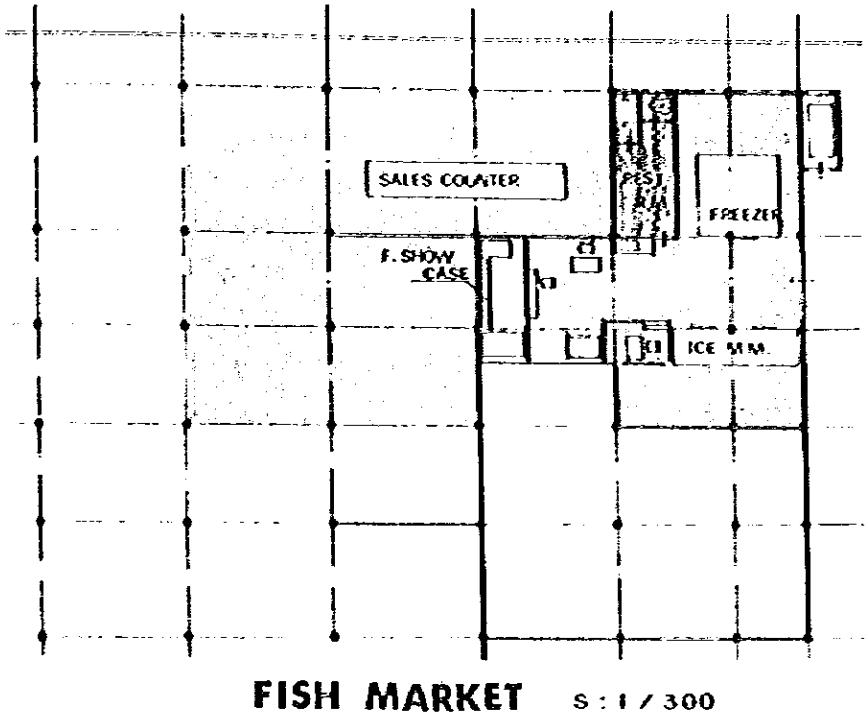


Fig.-2-14 Existing Fish Market

(2) Capacity of the Freezer

1) Number of Alia was about 200 as of 1979. The annual fish catch per ship is around 7.5 ton (The Fourth Five Year Development Plan).

Alia are being built at the pace of 50 - 60 boats per year presently. By 1984, the target year of the Fourth Five Year Development Plan, the total fleets including replacement is estimated to reach 350 - 400 and the annual fish catch to about 8.1 ton (The Fourth Five Year Development Plan).

Should we assume roughly, therefore, 164 ton out of the fish catch in 1984 (400 x 8.1 ton = 3,240 ton) will be frozen if the present ratio of 5.07% frozen fish vs. the total catch (the frozen catch of 76 ton against 1,500 ton of the total fish catch as of 1979 according to the Fish Market Record) is assumed.

The available capacity of the existing freezer is 20 ton, which is sufficient for 76 ton of the annual purchase; therefore, a freezer

with a capacity of approximately 20 x 164/76 = 43 ton will be needed by the year 1984.

2) Since the existing freezer started its operation from August of 1977, its actual record is limited. However, it is assumed that the volume of fish purchased by Fish Market increased by 15 - 20 ton in the record from 1978 to 1979. If it is assumed to increase at the similar rate to 1984, the amount of fish to be frozen will reach 151 - 176 ton by 1984.

By assuming in a similar way to the above 1), the capacity of approximately 20 x (151/76 - 176/76) = 40 - 46 ton will be required.

Judging from the assuming of the above 1) and 2), the required capacity of the freezer under the present plan is determined to be 50 ton.

(3) Capacity of the Ice Maker

Usage of ice presently sold in the existing fish market is summarized as follows:

1) For preservation of fish caught in villages
2) For transportation of fish from villages to the market
3) For use on board Alia-type fishing boat (to preserve fish until return to the shore)

It is assumed that demands for ice for the above purposes, 1) and 2) , will not increase radically since the distribution mechanism has been modernized since 1977, i.e. installation of refrigerators (at 10 points) and ice-makers (at 3 points) in the major villages, improvements in the fish collecting system. The ice-making machines in the present plan will be directed toward the demands in Apia area for the purpose 3). Partly because there were no facilities before 1977 to supply ice to fishing boats, Alia-type fishing boats were not provided with tanks to preserve ice.

Ice became available in recent years, however, and fishing boats with such equipment came to be built gradually.

By 1984 or the target year of the plan, the number of registered Alia-type fishing boats is expected to increase to 80 - 90 in Apia. With conditions assumed below, the required production capacity of the ice-making machines is calculated.

1) Diffusion rate of Alia-type fishing boats with ice-preservation equipment: 50%
2) Amount of ice used is determined by the weight ratio to be 1 : 1 as against the fish catch considering the atmospheric temperatures, the length of fishing time, etc.

assumed number of fishing boats		Monthly fish catch/boat		diffusion rate
(80 - 90)	x	8.1 ton/12 months	x	50% = 27 - 30 ton/month

Accordingly, the required production per day is to be 1 ton/day.

The total storage capacity for ice should be to allow 3-fold of the ice production capacity preparing for the highest demands at the peak time of the fish catch.

2-6-3: Structure of the Facilities

The Planned Fish Market are divided into two areas: market space for local fishermen, and the space to be administered by Fisheries Division (Fig.-2-15).

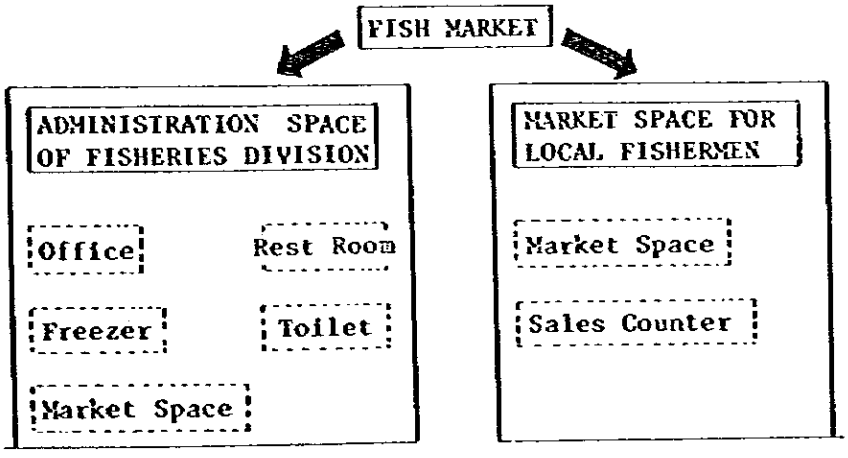


Fig.-2-15 Planning for Fish Market

(1) Market area for the local fishermen (500 m^2)

This is the area to be offered to the local fishermen to directly sell their catch. The floor space is 500 m^2. There are provided with counters for selling fish.

(2) Area managed by Fisheries Division (500 m^2)

This area consists of facilities having functions mentioned below.

1) Management/Administration Facility

This is the part from which the whole fish market is to be managed and operated, and assumed number of employees and rooms are as follows:

Office:	35 m^2
Rest Room:	28 m^2
Toilet:	28 m^2
Storage:	40 m^2
Total Area:	140 m^2

Assumed number of employees:

Manager	1
Assistant Manager	1
Fish Buyer	1
Freezer Keeper	1
Cashier	1
Clerk	1
Sales Girl	1
Driver	3
Night Watchman	1

Total Number of Employees: 11

2) Freezer/Storage Facilities

This is to freeze and preserve fish purchased and collected from local fishermen and villages and consists of the following.

Fish washing space
50 ton Freezer
Ice-making machine with 1 ton/day capacity

Total Area: 295 m^2

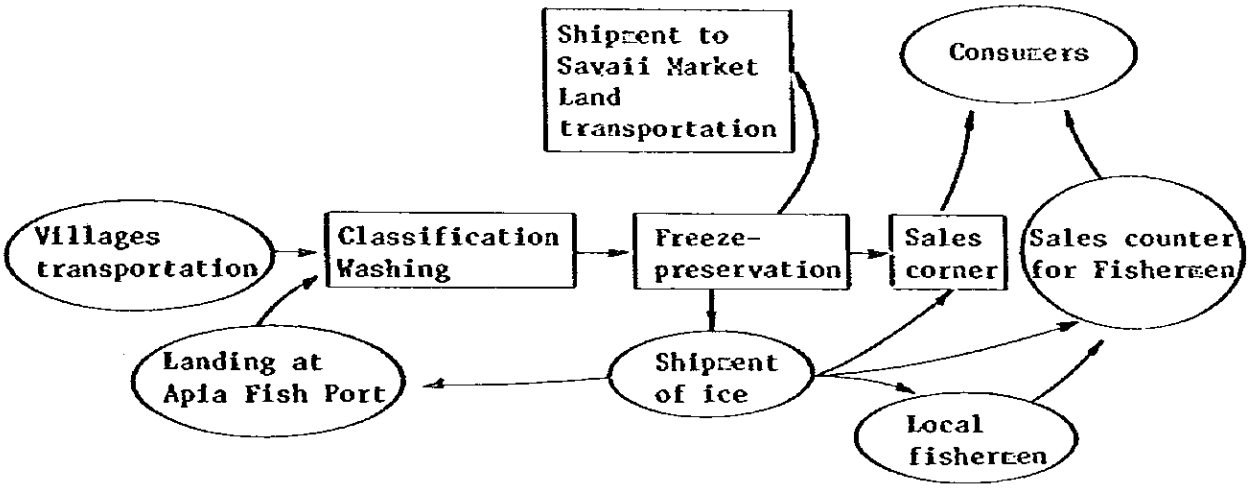
3) Sales Facility

The area is to sell frozen fish. The floor space is 65 m^2, which is provided with a sales counter with a total length of 6 m and one freezer-show case.

2-6-4: Layout Plan

Planning the fish market layout is included in the Fish Port Overall Plan as one functional facility. In planning the layout, the following items are taken into consideration:

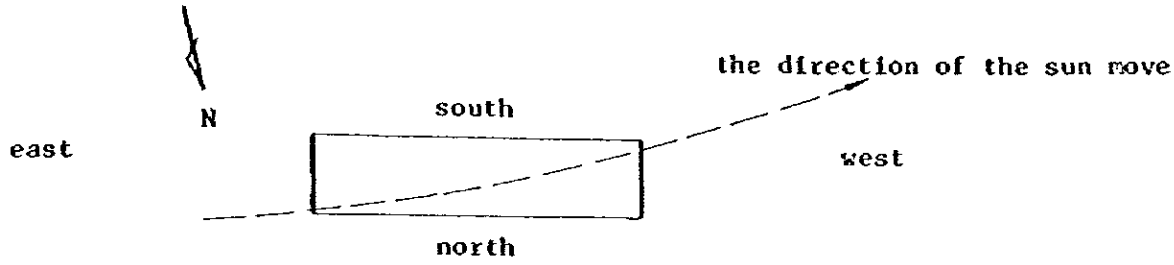
(1) Alignment with the plan of the upper level
(2) For a smooth flow of fish along the flow chart in Table -2-2
(3) Relation with the existing fish market, more specifically meticulous review of the flow diagram shown in Fig. -2-16.



Apia Fish Port	Fish Market			
Wharf Landing- Wharf	Fish Classi- fication Space Washing Space Parking Space	Freezer Ice-maker	Sales Corner Freezer. Show-Case	Market- counter for Fishermen
	Administration Office, Rest Room, Toilet			

Table-2-2 Flow Diagram of Fish and Functions of Facilities

The building is to be placed to avoid the strong sunshine, since the perishable fresh fish is handled.



The sides facing the north and the south are not exposed to the slant sun.

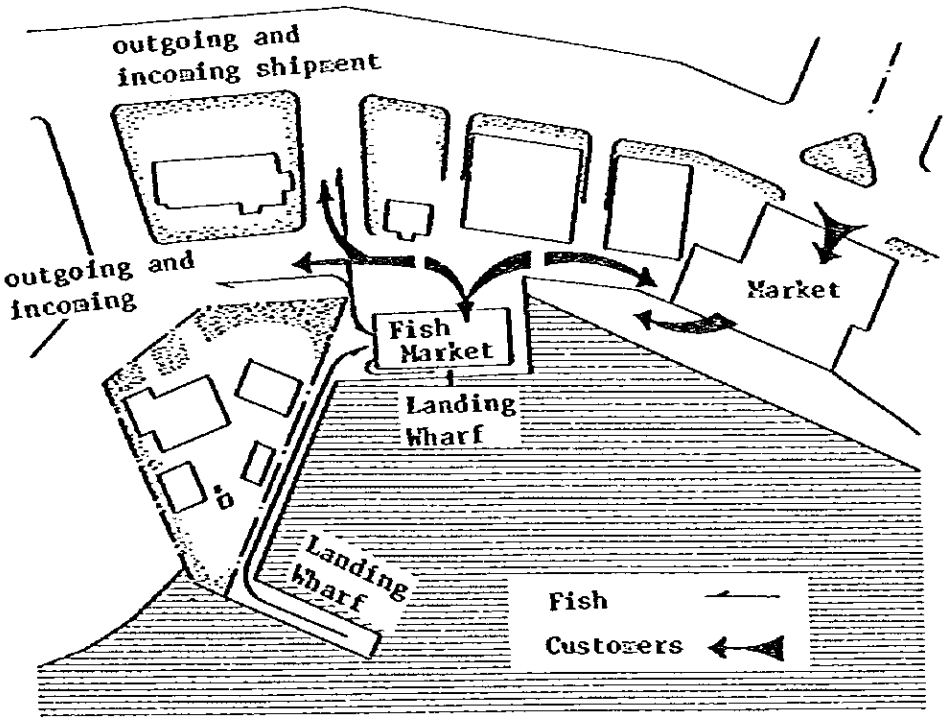
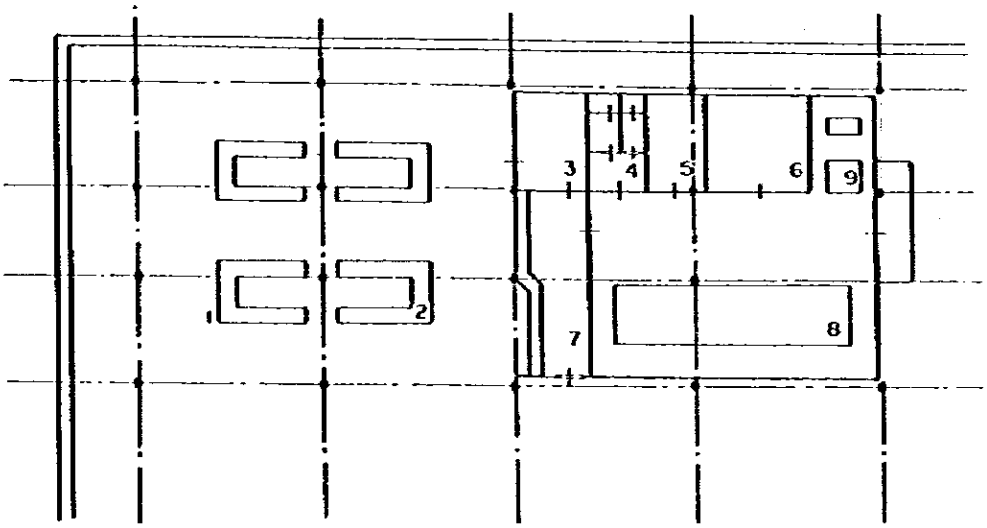


Fig.-2-16 Flow Diagram Plan

2-6-5: Architectural Plan

(1) Plan

As mentioned in the basic items, the plan shown in Fig. -2-17 was formed based on the results of consultations with Western Samoa government personnel concerned.



No. 1: Market space for local fishermen
No. 2: Sales Counter for local fishermen
No. 3: Office
No. 4: Toilet
No. 5: Rest Room
No. 6: Storage
No. 7: Market Space for Fisheries Division
No. 8: Freezer
No. 9: Ice maker

Fig.-2-17 Plan of Fish Market

Table 2-3: Rooms and Floor Spaces of Fish Market

Rooms	Floor spaces
(1) Area Administrated by Fisheries Division	
1) Management/administration facilities	
Office	35 m^2
Toilet	28 m^2
Rest Room	28 m^2
Storage	49 m^2
2) Sales facility Freezing/storage facility	
Freezing/storage room (50 ton freezer, Ice maker with 1 ton/day capacity, Generator)	295 m^2
Sales counter (Counter Freezer show case)	65 m^2
(2) Area for Fishermen	
Sales facility for fishermen Sales area (Sales counter)	500 m^2
Total floor area	1,000 m^2

(2) Structure

Main Structure:	The main structure is of steel structure, one-storied and rigid-frame.
Foundation:	Since the building site comprises mainly of reclaimed ground, the foundation design should be planned with utmost care. The site should be prepared by rolling compaction sufficiently so as to omit pile driving.
Wall:	Walls are of concrete block which is the most commonly available material in Western Samoa. Perforated blocks will be used at some points for ventilation.
Roof:	Since the area is a high-rain area, the roofs should be of a single slate roofing with a sufficient gradient.

(3) Determination of Design Conditions

Having considered the actual local conditions, the following conditions are determined:

Surcharge	In accordance with Japanese laws and regulations.
Wind pressure:	300 kg/m^2
Soil bearing capacity:	5 ton/m^2
Standard Design Strength of Concrete:	180 kg/cm^2
Steel bar & Steel Frame Strength:	In accordance with Japanese laws and regulations.

(4) Finishing Materials

In selecting finishing materials, local conditions, meteorological conditions, etc. such as weatherability, damp-proofness as well as corrosion prevention, and local availability for maintenance purposes were considered.

Main finish materials are listed below:

1) Exterior finish

Roof:	Slate single roofing
Outer wall:	Concrete block face layer paint finish
Fittings:	
Window:	Wooden sash, paint finish, louver window
Door:	Wooden door
Floor:	Concrete metal trowel-finish

2) Interior finish

	Floor	Wall	Ceiling
Office	Mortar finish	Mortar, Paint	Slate, Paint
Toilet	SP Tile	SP Tile	Ditto
Rest Room	Mortar	Face Block Layer, Paint	Ditto
Storage	Mortar	Ditto	Open-board ceiling, Paint Finish
Freezer	Mortar	Ditto	Paint finish showing Roof Wood Wool Pattern
Sales Corner	SP Tile	Ditto	Ditto
Sales Area of Local Fishermen	Mortar	Ditto	Ditto

2-6-6: Plan for Architecture Facilities

(1) Basic Items

1) The electric standards applicable shall be in accordance with New Zealand Standards and regulations.

2) General machineries (such as lighting fittings, plug sockets, etc.) shall be procured locally as much as possible in order to conform to the above (a) standard and for easy maintenance and replacement after completion.

(2) Plan for Electric Facility

1) Power Supply Facilities

Power is to be supplied through transmission lines which is led into the main panel of the facilities concerned at the cost of the Western Samoa Government.

The voltage supplied is three-phase, four line 400/230 V 50 Hz. Loads on the facilities are listed below:

1.	Lighting outlets	12.7 kW/Hr.
2.	Freezer	10.0 kW/Hr.
3.	Ice-maker	8.1 kW/Hr.
4.	Illumination	2.5 kW/Hr.
	Total	33.3 kW/Hr.

An Emergency generator is provided so as not to cut off the power to the freezer in case of power failures.

2) Trunk Line Facility

Power is supplied from the main panel to respective control panels and the panel board for lamps.

The trunk line system is shown schematically in Fig.-2-18.

3) Lamps and Plugging

The lighting is provided mainly by fluorescent lamps and partially by incandescent lamps and mercury-arc lamps. Mercury-arc lamps are mainly used for exterior lighting.

The illumination intensity for respective rooms is listed below:

Office:	300 LX
Rest Room:	300 LX
Storage, Freezer Storage:	150 - 100 LX
Sales Area:	250 LX
Toilet:	100 LX

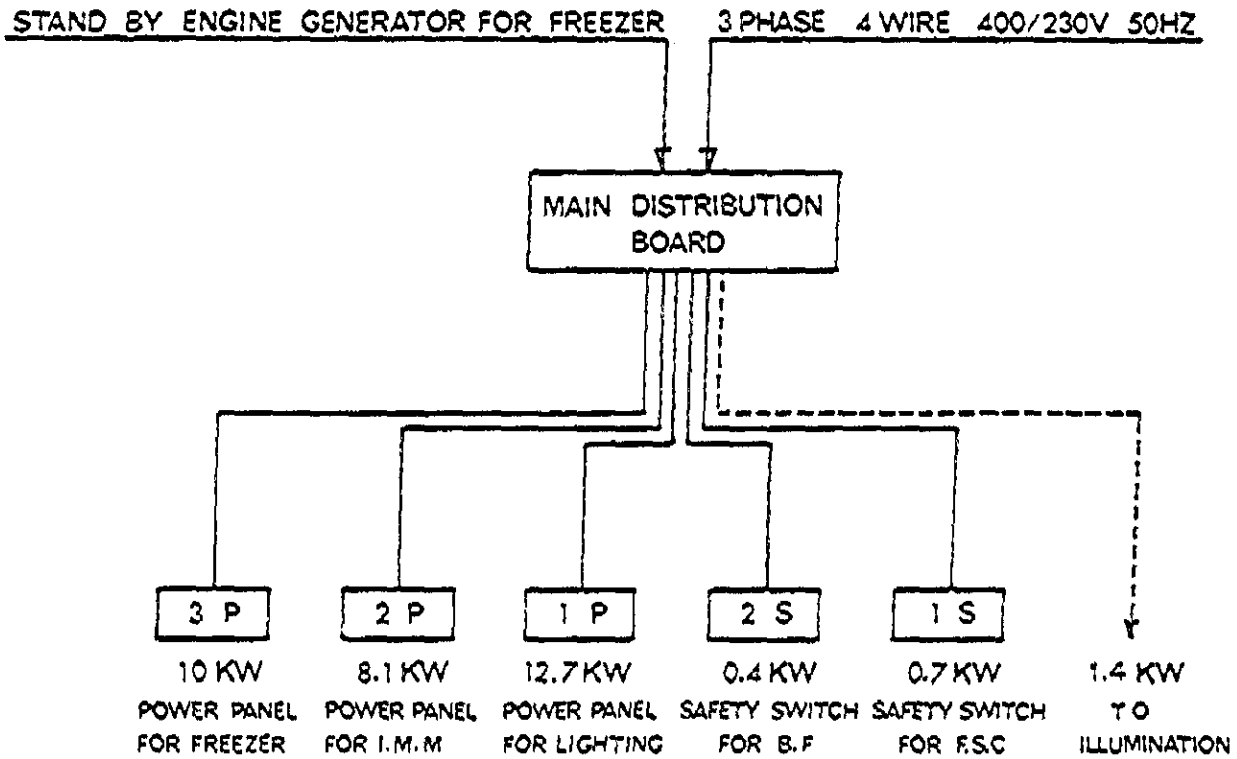


Fig.-2-18 Distribution Diagram of Trunk Line System

For outlets, plug sockets of single 230 V grounded type will be used. Where machines with a high capacity are to be used, independent circuits should be provided.

4) Telephone Facility

The telephone facility up to the terminal receivers is to be constructed by the Western Samoan Government. However, piping for transmission lines is to be constructed by the contractor.

5) Lightening Rod

Lightening rods are provided.

(3) Plan for Air Conditioning/Ventilation Facilities

Air conditioning (cooling) is not to be provided as a rule, and the natural ventilation will be relied on. However, ceiling fans are to be provided at the office and the rest room and a ventilation fan at the toilet.

(4) Water Supply/Drainage Plan

1) Water Supply Facility

Water is supplied from the public water supply to respective terminal appliances.

2) Drainage Facility

Waste water is classified into sanitary sewage, miscellaneous waste water and waste water from fish washing area. The sanitary sewage is passed through septic tank, the miscellaneous waste water is let out to the sea and the waste water from the fish washing area is discharged into the sea after trap processing.

(5) Freezing, Ice-making Facilities

1) Freezer

The room of the freezer is consisted of prefabricated panels with the mechanical joint.

Specification of
panels:

Surface material: Color aluminum sandwitch panel
Insulating material: Hard polyurethane foam of 100 m/m thickness

The freezer is divided into four chambers with a total capacity of 50 ton. The holding temperature is set at -25°C.

The freezing machine shall be of separate-type providing with freezing units in respective chambers. The system enables to operate each unit separately.

2) Ice-making Machine

The ice-making capacity is 1 ton per day and the shape of ice is of plate ice.

The capacity of the ice storage is 3 ton. The storage room is built with prefabricated panel system.

Specification of
Panels:

Surface material: Aluminum sandwitch panel
Insulating material: Hard urethane foam of 100 m/m thickness

2-6-7: Equipment and Fixtures of the Building

Equipment and fixtures of the plan to be provided under the grant are listed below:

(1) Equipment

1) Freezer ..... 1 Unit

Freezer capacity: 16.1 m x 3.6 m x 2.2 m = 126.72 m^3
(JRT 50 ton)

Holding temperature: -25°C

Specifications: Prefabricated freezer

2) Ice-making Machine ..... 1 Unit

Production: 1 ton/day

Ice storage capacity: 3 ton, prefabricated,

3) Emergency Generator ..... 1 Unit

Diesel Generator: 30 KVA

4) Freezer Show Case ..... 1 Unit

(2) Fixtures

1)	Insulated Fish Carrying Basket	100 pcs.
2)	Floor Scale 150 kg.	1 pce.
3)	Table Scale 20 kg.	1 pce.
4)	Saw for Cutting Frozen Fish	1 pce.
5)	Knives for Fish	5 pcs.
6)	Trolleys for Fish Carrying	4 pcs.
7)	Fish Price Tags	200 pcs.
8)	Cash Register Manual	1 pce.
9)	Adding Machine	1 pce.
10)	Gloves Rubber	1 dozen
11)	Aprons	20 pcs.
12)	Small Freezer Box	1 pce.
13)	Refrigerated Truck 2 ton	1 unit
14)	Four Wheel Drive Car	2 units

Chapter 3: Construction Plan

3-1: Scope of Construction Work

The survey team confirmed following items on the facilities described in the minutes and a scope of construction work after the discussions with the Government of Western Samoa.

(1) The facilities supplied under the grant aid from the Japanese Government

1) Market and Equipment
2) Wharf
3) Breakwater

(2) Responsibility of the Government of Western Samoa

1) To secure that the sea area necessary for the construction of the facilities be freely accessible
2) To secure land necessary for the execution of the Project
3) To provide electricity, water supply, drainage and any other incidental facilities necessary for the construction and the operation of the facilities
4) To ensure prompt unloading and custom clearance at the port of entry in Western Samoa and internal transportation of materials, machineries and equipment to the site
5) To exempt Japanese personnel concerned from any taxes, duties, fees, levies and other imposts which may be imposed under the laws and regulations in effect in Western Samoa on the personnel and any equipment, machineries, materials and supplies entered or brought into Western Samoa for the purpose of carrying out the services in connection with construction and installation of the facilities and equipment
6) To obtain the persmission and approval necessary for construction of facilities in Western Samoa.

3-2: Execution Plan

3-2-1: Construction Conditions in Western Samoa

From the results of the field survey, following conditions must be considered in order to proceed fish port construction in Western Samoa.

(1) Marine Construction Equipment

In Western Samoa, operation of marine construction has rarely been done except for the commercial port. Therefore, floating cranes and pontoons are not available. Several tugboats available in Apia are now operated for large vessels entering from or to the commercial port at present, but they will not be available for this operation. No stone carriers, earth carriers, etc. are also available, and only small fishing boats (not Alia-type) can be used.

(2) Land Construction Equipment

For the land operation, equipment may be leased from P.W.D., S.P.D.C. and private companies.

As for the cranes, only one is available for the size larger than 20 t. This can not be used for this operation. There are no difficulties concerning the small cranes.

The trucks to be used for transportation (including dump trucks), bulldozers and loaders used for discharging are all owned by S.P.D.C. and the private companies and there is no problem.

(3) Materials

Upolu Island where Apia is located at is a volcanic island and the hard rocks like the basalt can be obtained. Large volume of boulders are obtained from the agricultural development, etc. and over 1 ton size of armor stones will be easily obtained. Price changes according to the method of transportation. Coarse aggregates for concrete are prepared by breaking the pieces of boulders and rocks collected from the ricky hills (S.P.D.C.) and a sufficient volume will be available. Fine aggregates are obtained by dredging the coral sand.

Other materials like wood are obtained easily but the stock of imported steel materials will create some problems.

Generally coral sand is used for the land fill and it is easily compacted and the quality is good.

(4) Labor

Labor cost will be 3.5 Samoan dollars per day for unskilled works and sufficient labor force is expected.

(5) As to the materials which are required in large quantities and which require the high precisions such as structural materials, wall face material, roof material, etc., it is planned to produce them in Japan having considered the available quantities in stock, the work precision, the delivery and the overall unit prices, etc.

(6) Regulations Related to Construction

At present the Western Samoa Government has not established either the design standards or the engineering specifications related to civil engineering works. New Zealand construction standards are now being taken into consideration in P.W.D. constructions, but they are not definite. Therefore, there should be no problems if Japanese construction standards and the engineering specifications are relied on.

The design standards concerning architecture are to be in accordance with the Japanese Laws and Standards; provided, however, they shall be adapted to the actual situations at sites.

3-2-2: Execution Plan

(1) Description of Execution Method

Following are detailed items of works for constructing of fish port facilities.

Basic facilities:

1) Excavation
2) Rubble mound (foundation rubble, backfill rubble)

3) Armor stones
4) Trimming of rubble mound
5) Precasted concrete blocks (casting and installation)
6) Land filling
7) Cast-in-place concrete (superstructure and pavement)
8) Installation (anchor block)

Functional facilities:

1) Substruction
2) Floor concrete
3) Steel structure
4) Installation of equipment
5) Exterior and interior finish

From the result of the investigation of the construction conditions in Western Samoa it was decided that item 1) through 7) will be performed by land equipment due to lack of marine construction machineries in Western Samoa.

(2) Construction Yard

A large area will be required for selection and stock of rock supplies and production of concrete blocks. The distance from the yard to the construction site will influence the total construction cost. Therefore, the construction supply yard and construction yard will be built at one section bordering the Fisheries Division shown in Fig.-3-1, and the total area will be about 10,000 m^2.

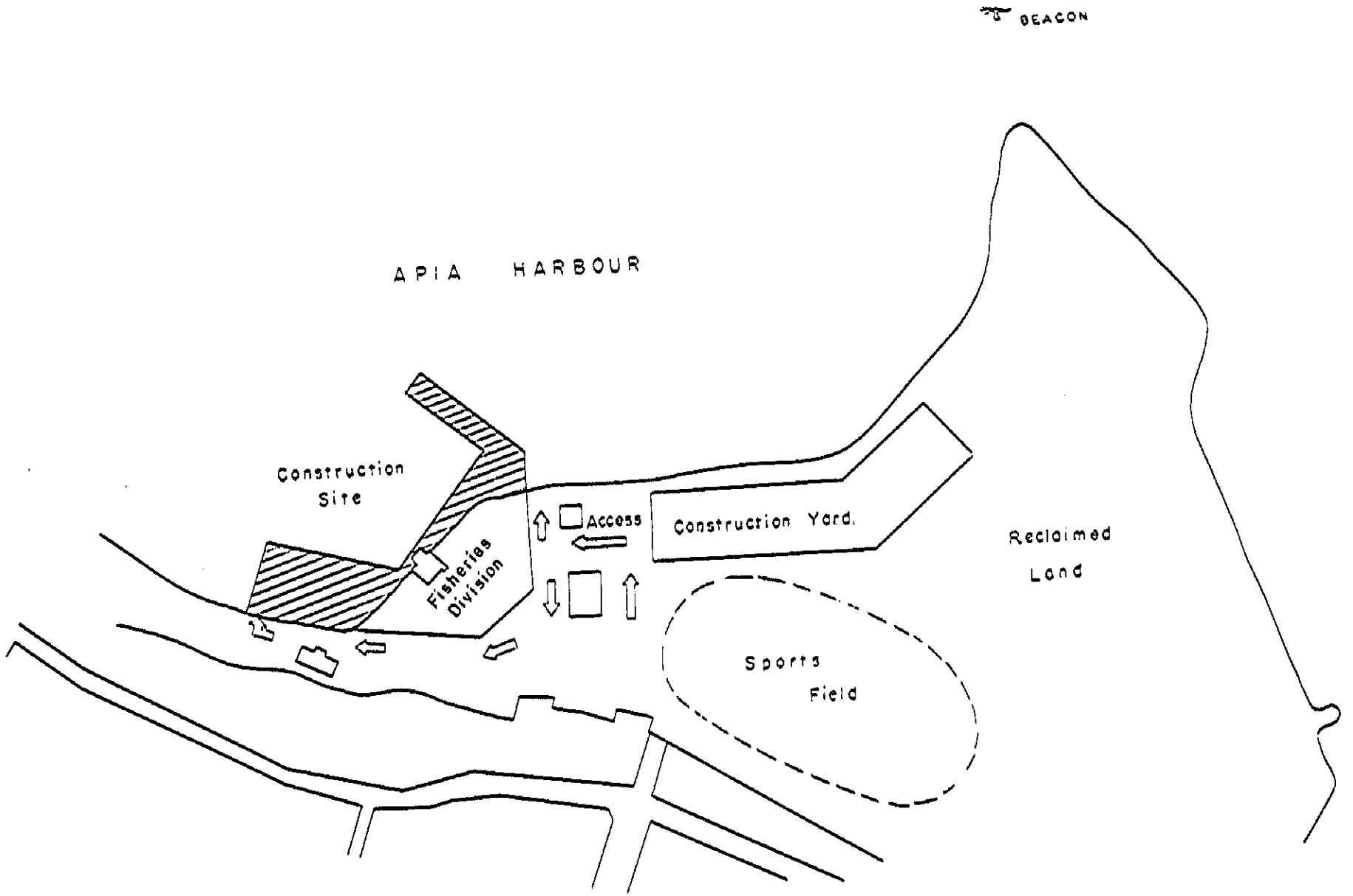
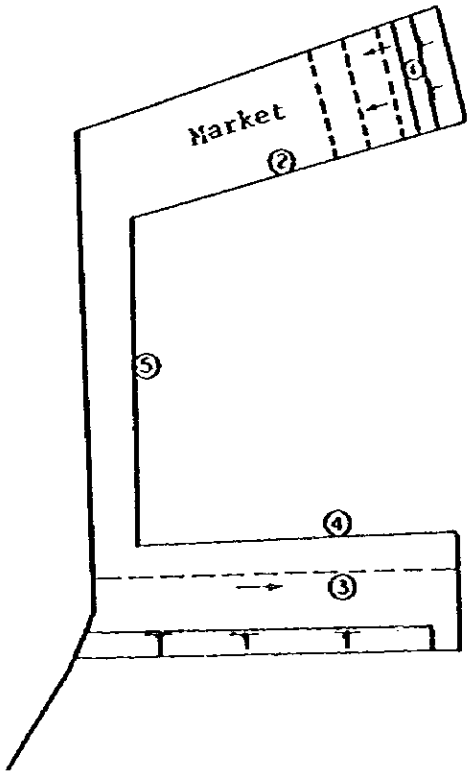


Fig.-3-1 Construction Yard

(3) Execution Procedures

A new market will be built on the newly prepared land. The construction for the market including the basic construction will require 5 months. Therefore, leveling of the ground for the market should be done first in the fish port construction. The procedure is described below:



Procedure

1. Seawall:
   End-on System
2. -1.5 m Wharf
3. Breakwater:
   End-on System
4. -3.0 m Wharf
5. -1.5 m Wharf

Land filling

Substruction and Steel Structure of Fish Market

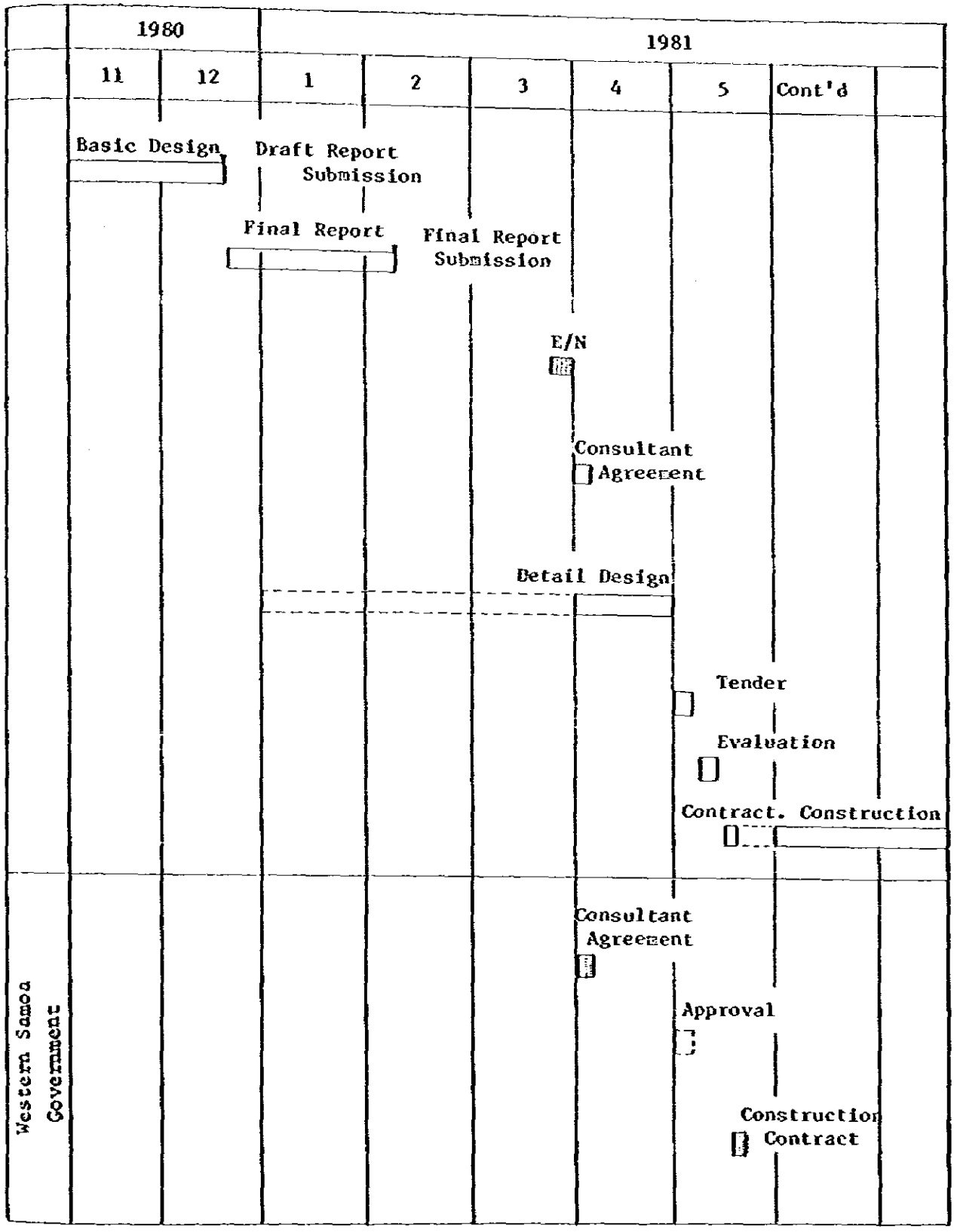
Installation of Equipment

Exterior and Interior Finish

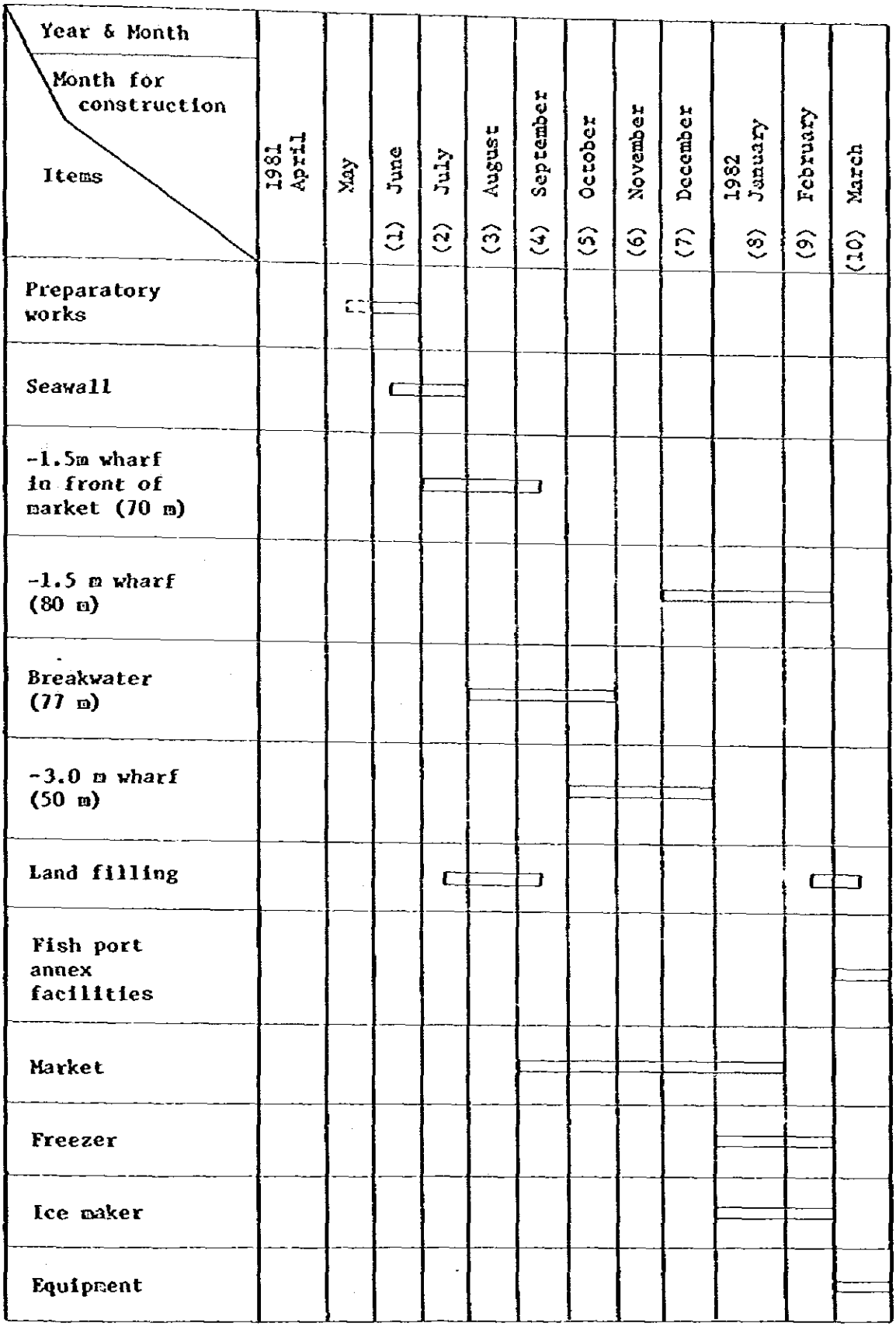
Complete

3-3: Construction Schedule

(1) Work Schedule up to Construction



(2) Construction Schedule



Chapter 4: Appraisal of the Project

4-1: Financial and Economic Analysis

4-1-1: Methods for Measuring Investment Effects

There have been proposed several methods for measuring investment effects of fishing port construction in Japan. The first of such method is the Cost-Benefit Analysis calculating the cost benefit ratio and the internal rate of return, which is popularly used in economic analysis of the development projects.

The second is to focus the evaluation through the phase of economic effects extended by the fishing port construction on the regional development, and conducting the analysis using the regional input-output analysis. Since the regional input-output analysis is an economic analysis mainly leading by the demands, it is not possible to get the direct changes in the production volume caused by the fishing port construction. Therefore, these direct changes were taken down as the change in fish catch in the area including its neighboring fishing port and the change in the marine product trade between the production area and the consumption area caused by the improved transportation facilities. This relation was input in the input-output relations model in order to review the chronological changes in the economic index. This method was developed for "System Analysis Concerning New Nagasaki Fishing Port Construction Plan" conducted by The Fishing Port Department of Fishery Agency in 1952. Results of this analysis are reliable if the project was of a considerable size, but this can not be adapted for evaluating the investment effects of rather small scale investments in view of computation accuracy.

The third method is the system used for "Investigation of Economic Effect on Fishing Port Economy" by Fishing Port Department, Fishery Agency, since 1969. The investigation is the posteriori investigation system, and the evaluation of economic effects is calculated based on the "Economic Effect Computation Table" in respect of the following 6 items in accordance with "Basic Pointers for Economic Effect Measurement" determined by the Council for National Integrated Development in 1951:

1) Increase in national wealth
2) Increased production or preventive effect against decreased production by facilities
3) Effect on local economy
4) Cost benefit ratio
5) Investment income ratio
6) Economic effect of construction work

This method aims mainly at measuring investment effects, and judges the effects by the investment income ratio which is the ratio of the cost benefit ratio and the investment income ratio; the former is the ratio of the invested capital, its depreciation and payment of interests etc. as compared to the benefits accrued by the project while the latter is the ratio of the invested capital and the increase in the national income generated thereby.

The fourth method is a method proposed in the "Study Concerning the Evaluation Standard of Investment Effects of Fishing Port" conducted by Fishing Port Department of Fisheries Agency in 1954.

This method of evaluation aims at taking down the changes caused by the fishing port construction not only through their economic side, but also as the structural changes in the community since the fishing port has a very close relation with the community of the fishing village that the fishing port may be defining social structure of the community.

The method uses evaluation of the changes in the community which are directly and indirectly caused by the construction of the fishing port based on the concept "Stability (of the structure) - the degree of satisfying a certain amount of element for a certain standard" and "Activity - the volume by which a certain element amount increases", and the economical structure which is one phase of the community is evaluated based on the concepts of "income" and "benefit".

In order to integrally evaluate the community, the three items of evaluation standards, namely;

1) the fishery production as the base for a village economy
2) community environment as the base for a society, and
3) individuality as the common value

are set, and these are evaluated from the points of stability and activity. In addition to the calculation of the benefit effect, the income effect which includes the income obtained as the distribution after substracting the necessary expenses from the production volume and the propagating effects on the various industries generated by the final demand generating from the above income and the intermediate demands required to generate the production is calculated and evaluated.

In this evaluation method, the input-output analysis which is significant only in respect of its precision in large scale projects was not used, but the method of the propagating effects of from one industry to another industry was used instead. It is an excellent method for evaluating the economical effects of medium and small scaled projects. However, the factors which determine the reproduction on an expanded scale must be amended through collation of the production volume obtained as a result of tentative calculation and the actual production volume, and therefore it will be a prerequisite for this method to have a minimum amount of data available for facilitating the collation.

The above four methods have advantages and disadvantages of their own, but we selected the first method - the cost benefit analysis popularly used for economical assessment of the development project, which we used also for the financial analysis. In addition, we used the third method - the system "Fishing Port Economic Effect Investigation" of Fisheries Agency and compared the results obtained with those of the investigation of a Japanese Fishing Port.

In Japan, the following items are usually cited as the direct and indirect effects of construction investment of fishing ports under the prevailing Fishing Port Improvement Projects.

Items for Evaluation of Investment Effect at Coastal Fishing Port

Direct Effects	Indirect Effects
Production Increase or new occurrence of fish catch & landing, Increase in the number of operating days, Increased variety of fishing operations (Occurrence of new type of fishing operation)	**Improvement in Regional Economy** Increased income of those who handle products, processing operation and stores, Increased district tax revenue, Increased employment opportunities, Settlement of inhabitants encouraged by the periodical operation, Development of related businesses (shipbuilding, repair, oil merchants, material dealers, processing plants, etc.)
Distribution, Freshness Preservation Improvement or stabilization of fish prices, (Price formation is improved by the increase in the collection volume) Improvement in fish preservation.	**Extended Scope of Supply** Increase in the protein intake by local inhabitants.
Preparation for Fishing Expedition Simplified landing operation of fish catch, curtail labor in loading/unloading operation of fishing boats, Shortened time for preparation of fishing expeditions (Oil and water supply, loading food, water and materials, etc.)	**Healthier Operation of Fishing Industry, Increased Incentive for Production** Lowered cost in collection of marine products, Increased income through shipment on their own (Cooperative)
Safety of Fishing Boats Shortening of berthing time and saving materials used such as ropes, Decrease in the damages to boats, Prolonged durable years for boats	**Improved Productivity by Curtailed Labor** Extended fishing ground, Utilizing so far unexploited resources
	Increased Income of Fishermen Wage income from other industries for the labor saved, Increase in income from side jobs
Increased safety to the Life of Fishermen	**Improved & Modernized Fishing Boat Equipments**
Suspension of Shelter to Other Ports Reduced expenses in navigation (personnel, food, fuel costs), Improvement in fishing system	**Improved Living Environment** Education in hygiene, transportation, communication, safety and disaster prevention, Decrease in medical expenses due to decreased accidents and injury, Improved health due to increased period of rest

Direct Effects	Indirect Effects
Construction of Fishing Port Site Provision of public facilitie on the coastal land (Cooperative office, Product Classification Center, Processing Plant, Oil and Water supply, crew's dormitory, roads, parking area, fisherren's hall, Training Center, etc.)	Improved Environment Improved environment due to the increased land area, and efficient form of land utilization, Congestion of inhabitants, Centralization of economy, Speedier transportation of incoming and outgoing goods, and promotion of obtaining better quality goods
	Improved dietary life, Improvement in eduction, Decrease of migrant workers

Following benefits are envisaged for this Project.

1) Shortened time for the incoming fishing boats for discharging the fish catch
2) Increased fish catch due to the improved operational efficiency in fishing boats
3) Improved preservation of fish catch
4) Accelerated modernization in fishing boats
5) Increase in supply and distribution volume of fish
6) Improved freshness preservation due to the use of ice
7) Increased employment opportunity
8) Decrease in import of canned and frozen fish
9) Increased land area by the land reclamation

These economical effects, the direct and indirect benefits caused by the improvement made to Apia Fish Port are varied and extensive, but this section limited these benefits to those listed below and those which may be measured quantitatively.

1) Increase in fish catch due to the operational efficiency of fishing boats
2) Decrease in consumption of imported canned fish and frozen fish
3) Increase in the area which may be usable

4-1-2: Calculation of Costs

(1) Fishing Port Construction Cost

The fishing port construction cost comprises construction cost, the reserve fund, designing and supervising costs.

(2) Administration/Operation Costs

1) Personnel Cost

The number of administration personnel will be the same as the present number; therefore, the personnel cost is assumed to be the same as present. The present personnel cost is listed below:

Manager	1	4,100 Tala/year
Assistant Manager	1	4.50 Tala/day
Fish Buyer	1	3.50 Tala/day
Freezer Keeper	1	3.50 Tala/day
Cashier	1	3.00 Tala/day
Clerk	1	2.75 Tala/day
Sales Girl	1	2.50 Tala/day
Driver	3	3.50 Tala/day
Night Watchman	1	5.48 Tala/day

Since the personnel cost does not increase by the implementation of the project, it is not included in cost calculation for the economic analysis.

2) Electricity Cost

The power required for Apia Fish Port and the fish market is about 30 KW. Therefore, assuming the load on the freezer and the ice-maker at operation is 50% and the rate of employment 60%, the following formula holds:

30 KW x 0.5 x 0.6 x24 hr. x 365 days = 78,840 KWh

The cost for required electricity is calculated as below when the price is 23 Sene/KWh:

78,840 KWh x 0.23 = 18,000 Tala/year

c. Other Maintenance Operation Cost

8,000 Tala is estimated to be required annually for the maintenance costs such as costs for refrigerated trucks, fish carrying vehicles, fuel, water supply and others.

(3) Facility Depreciation Costs

The facility (including road pavement) and equipment are estimated to be replaced within respective depreciation years and for those requiring re-investment within the 25-year-review period, the cost is appropriated in the applicable year.

The depreciation years for respective facilities and equipment are listed in the table below:

Depreciation Year	Type of Facility/Equipment
5	Refrigerated Truck, Fish Carrying Vehicle
9	Ice-maker, Freezer Facility
20	Road (Pavement)
25	Building of Market

4-1-3: Calculation of Benefits

(1) The increase in fish catch caused by increase in operational efficiency of fishing boats

The increase in fish catch which is expected to be brought about by the increase in operational efficiency is calculated by the formula shown below:

$$B_1 = \sum_{t=1}^{25} HPV_0(N_1 - N_0) + \frac{1}{2} \sum_{t=1}^{25} HP(V_t - V_0)(N_1 - N_0)$$

V_t = the number of fishing boats after t year(s)
V_0 = the number of fishing boats at the start of the fishing port construction
N_1 = the average annual number of fishing navigations after completion of the fishing port
N_0 = the average annual number of fishing navigations before the construction start of the fishing port
H = the average fish catch per one navigation
P = the average fish price

According to the record of Apia Fish Market, the total number of fishing boats selling fish to the market from January, 1979 to October, 1980 amounted to 2,054 while the total number of days with trade activities was 431. (Since there are two types of fish markets, i.e. the fish market operated directly by the government and the one for local fishermen, the former is referred hereinafter as the government's market to avoid possible confusions). If it is assumed that the number of days when the government's market is open to trade or the number of days when fishermen sell fish to the government's market coincides with the number of days when fishing is possible, it will average 235 days per one year.

At the village of Alipata, which is a big fishing village in the island of Upolu, 75% of the total fish catch is distributed for local consumptions including fishermen's private consumption and the remaining 25% is sold to the government's market. Applying this distribution rate to the areas around Apia, since the average number of fishing boats which daily ship to the government's market is about 5, the formula below holds:

5 boats x 4 = 20 boats

If this is applied to the number of existing Alia boats of 40, about 50% of operational efficiency is obtained. The average fish catch per one boat is about 71 kg. If 8.1 ton of annual fish catch per one Alia boat estimated in the Fourth Five Year Development Plan is divided by the above catch, the number of days for

annual fishing navigations become 114. Therefore, assuming 115 days for the annual fishing navigations days seems to be reasonable. Increase in fishing days which is brought about by the reduction in the time required for going to and returning from the fishing trips, accelerated fishermen's morale is estimated to be 3 days per month and 36 days per year.

The average fish price at the government's market is 60 Sene/Lb. or 1.33 Tala/kg. (as of November, 1980) The reason why the increase in fishing boats should be multiplied by 1/2 is because it is not attributable to the new fishing port construction exclusively but to other factors such as shipbuilding of new boats etc. Therefore, it is deducted by 50% or by unattributable factors.

At the estimated progress rate of the Fourth Five Year Development Plan and at the present fish boat increase rate in Apia area, the net increase after deducting replaced boats will be 10 annually.

Unit: 1,000 Tala

Year	Number of Fishing Boat	Increase in Fishing Boat	Benefit Value
1981	60	0	221.0
1982	70	10	237.9
1983	80	20	255.0
1984	90	30	272.0
1985	100	40	288.9
1986	110	50	306.0
1987	120	60	323.0
1988	130	70	339.9

The number of fishing boats that will use Apia Fish Port exceeds the planned capacity by 1.5 fold after 1988: the increase in benefits is not expected unless the fishing port facilities are expanded. Therefore, the benefit will level off after 1989.

(2) Reduction in imported canned and frozen fish

Since canned fish involves the taste of people and preservability, it will take some time to replace it. However, since almost all of frozen fish is presently consumed in Apia, that is the major consumption area, the increase in the market trade accompanied with the increase in fish catch is expected to contribute by 50% to the reduction of frozen fish.

C.I.F. price of frozen fish is 0.88 Tala/kg. (1979)

Year	Decrease in Frozen Fish (kg)	Benefit Value (1,000 Tala)
1981	20,768	18.3
1982	22,365	19.7
1983	23,963	21.0
1984	25,560	22.5
1985	27,158	23.9
1986	28,755	25.4
1987	30,353	26.7
1988	31,950	28.1

(3) Increase in Usable Land Space

The value of the benefits that are produced by the fishing port construction in the terms of land area highly-valuable as the production space is computed in the terms of land rents equivalent to that of such land area.

The land area of the whole facility excluding the breakwater center line is computed as follows:

Benefit value = the whole facility area (3,977 m^2) x land price (40 Tala/m^2) x percentage of rent (0.01)
≒ 1,600 Tala/Year

4-1-4: Economic Analysis

The costs and benefits computed by the market price are converted into the border price. Standard conversion factor is calculated according to the formula below.

$$SCF = \frac{Im + Ex}{(Im + Ti) + (Ex - Tx)}$$

wherein

SCF = standard conversion factor
Im = total import value (CIF price)
Ex = total export value (FOB price)
Ti = total import custom duty
Tx = total export custom duty

According to Annual Statistical Abstract 1979, the following value was obtained.

$$SCF_{79} = 0.89$$

As to the evaluation of the labor force, assuming that the domestic market prices express the opportunity cost for skilled labor, the shadow wage ratio is computed as $SWR_S = SCF = 0.89$.

As to the unskilled labor, assuming that the marginal production volume of agricultural labor expressed the opportunity costs, the shadow wage ratio of unskilled labor is calculated as below.

$$SWR_U = \frac{D}{S} \times W \times \frac{SCF}{W} = \frac{D}{S} \times SCF$$

wherein SWR_U = unskilled labor shadow wage ratio
D = number of agricultural laborers
S = total number of labor sources
W = average wages

According to the 1979 census,

$$SWR_{79} = 0.61$$

is obtained.

The result of the cost benefit analysis in the term of border prices computed by the above conversion rate is shown in the table following. In the case the discount rate is 8%, the standard rate in Western Samoa, the cost benefit ratio is 19.6% and the net present value is 554,500 tala while the internal rate of return is 11.06%.

The internal rate of return (IRR) of 11.06% indicates that the cost and benefit become equal at the discount rate of 11.06%; it is therefore obvious that the project has a sufficiently high value for the national economy as well as the feasibility.

Economic Analysis (Border Price: 1 Tala = ¥250)

Unit: 1,000 Tala

Year	Construction Investment	Electricity	Maintenance	Depreciation for Facility	Total	Increase in Fish Catch	Decrease in Frozen Fish	Increase of Area	Total Benefits	Net Benefits	8% Cost	8 % Benefits	8 % Net Benefits	Discount Rate 11% Net Benefits	Discount Rate 12% Net Benefits
1981	2318.4	16	7.1	—	2341.5	196.7	18.3	1.4	216.4	△2125.1	2341.5	216.4	△2125.1	△2125.1	△2125.1
2	—	16	7.1	—	23.1	211.8	19.7	1.4	232.9	209.8	21.4	215.6	194.3	189.0	187.3
3	—	16	7.1	—	23.1	227.0	21.0	1.4	249.4	226.3	19.8	213.9	194.1	183.7	180.5
4	—	16	7.1	—	23.1	242.1	22.5	1.4	266.0	242.9	18.3	211.1	192.8	177.6	172.9
5	—	16	7.1	—	23.1	257.1	23.9	1.4	282.4	259.3	17.0	207.6	190.7	170.8	164.7
6	—	16	7.1	84	107.1	272.4	25.4	1.4	299.2	192.1	72.9	203.7	130.8	114.0	109.0
7	—	16	7.1	—	23.1	287.4	26.7	1.4	315.5	292.4	14.6	198.8	184.2	156.4	148.1
8	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	13.5	193.8	180.3	148.8	139.8
9	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	12.5	179.4	166.9	134.1	124.8
1990	—	16	7.1	117.6	140.7	302.6	28.1	1.4	332.1	191.4	70.4	166.0	95.7	74.8	69.0
1	—	16	7.1	84	107.1	302.6	28.1	1.4	332.1	225.0	49.6	153.8	104.2	79.3	72.4
2	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	9.9	142.5	132.6	98.0	88.8
3	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	9.2	131.9	122.7	88.3	79.3
4	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	8.5	122.1	105.2	79.6	70.8
5	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	7.9	113.1	97.4	71.7	63.2
6	—	16	7.1	84	107.1	302.6	28.1	1.4	332.1	225.0	33.8	104.7	65.7	47.0	41.1
7	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	6.7	96.9	83.4	58.2	50.4
8	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	6.2	89.8	77.3	52.4	45.0
9	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	5.8	83.1	71.6	47.2	40.2
2000	—	16	7.1	117.6	140.7	302.6	28.1	1.4	332.1	191.4	32.6	76.9	41.1	26.4	22.2
1	—	16	7.1	162.8	185.9	302.6	28.1	1.4	332.1	146.2	39.9	71.3	29.0	18.1	15.2
2	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	4.6	66.0	61.4	34.5	28.6
3	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	4.2	61.1	56.8	31.1	25.5
4	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	3.9	56.6	52.6	28.0	22.8
5	—	16	7.1	—	23.1	302.6	28.1	1.4	332.1	309.0	3.6	52.4	48.7	25.2	20.4
合 計	2318.4	400	177.5	650.0	3545.9	7141.3	663.3	35.0	7839.6	4293.7	2828.3	3382.8	554.5	9.1	△ 143.1

B/C Ratio When 8% $B_0/C_0 = 3382.8/2828.3 = 1.196$ $IRR = 11 + \frac{9.1}{9.1 + 143.1} = 11.06\%$

4-1-5: Financial Analysis

Review shall be made in order to determine whether the management of the fish market will succeed or not. The planned fish market is divided into the area which is managed by the Fisheries Division and the area where the local fishermen will bring in their own catch for sale. The existing fish market charges 30 sene per basket (15 to 20 kg capacity) from the fishermen who bring in their catch. However, we understand that the new fish market plans not to charge any fees in order to give incentives to the fishermen and to increase the distribution volume. In view of the public character of the facility, the administrator assumed as the Fisheries Division have to include as their duties the maintenance and supervision of the fishing port facilities and the overall management of the fish market facility. There will be included among the ordinary income on which the management will be based the income from the fish sales commission, ice sales prices, and the payments will include the personnel expenses for the staff required for management, the electricity, the maintenance and operation cost and the depreciation. Since the project is based on a grant aid from Japan no interests for investment, was included. The breakwater, the seawall, and the landing wharf were considered as the permanent structures and therefore excluded from the depreciable costs.

(1) Income from fish sale

At the fish market operated directly by Fisheries Division, purchasing prices and selling prices of fish are presently classified into the following three groups.

The 1st Group

Purchasing price:	35 Sene/Lb.
Selling price:	40 Sene/Lb.

The 2nd Group

Purchasing price:	45 Sene/Lb.
Selling price:	60 Sene/Lb.

The 3rd Group

Purchasing price:	60 Sene/Lb.
Selling price:	75 Sene/Lb.

According to the buying record in the fish market in 1979, the 2nd group trade amounted to 95% of the whole trade, and 3rd group 4.5% and the 1st group 0.5%.

Since the types of fish handled by the market are expected not to change drastically in the future, the commission of the government operated market will average around 33 Sene/kg. The estimated trade amount and the commission of the market are listed below:

	Trade Amount of Market (ton)	Commission (1,000 Tala)
1981	160.8	53.0
1982	187.6	61.9
1983	214.4	70.8
1984	241.2	79.6
1985	268.0	88.4
1986	294.8	97.3
1987	321.6	106.1
1988	348.4	115.0

(2) Income from Ice Sale

The present selling price for ice is 3.75 Sene/kg. According to the trade record of the market operated by Fisheries Division, the annual sales amounts to 66 ton although it varies from month to month.

The estimated trade amount of ice for respective years is listed below:

Year	Ice Sale (ton)	Sales amount (1,000 Tala)
1981	245	9.2
1982	285	10.7
1983	325	12.2
1984	330	12.4
1985	330	12.4

The increase in trade is not expected after 1984 because the operation

rate reaches to 90% in 1984 and the ice-making capacity becomes at its maximum.

(3) Financial Analysis

The following table shows the cash flow analysis by calculation of the income and the cost. The cost and benefit ratio in the case of 8% discount rate will be 27.2%. The net present value becomes 2,673,000 tala. The internal rate of return is 38.25%.

This suggests that if the fishing port is offered under a grant aid from Japan, the management will be sufficiently maintained on a self-supporting accounting and that re-investment will be feasible except for the basic facilities such as the breakwater and the wharf.

Financial Analysis (Market Price)

Unit; 1,000 Tala

Year	Income			Expenditure				Pre-depreciation Profits	Depreciation	Total Cost Discount	Income 8 % Discount	Balance 8 %	Net Profit 8 %	Net Profit 38 %	Net Profit 39 %
	Income from Fish Sale	Income from Ice Sale	Total Income	Personnel Cost	Electricity	Maintenance	Total Expenditure								
1981	53.0	9.2	62.2	13.4	18	8	39.4	22.8	45.8	△ 23.0	62.2	85.2	△23.0	△23.0	△23.0
2	61.9	10.7	72.6	13.4	18	8	39.4	33.2	45.8	△ 12.6	67.2	78.9	△11.7	△ 9.1	△ 9.1
3	70.8	12.2	83.0	13.4	18	8	39.4	43.6	45.8	△ 2.2	71.2	73.1	△ 1.9	△ 1.2	△ 1.1
4	79.6	12.4	92.0	13.4	18	8	39.4	52.6	45.8	6.8	73.0	67.6	5.4	2.6	2.5
5	88.4	12.4	100.8	13.4	18	8	39.4	61.4	45.8	15.6	74.1	62.6	11.5	4.3	4.2
6	97.3	12.4	109.7	13.4	18	8	39.4	70.3	45.8	24.5	74.7	58.0	16.7	4.9	4.7
7	106.1	12.4	118.5	13.4	18	8	39.4	79.1	45.8	33.3	74.7	53.7	21.0	4.8	4.6
8	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	74.3	49.7	24.6	4.4	4.2
9	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	68.8	46.0	22.8	3.2	2.0
1990	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	63.7	42.6	21.1	2.3	2.1
1	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	59.0	39.5	19.5	1.7	1.6
2	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	54.7	36.5	18.1	1.2	1.1
3	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	50.6	33.8	16.8	0.9	0.8
4	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	46.8	31.3	15.5	0.6	0.6
5	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	43.4	29.0	14.4	0.5	0.4
6	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	40.2	26.9	13.3	0.3	0.3
7	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	37.2	24.9	12.3	0.2	0.2
8	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	34.4	23.0	11.4	0.2	0.2
9	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	31.9	21.3	10.6	0.1	0.1
2000	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	29.5	19.7	9.8	0.1	0.1
1	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	27.3	18.3	9.1	0.1	0.1
2	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	25.3	16.9	8.4	0.1	0
3	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	23.4	15.7	7.8	0	0
4	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	21.7	14.5	7.2	0	0
5	115.0	12.4	127.4	13.4	18	8	39.4	88.0	45.8	42.2	20.1	13.4	6.6	0	0
合 計	2627.1	304.9	2932.0	335.0	450	200	985.0	1947.0	1145.0	802.0	1249.4	982.1	267.3	0.8	△ 2.4

B/C Ratio When 8% $B_0/C_0 = 1249.4/982.1 = 1.272$ $IRR = 38 + \frac{0.8}{0.8+2.4} = 38.25\%$

4-2: Project Appraisal

In the preceding section, the Economic and Financial analysis of the project was made and it was concluded that this project would contribute to the national economy of Western Samoa and that the management thereof on a self-supporting accounting basis would be possible.

In this section, we shall review the degree of which the project will be effective compared to the investment in fishing port construction in Japan in a manner similarly to the method employed in "Investigation of Economic Effect of Fishing Port", and discuss the significance of the Project. The next table discloses the result of comparison made of the total average of the investigation of economic effects of 87 fishing ports conducted by Fishing Port Department of Fisheries Agency up to 1973 and the estimated economic effects of construction of Apia Fish Port.

The durable years of the basic facilities for the fishing port were set at 50 years, and the benefit amount the total average of the durable years. Although there will be no interests accrued since Apia Fish Port will be offered under a grant aid from Japan, the interest of 8% per annum was calculated for the purpose of comparison.

Unit: 1,000 yen

		Total average of 87 fishing ports in Japan	Apia fish port
Value of invested capital	D	758,656	600,000
Value of benefits	E	114,721	89,850
Planned depreciation years	F	44.2	40.7
Total depreciation value	G=D	758,656	600,000
Annual depreciation value	H=G/F	17,155	14,742
Annual expenses			
Interest	J	52,425	48,000
Personnel	K	1,078	3,350
Others	L+N	864	6,500
Total expense	P=J+K+L+N	54,367	57,850

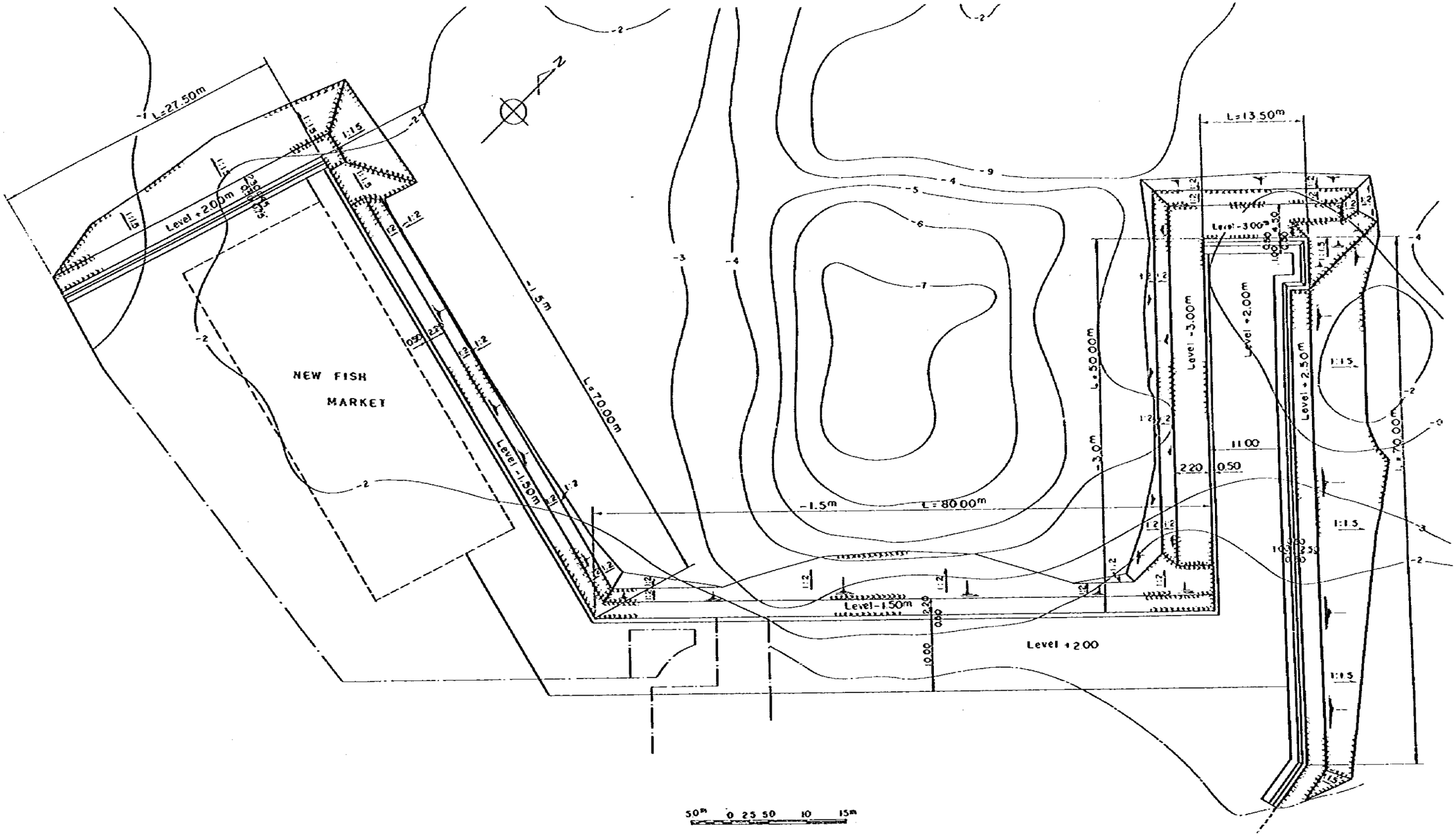
		Total average of 87 fishing ports in Japan	Apia fish port
Annual expenditure	Q=H+P	71,522	72,592
Excess-benefits	S=E-Q	43,197	17,258
Increase in GNP	T=J+K+S	96,702	68,608
Investment turnover	U=E/D	15.1%	15%
Cost benefit ratio	V=E/Q	160.4%	123.7%
Investment income ratio	W=T/D	12.7%	11.4%

When compared to the fishing port investment in Japan, the investment efficiency in Apia Fish Port is by no means low. It is to be noted that the estimate is close to the average figure even when the construction interest which is expected to be nil is included.

As discussed before, the fishing industry in Western Samoa is presently at a stage where the commercial fishermen are just emerging from out of the self-sustain fisheries, and there are vast differences quality-wise comparing with Japanese fisheries present status. However, the Fisheries Development Plan for Western Samoa, particularly the coastal fishing promotion by diffusing Alia type boats will accelerate the step-wise development of the fishing technique of the local fishermen and encourage the local demand. Thus, it will be different from the fisheries development plans in many other developing countries where the relation between the fishing technique of local fishermen and the demand and supply is disregarded. It may be compared as a steady pace with which the Japanese fishing industry has developed from the coastal to the offshore fishery and then to the ocean going fishery.

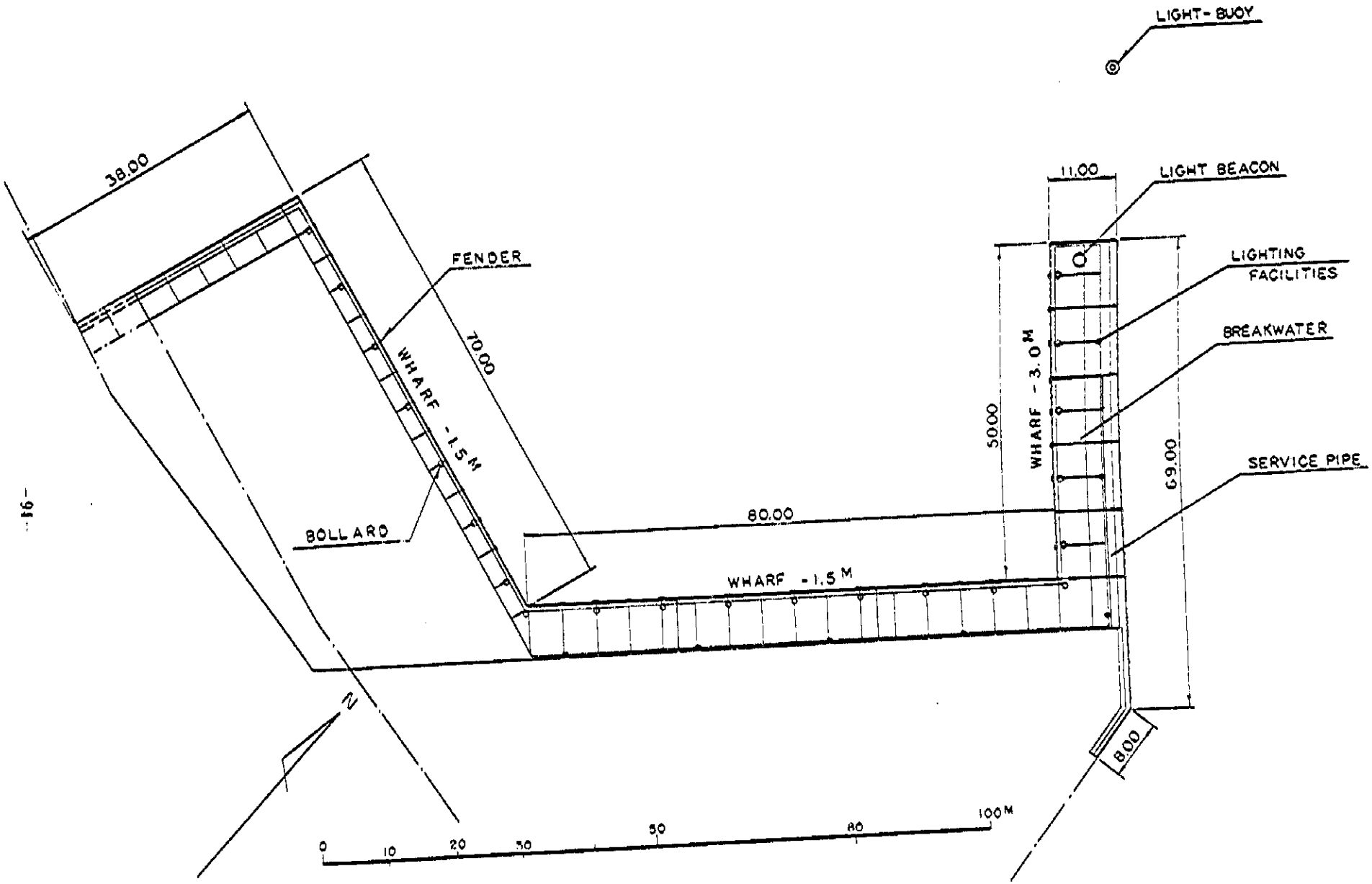
The construction of fishing port at such a development stage is expected to give impact to the fishing industry in Western Samoa, expand its distribution volume, and incite the domestic demands accompanied by the said increase, thereby building a foundation for a still another development. Thus, it is concluded that the effectiveness of the grant to the project is immense.

BASIC DESIGN DRAWING



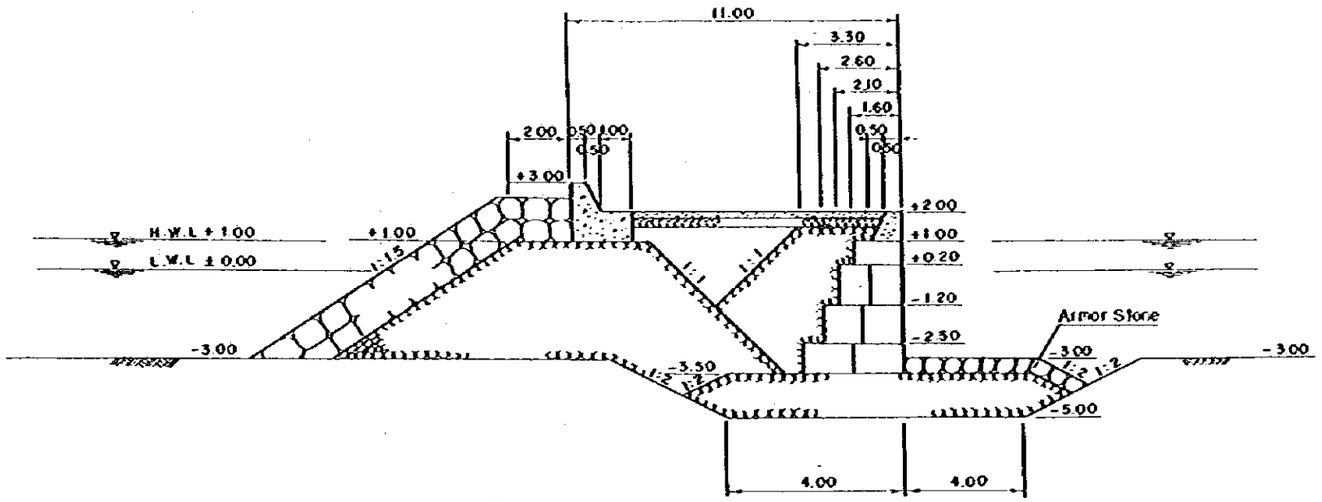
APIA FISH PORT COMPLEX

01 GENERAL NEW FISH PORT PLAN

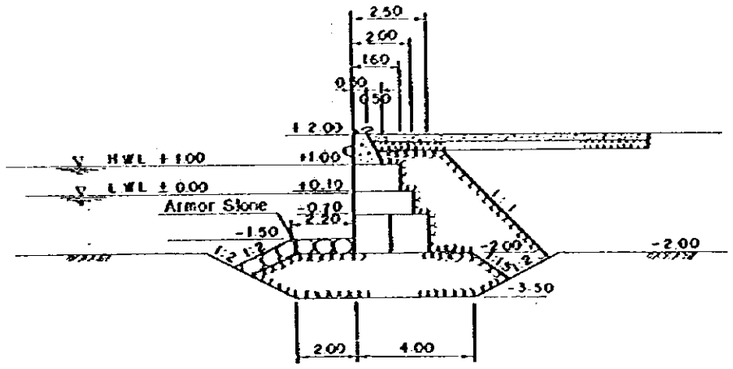


APIA FISH PORT COMPLEX

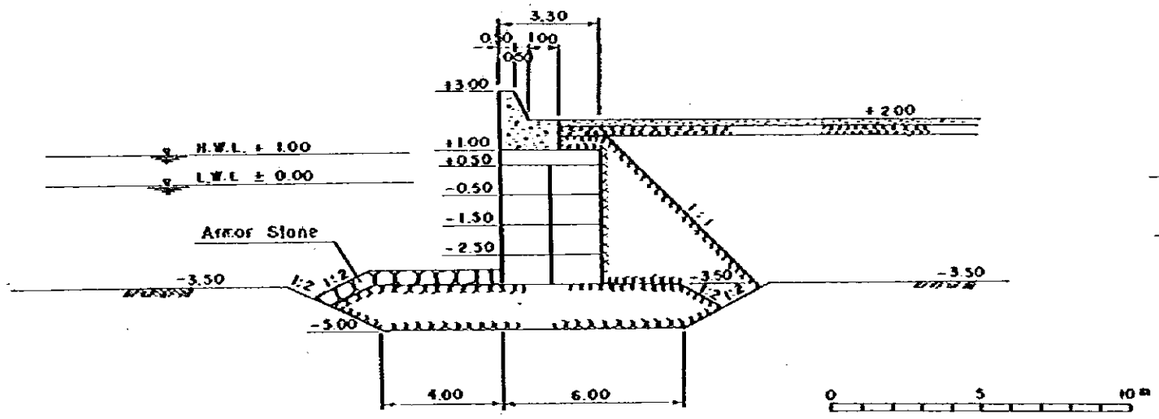
02 LAYOUT OF NEW FISH PORT FACILITIES



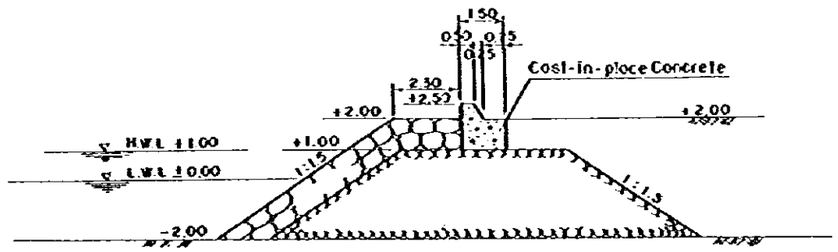
Breakwater and Wharf (-3.0 m)



Wharf (-1.5 m)



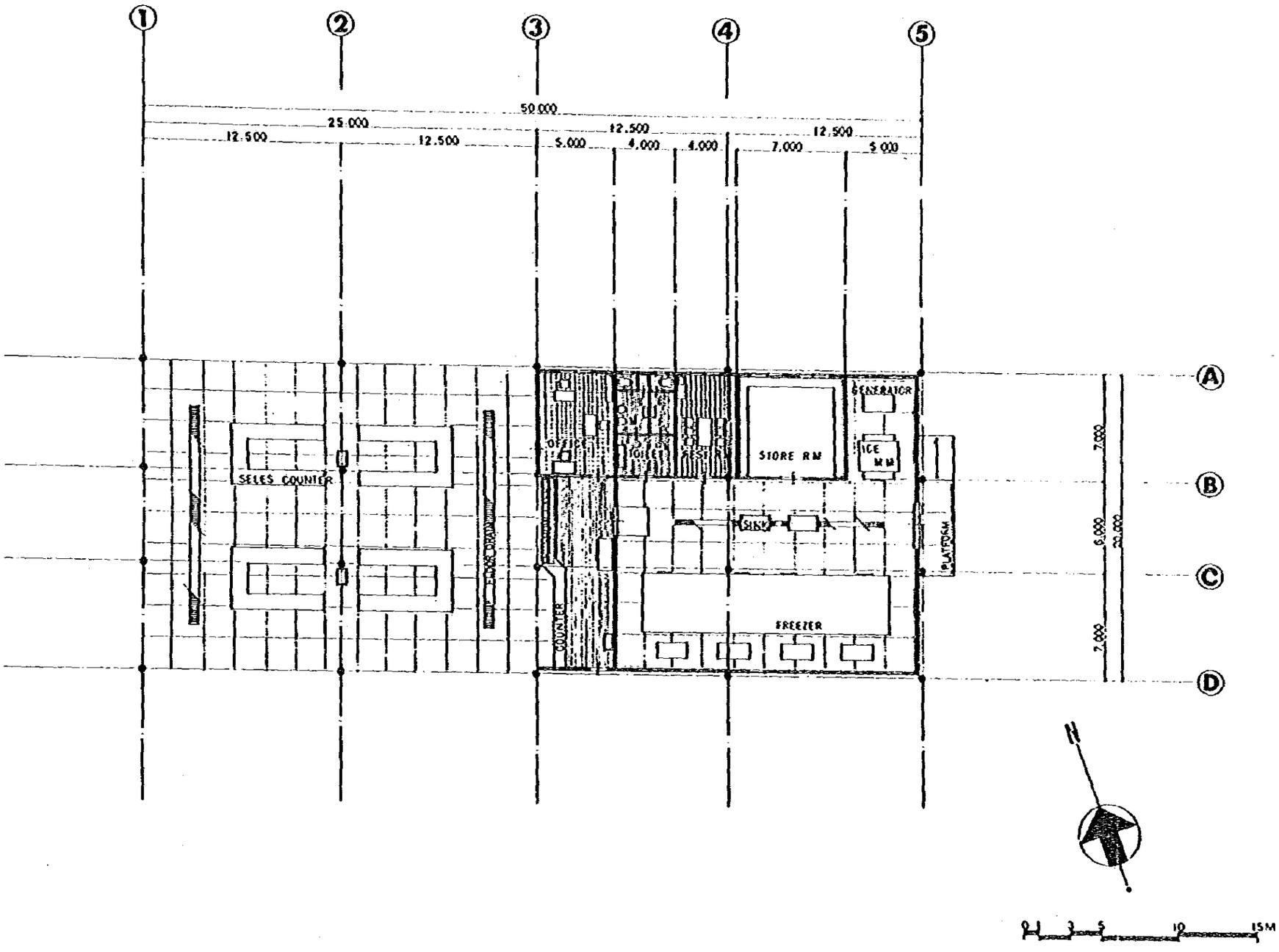
Breakwater Head



Seawall

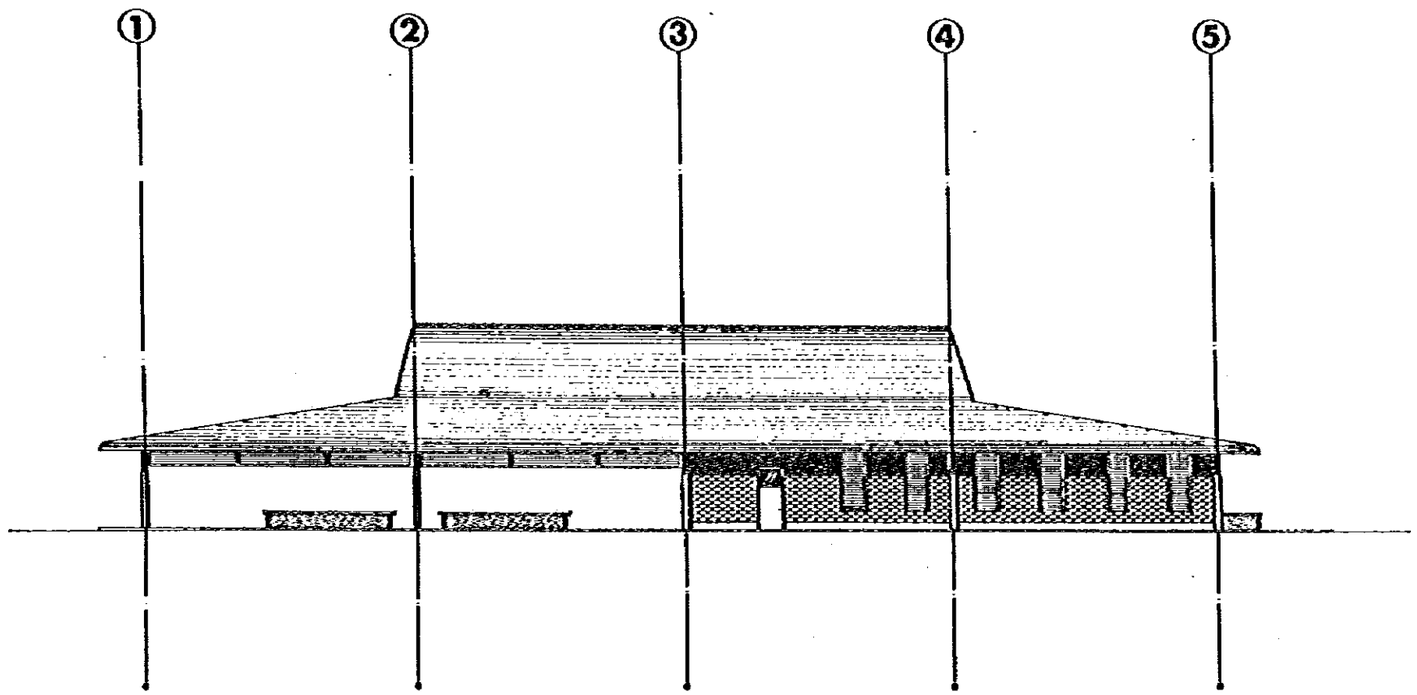
APIA FISH PORT COMPLEX

03 TYPICAL CROSS SECTIONS

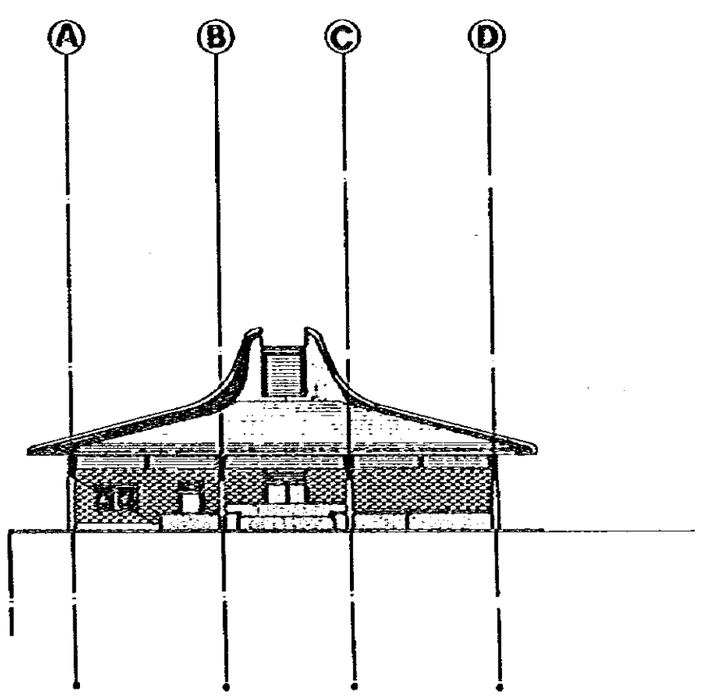


APIA FISH PORT COMPLEX

FLOOR PLAN 04



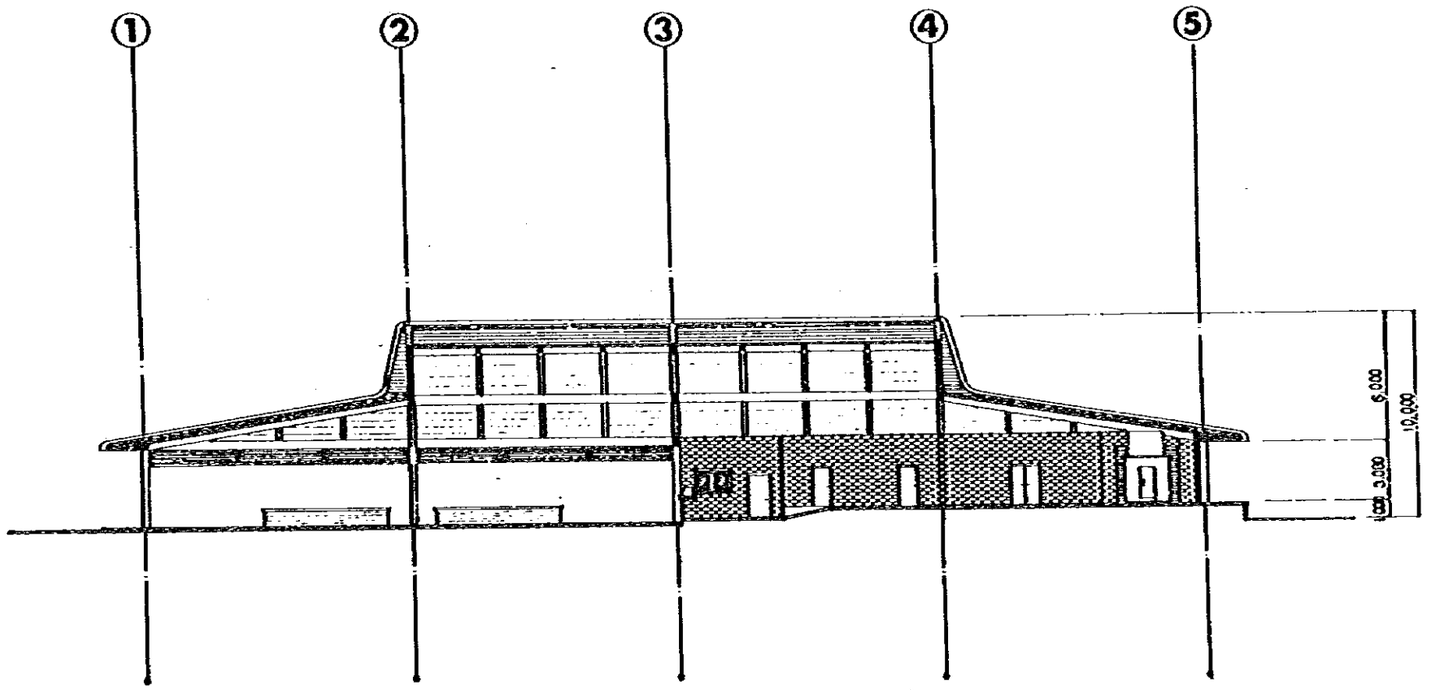
SOUTH ELEVATION



WEST ELEVATION

APIA FISH PORT COMPLEX

ELEVATION 05

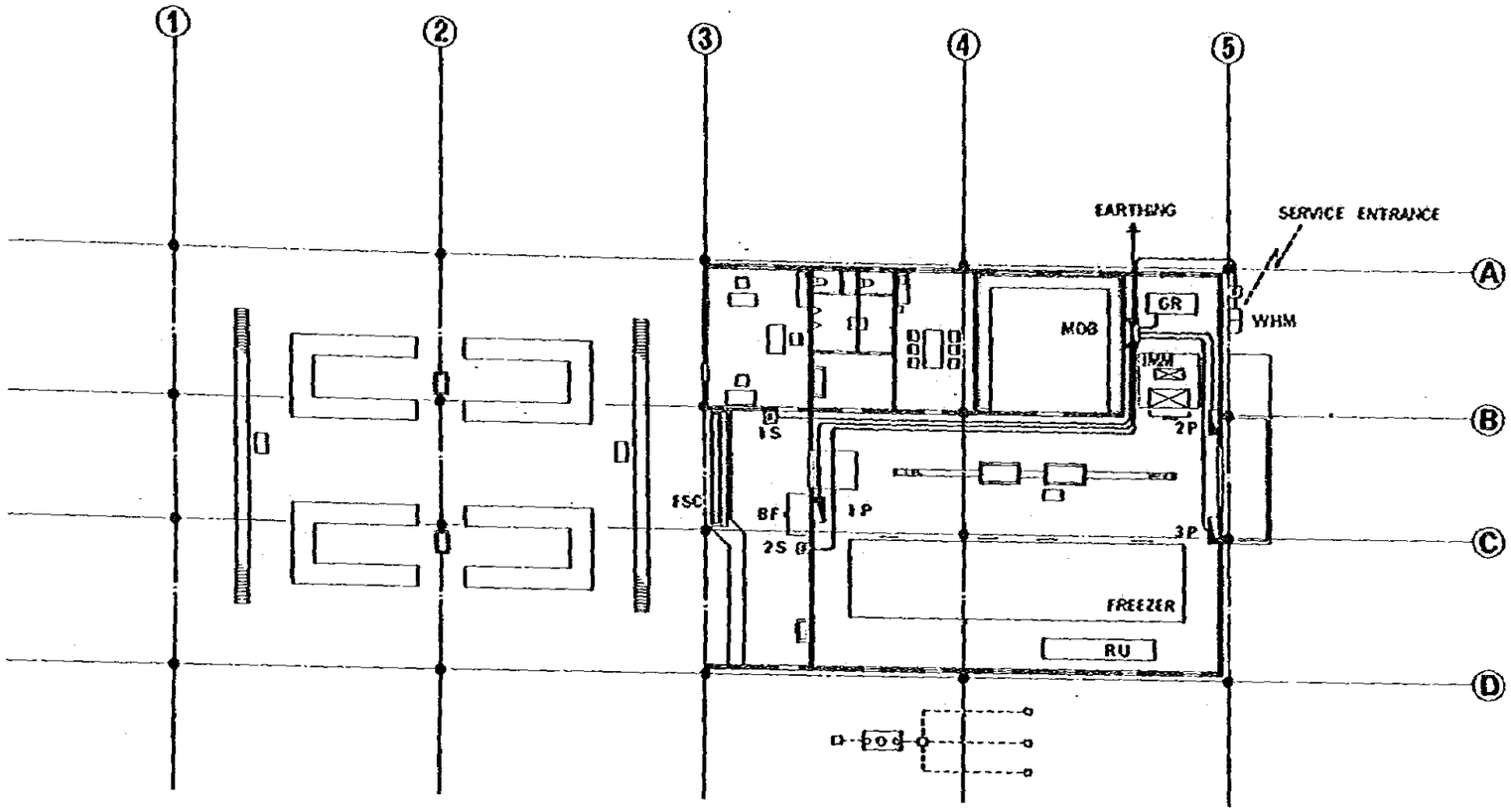


SECTION

0 1 3 5 10 15M

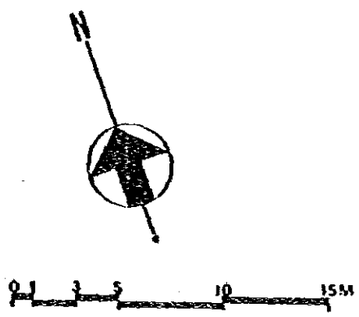
APIA FISH PORT COMPLEX

SECTION 06



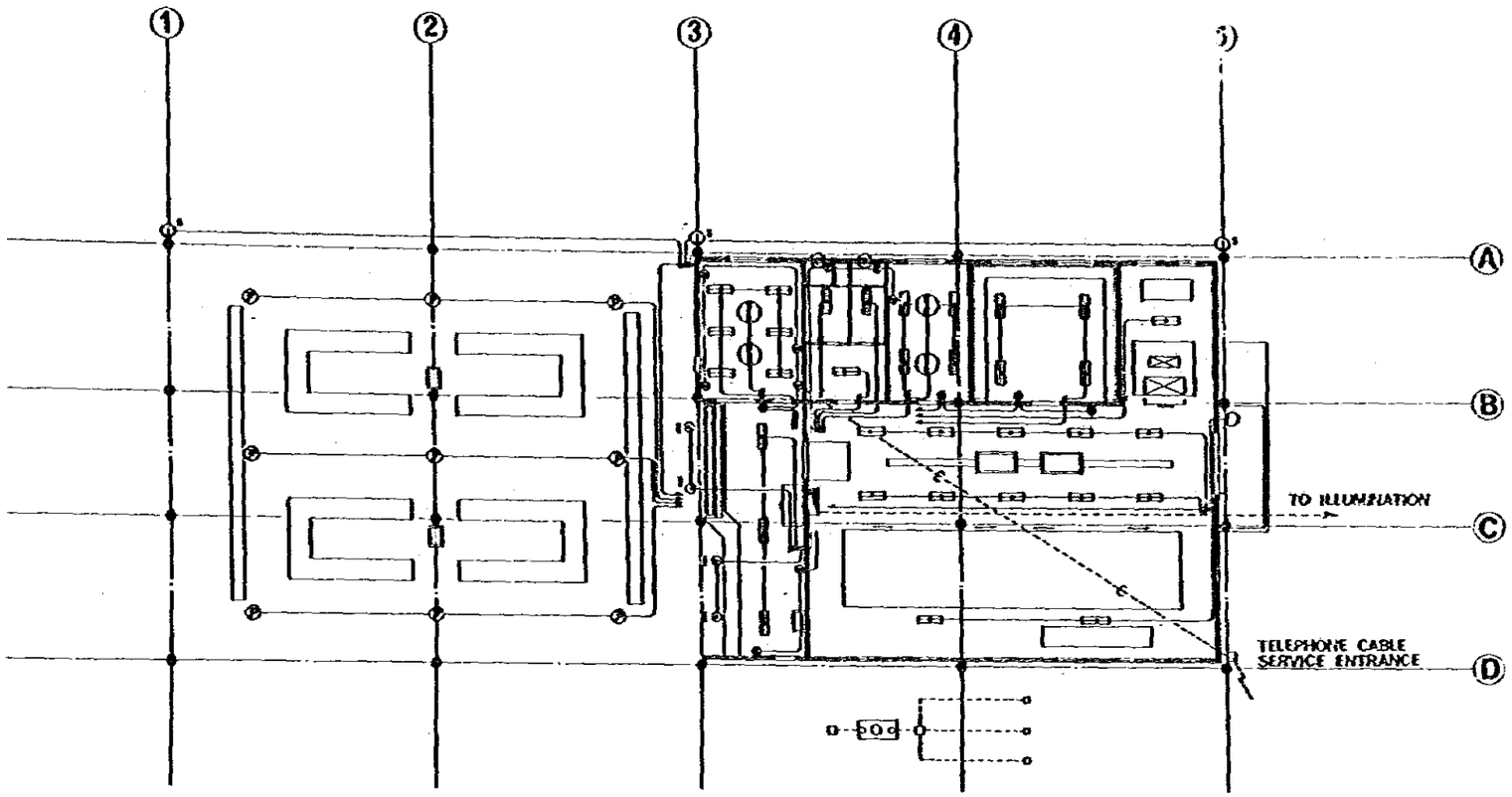
LEGEND

IWM : ICE MAKING MACHINE
RU : REFRIGERATING UNIT
BF : BOX FREEZER
FSC : FREEZING SHOW CASE
GR : GENERATOR
MDB : MAIN DISTRIBUTION BOARD
WHM : WATT HOUR METER
1S : SAFETY SWITCH FOR FSC
2S : SAFETY SWITCH FOR BF
1P : DISTRIBUTION BOARD FOR LIGHTING
2P : POWER PANEL FOR IWM
3P : POWER PANEL FOR FREEZER



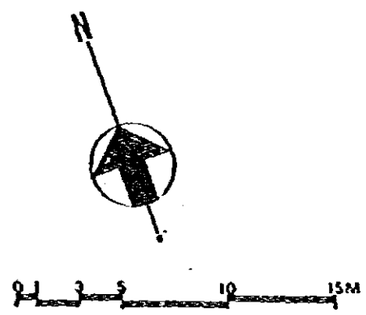
APIA FISH PORT COMPLEX

POWER SUPPLY PLAN 07

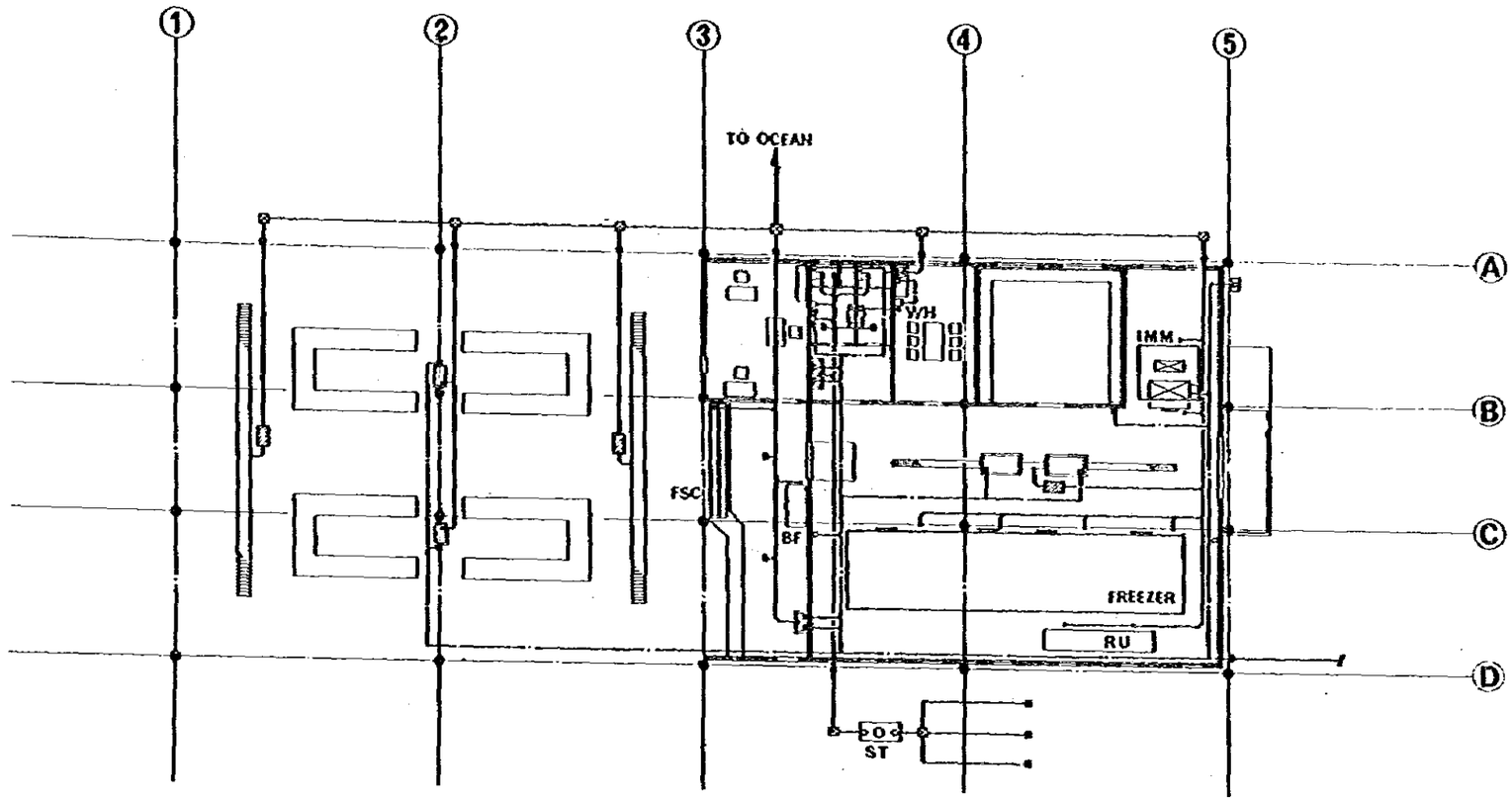


LEGEND

IMM : ICE MAKING MACHINE
RU : REFRIGERATING UNI
BF : BOX FREEZER
FSC : FREEZING SHOW CASE
GR : GENERATOR
: FLOURESCENT LIGHT
: INCANDESCENT LIGHT
IO : INCANDESCENT LIGHT
: MERCURY LIGHT
: CEILING FAN
: VENTILATING FAN
: OUTLET
: TELEPHONE OUTLET
: SWITCH
: DISTRIBUTION BOARD

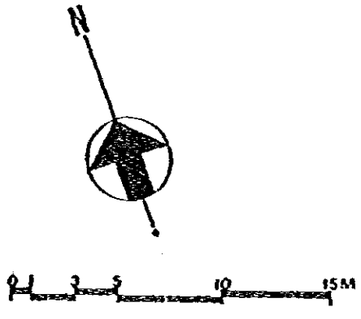


APIA FISH PORT COMPLEX **LIGHT, POWER POINT PLAN 08**



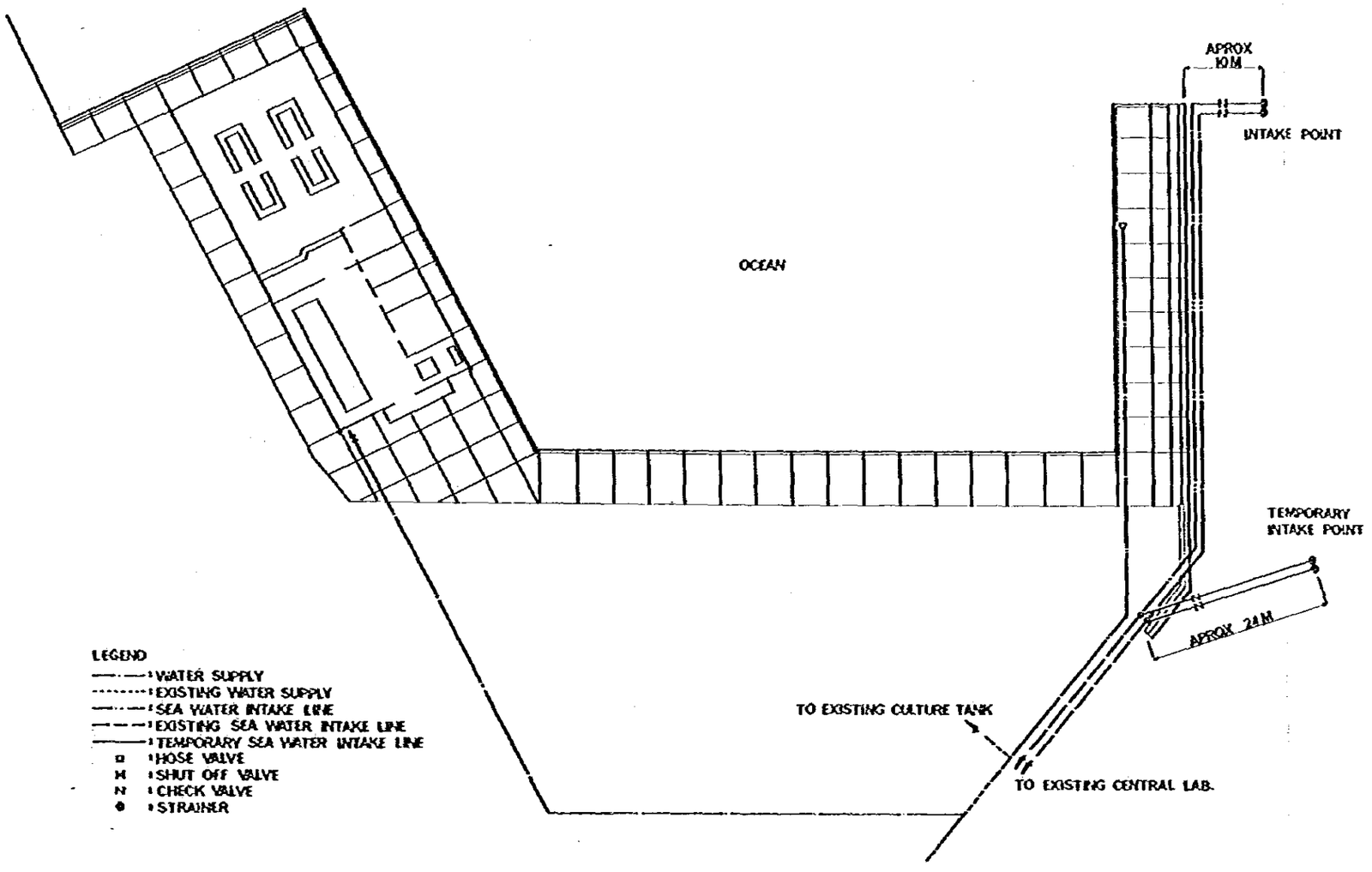
LEGEND

IMM : ICE MAKING MACHINE
RU : REFRIGERATING UNIT
BF : BOX FREEZER
FSC : FREEZING SHOW CASE
ST : SEPTIC TANK
WH : WATER HEATER
— — : WATER SUPPLY
–·– : HOT WATER SUPPLY
—— : DRAINAGE
: WATER CLOSET
: LAVATORY
: URINAL
: CLEAN OUT
: FLOOR DRAIN TRAP
: GREASE TRAP
: FAUCET
: SINK



APIA FISH PORT COMPLEX

PLUMBING PLAN 09



APIA FISH PORT COMPLEX **PLUMBING PLAN-1 10**

JICA