REPUBLIC OF INDONESIA

FEASIBILITY STUDY REPORT ON THE EXPANSION PROJECT OF THE BITUNG PORT

MARCH 1978

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF INDONESIA

FEASIBILITY STUDY REPORT ON THE EXPANSION PROJECT OF THE BITUNG PORT

MARCH 1978

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan had decided to conduct a feasibility study for the expansion project of the Bitung Port, and the study was carried out by the Japan International Cooperation Agency (JICA).

In view of the importance of the project, JICA conducted the preliminary study in February 1977, followed by the full study in June and July 1977 with the cooperation of the organizations concerned of the Indonesian Government.

After completion of a field survey, the study team analysed and evaluated the findings and data obtained through the all-out cooperation of the Indonesian Government. After adjustments have been made in Indonesia, the report has now been finalized for submission to the Government of Indonesia.

I hope that the present study will serve to expedite the implementation of the project, and contribute to strengthening the friendly relations between the Republic of Indonesia and Japan.

I would like to take this opportunity to express my heartfelt gratitude to all the persons who participated in this study and to all the Indonesian authorities concerned for their cooperation.

March 1978

Shinsaku Hogen
President
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Mr. Shinsaku Hogen
President
Japan International Cooperation Agency

Dear Sir;

It is my great pleasure to submit herewith a report on the Feasibility Study for the Expansion Project of the Bitung Port of the Republic of Indonesia.

In order to examine the feasibility of the expansion project, the Japanese survey team headed by myself conducted a principal survey for 30 days from June 28 last summer, at the request of the Japan International Cooperation Agency. The findings of this survey was discussed to study the feasibility of the Bitung Port expansion project, and this is the report.

In the stage of the survey, the Japanese survey team joined efforts with the Indonesian counterpart to make a thorough end-to-end settlement of all major problems. As a result, the Japanese survey team and the Indonesian Authority in charge reached an agreement on many points.

On behalf of the Japanese survey team and myself I would like to express my deepest appreciation to the government of the Republic of Indonesia, for their unlimited cooperation and assistance and warm hospitality extended to the team during its stay in Indonesia.

My indebtness is also great to the Japan International Cooperation Agency, the Ministry of Transport, the Ministry of Foreign Affairs, and the Japanese Embassy in Indonesia, that have given us valuable suggestions and assistance in the field survey and in preparation of this report.

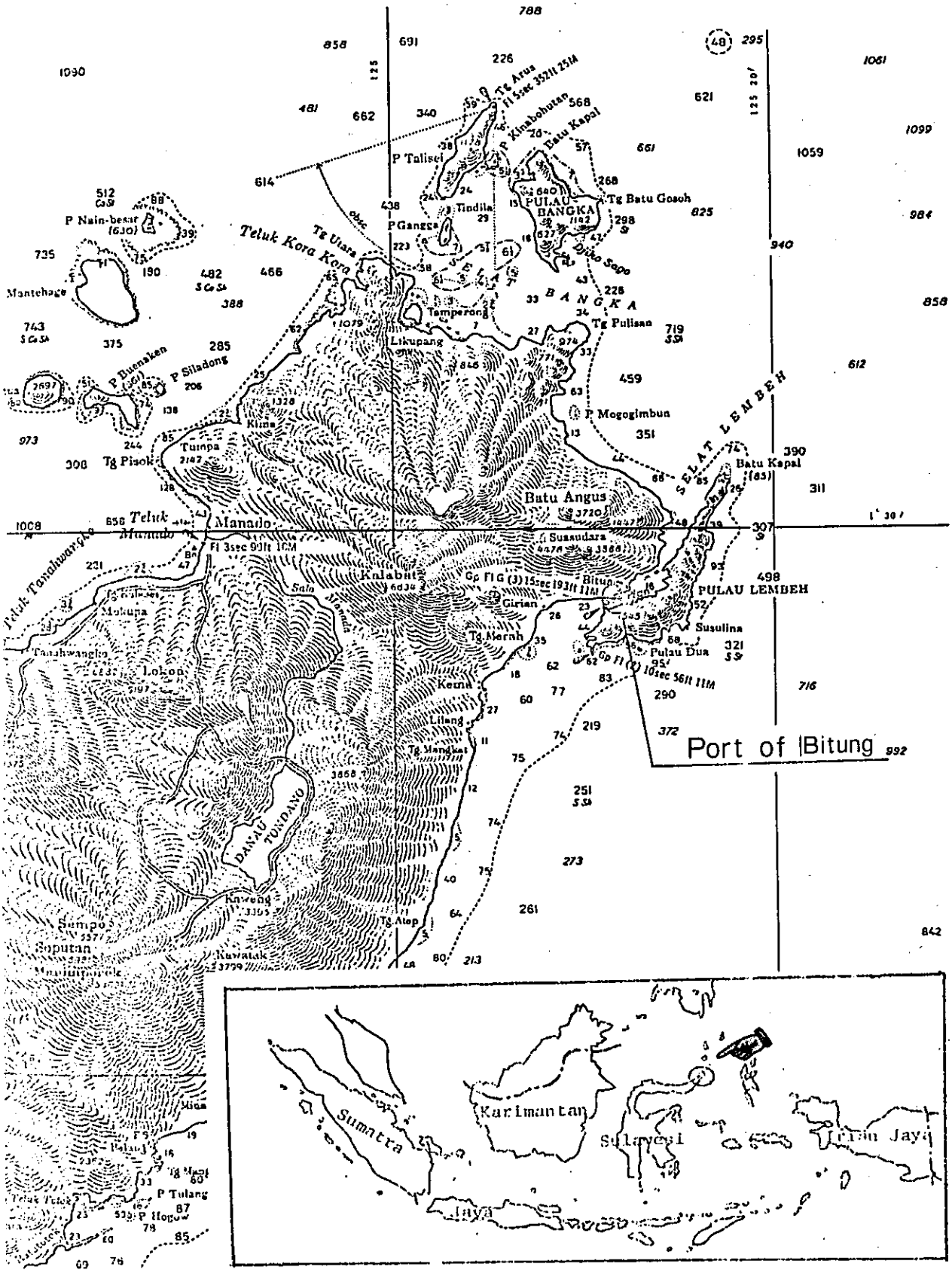
Sincerely yours,

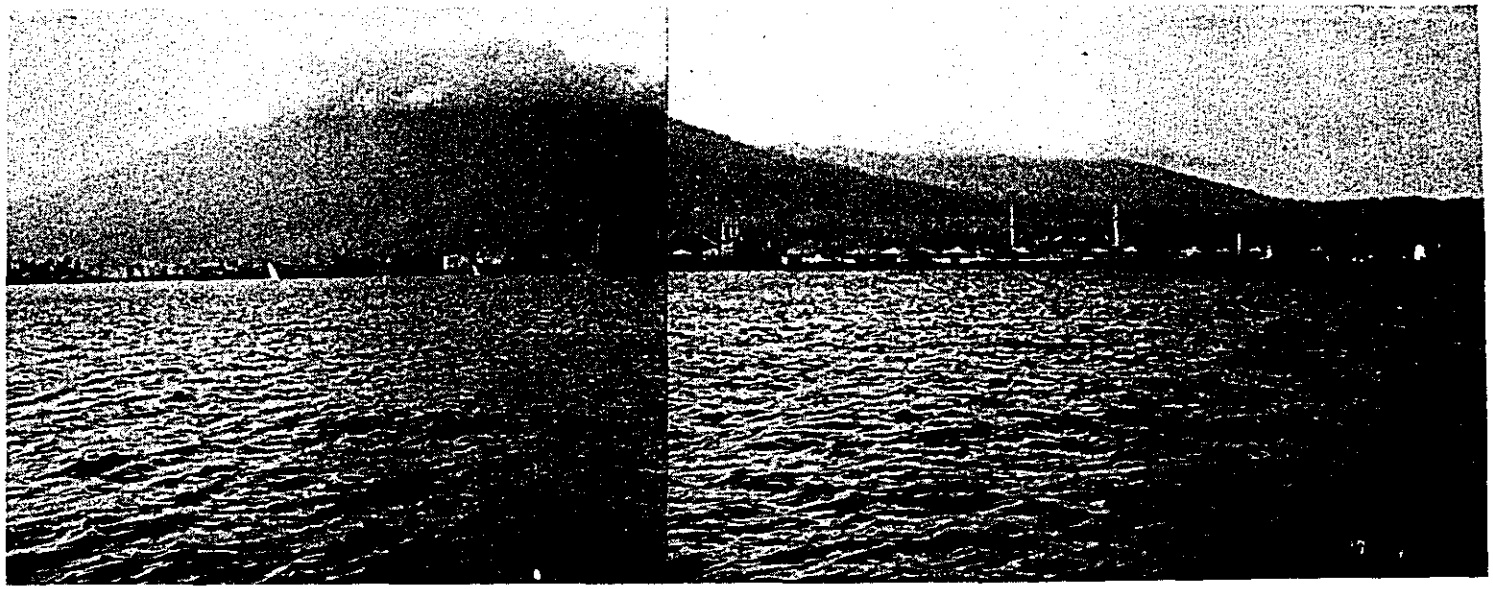
March, 1978

Osamu Harada

Osamu Harada, Head,
Japanese Survey Team for the
Expansion Project of Bitung Port
(The Overseas Coastal Area
Development Institute of Japan)

Location Map

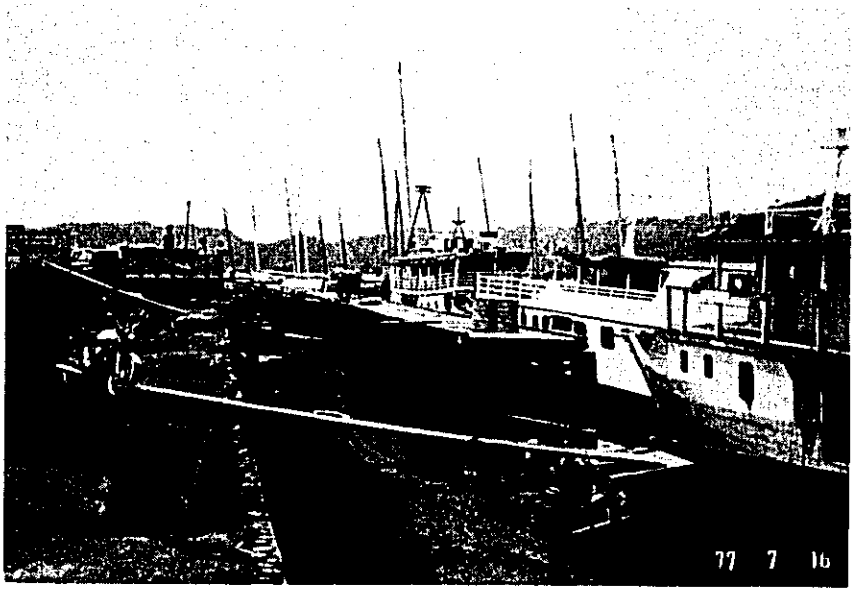




Front View of the Port Bitung

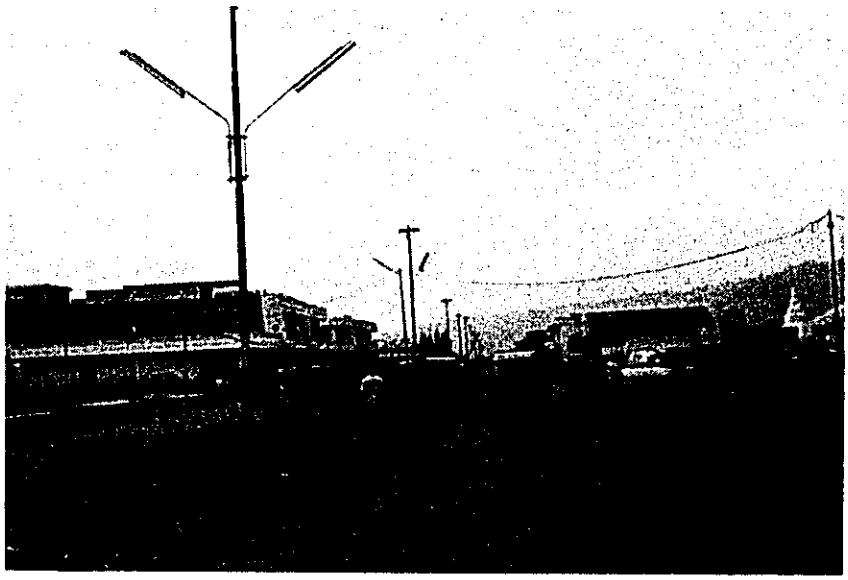
Berthing Facilities of the Port of Bitung

Concrete Pier
for
Ocean-going Vessels
and
RLS Vessles



Wooden Pier
for
Sailing Vessels

City of Bitung



CONTENTS

LIST OF FIGURES

LIST OF TABLES

Page

Conclusion and Recommendations

Conclusion and Recommendations

1. Feasibility

1-1. General

The Port of Bitung is situated at the northern end of Sulawesi Island, and it is one of the major ports in eastern Indonesia forming an important base on sea transport linking Sulawesi, Maluku and West Irian.

Recently, the traffic through the Port of Bitung has remarkably increased and improvement of port facilities is urgently required.

Responding to such a situation, here in this report, a long-term plan to expand the port facilities is described for the year 2000 and then a medium-term plan, for the year 1985.

The expansion plan is to be carried out in the area adjacent to the east side of the present Port of Bitung. It is possible to formulate a project of improving the facilities of the required size with a reasonable amount of investment because of favorable natural and social conditions in the expansion site. The project formulated consequently is feasible both technically and economically as a whole.

1-2. Project Site

As a site for expansion of the Port of Bitung, some ports in the vicinity of the Port of Bitung in North Sulawesi Province and some areas near the Port of Bitung were selected and examined. After the investigation of the natural conditions, calmness of the harbor, construction cost and communication with the existing city and the port, in each selected site, it has become clear that the eastern area of the Port of Bitung is the most suitable place for the project.

1-3. Technical Feasibility

The project site comprises the land and water areas from the east side of the present Port of Bitung to the west end of the shipbuilding yard. The site has good natural conditions and suits to communication with the existing port so, it is most advantageous for port construction and operation.

Being sheltered by Lembeh Island, the water area in the project site is calm and there are no hindrances to the construction of facilities, to ship navigation and to cargo handling after completion of the facilities.

The current velocity of Lembeh Strait is about 0.5 - 1.0 m/sec and poses no difficulty for navigation of vessels.

The basic stratum at the site of construction of wharves is somewhat deep at 20 - 30 meters and the soil is strong enough as a structural foundation. Therefore, there is no technical problems in construction design. The construction cost can be settled consequently within a moderate range.

Acquisition of the port land is more or less restricted with the topographic conditions and the relationship to the existing berthing facilities, permitting only a narrow space depending on the location, but no trouble is contemplated for port operations, as a whole.

The new port is located adjacent to the facilities of the existing Port of Bitung so that it will be able to function intergrally with the existing facilities.

Communications to and from the City of Bitung are also very good.

Seasonal sand deposition due to littoral drift is seen at a part of the basin to be newly provided for domestic trade vessels and at the west-end of the existing concrete piers. However, the deposition due to littoral drift is slight and causes few problems to port operation.

Accordingly, the project is feasible as a whole with no technical problems in port construction and operation.

1-4. Feasibility in Economy and Finance

This project is aimed at improving the capacity of the facilities of the Port of Bitung to cope with the increasing demand for traffic accompanying the development of the regional economy and is, therefore, indispensable to regional development.

The project has an effect of breaking the bottleneck in regional development through port development. Additional effects are also expected such as the development of regional industries and cities. Through such effects, it will greatly contribute to the economic development of Indonesia.

In the cost benefit analysis, only the benefit resulting from rationalization of port operations which could be grasped quantitatively was assessed. As a result, the internal rate of return (I.R.R.) was given as 19.7%, and the cost-benefit ratio (B.C.R.) as 1.37 (with the discount rate at 15%). Although only part of the benefit was calculated, a high value was obtained.

Considering this result and the effect upon the regional development as stated above, the project is economically entirely feasible.

According to the results of the financial analysis, it was found that if the port dues and charges and the financial support to the port management were maintained at the present level, port management would suffer losses of about 400 million Rp. per year in 1985.

In order to get out of debt, there are two possible solutions for port management - the revision of port tariff, or to obtain a financial subsidy for port management. In view of the necessity of this project, large contributions to the economy of Indonesia and the fact that the amount of deficit is relatively small, it seems to be reasonable to subsidize the port to an appropriate degree. Therefore, this project as a whole is financially feasible.

2. Port Planning

2-1. Service Area, Activity in Service Area, and Target of Port Planning

The service area of the Port of Bitung extends over North Sulawesi Province, Central Sulawesi Province and the northern part of Maluku Province.

The service area is divided into areas in the direction of the land and sea. The area in the direction of the land comprises the most part of North Sulawesi Province, and the area in the direction of sea includes the rest of North Sulawesi Province, Central Sulawesi Province and the Northern part of Maluku Province.

The Port of Bitung is a gateway to North Sulawesi Province which is a direct hinterland, and plays its role as a transit port for each place in the service area in the direction of the sea.

The population and GRP in the service area in the target year of the respective plans are as follows:

Fiscal Year	Population (unit: one thousand)	GRP (unit: billion Rp.) Value of 1973
1976	3,396	233
1985	4,380	500
2000	6,780	1,650

The port tonnage traffic in the target years are as follows:

Port tonnage traffic in the Port of Bitung

Fiscal Year	Foreign Trade			Domestic Trade			Total		
	General Cargo	Oil	Total	General Cargo	Oil	Total	General Cargo	Oil	Total
1976	219.8	0.6	220.4	294.8	216.1	510.9	514.6	216.7	731.3
1985	321		321	685	520	1,205	1,006	520	1,526
2000	763		763	1,584	2,120	3,704	2,347	2,120	4,467

For the size of vessels, 15,000 D.W.T. were proposed for ocean going vessels; and a maximum 3,000 D.W.T. in the year in 2000; a maximum of 2,000 D.W.T. in 1985 for domestic trade vessels.

2-2. Long-Term Plan

For the layout of port facilities capable of coping with the traffic in the year 2000, three alternative plans were prepared in the site of expansion and their advantages and disadvantages were examined.

After examination on several conditions in these three alternatives, such as the construction cost, convenience of port operations after completion, difficulty of ship navigation and freedom for future expansion, it was found that Alternative-1 was better than the others, so it was selected as the proposed plan. (Refer to Figs. 9-6, 9-7 and 9-8)

The important contents of the plan are to construct new wharves as follows:

-10 m wharf	1 Berth	220 m	For ocean going vessels
-5.5 m wharf	16 Berths	860 m	For RLS vessels
-5.5 m wharf		160 m	For local vessels
-3 m wharf		130 m	For sailing vessels

Then, along with the existing facilities, the handling capacity of the Port of Bitung would be improved to 2.4 million tons per year including foreign and domestic trade.

2-3. Medium-Term Plan

According to the long-term plan, a medium-term plan was formulated with 1985 as the target year, as shown below. (Refer to Fig. 10-1)

The plan comprises the construction of:

-5.5 m wharf	6 Berths	For RLS vessels
-5.5 m wharf	150 m	For local vessels
-3 m wharf	130 m	For sailing vessels
Transit sheds	15,660 m^2	For sailing vessels

As a result, the handling capacity of the Port of Bitung would be improved by 1 million tons.

3. Basic Design, Construction Period and Construction Cost

3-1. Basic Design

The basic design of the important port facilities under the medium-term plan is represented in the following.

(1) Design Conditions

-5.5 m wharf	
Tide level	1.9 m (H.W.L.)
Wharf crown height	D.L. +3.0 m
Surcharge	Usually 2.0 t/m^2, in case of earthquake 1.0 t/m^2
Design seismic coefficient	Horizontal seismic coefficient k_h = 0.15
Berthing speed	15 - 20 cm/sec.
Objective vessel	2,000 D.W.T.; Length 77 m, Draft 5.1 m

(2) Type of Structure

A comparison between the structural type of steel sheet pile and that of piled pier was made. As a result, the steel sheet pile structure was adopted because it was cheaper in construction cost. (Refer to Fig. 11-1)

3-2. Construction Period and Construction Cost

Under the medium-term plan, survey, design and engineering are to be done in 1978, and the construction work is to start in 1980 and completed in 1984, to meet the increased traffic in 1985.

The construction cost is 21,422 thousands US$, including 10,989 thousands US$ (51.3%) in foreign currency. (Refer to Table 11-1)

4. Management and Operation

The Port of Bitung will become about twice the size of the present port and will become a major base port for foreign trade under the medium term plan. It is necessary for the port to be managed and operated rationally considering these conditions.

Regarding management and operation for the new Port of Bitung, the following should be noted.

(1) It is desirable to designate the foreign trade area clearly and to operate as one unit.

(2) To establish a systematic method of using the wharves according to the type of ships. Especially, it is necessary for local and sailing vessels to avoid mixing with larger vessels.

(3) It is desirable to have passenger ships use specific berths in relation to the passenger shed so far as practicable.

(4) This report does not recommend a system for specifying berths for handling coconut oil and cement. However, it is desirable to direct such vessels to the wharf located at the west end of the existing concrete piers. It is necessary to specify an exclusive wharf for such cargo in the future.

(5) For efficient cargo handling it is necessary to maintain cargo handling equipment and operate them efficiently.

5. Environmental Conservation

The City of Bitung and the Port of Bitung are located in a good natural environment. And the sea area around the Port of Bitung is good for the fishery industry. Accordingly, development of the Port of Bitung has to be carried out giving special attention to maintaining the beautiful environment and the fine fishery environment.

The port development is necessarily accompanied with the expansion of the City of Bitung and industrial development.

Therefore the sources of environmental pollution in the future will be various such as smoke and drainage from factories, trash and sewerage from cities, car exhaust and waste oil from the port and vessels.

However, these factors are not very unusual and harmful. These factors can be prevented by general regulations by the public, by suitable arrangement in urban plans and with efforts to prevent pollution by industries.

There will be no big problem on water pollution in the sea area of Port of Bitung, since it can be expected that the water pollution will be dissipated by the current in Lembeh Strait.

Special attention should be paid to oil contamination around the oil berths of Pertamina since the quantity of oil handled will increase. It will also be necessary to install oil-fences, oil preventing banks and set up oil collecting ships and oil-disposal facilities.

Introduction

INTRODUCTION

In response to the request of the Government of the Republic of Indonesia, the Government of Japan has decided to conduct a feasibility study on "Master-Planning and Predesign (The Port of Bitung)" in accordance with laws and regulations in force in Japan and the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the Technical Cooperation Programmes of the Government of Japan, will carry out the study in close co-operation with the Government of the Republic of Indonesia and the authorities concerned.

1. Outline of the Study

(1) Objectives of the Study

The objectives of the study on the expansion project of the Bitung Port are:

a) to review the study reports prepared by the Indonesian side,

b) to appraise technical, economic and financial feasibility of the project, and

c) to prepare the Plan-1 and Plan-2 reports of the Bitung Port.

(2) Principal Purpose

The study on the Bitung Port will include the following basic principles.

a) The development of the port will be in correspondence with the economic policy of Indonesia.

b) The port should be adopted to the latest technology in sea transportation.

c) The port should be developed as the center of the main development area IV with the possibility of international port in the future.

d) Sound financing system of the port should be studied.

e) The development of the port should be harmonized with the city and the natural environment.

f) The port facilities should be arranged in accordance with different shipping categories.

(3) Course of Action

The study will consist of the Plan-1 and Plan-2.

a) Plan-1

The Plan-1 is the master-plan of which the target year is 2000.

b) Plan-2

The Plan-2 is the medium term plan covering from 1979 up to 1985. It will include the improvement and expansion of the Bitung Port. The development plan of the port will be evaluated based on a 20-year financial and economic justification.

(4) Study and Survey

Study areas are Bitung Port and its hinterland. Survey areas are Bitung, Menado, Ujung Pandang and the ports concerned.

2. Scope of Work

The scope of work is as follows:

(1) Plan-1

a) Review present condition
b) Economic studies
c) Future forecast of the port traffic
   - Cargo flow
   - Ships flow
d) Review of environmental condition
e) Engineering study
f) Master-plan up to 2000
g) Evaluation of alternatives (cost estimations)
h) Man-power and administration

(2) Plan-2

In Plan-2, the items of Plan-1 will be included and the additionals are as follows:

i) Optimum port operation
j) Economic/financial analysis of the development projects
k) Preliminary design of port facilities, cost estimation with alternatives

3. Organization of the Survey Team

The survey team was organized as follows:

Head of the Team:	Osamu HARADA (Team leader & Port planning) Senior Adviser, The Overseas Coastal Area Development Institute of Japan (OCDI)
Members :	Akio SOMEYA (Regional planning & Transport economy) Engineer, (OCDI)
	Katsuhisa YAMAZAKI (Economic & Financial analysis) Economists, (OCDI)
	Isamu HOTTA (Hydraulic) Engineer, Pacific Consultants International (PCI)
	Hirohito UCHINO (Cost estimate & Construction) Engineer, (PCI)
	Tadao YAMAZAKI (Soils & Design) Engineer, (PCI)
	Minoru TAKASE (Port engineer & Coordinator) Counselor, Japan International Cooperation Agency (JICA)

4. Schedule of Field Survey

We started the survey for physical condition on June 19, the planning and economic survey on June 28, and finished with the schedule of the survey mostly on July 24.

We could execute the survey on our schedule with good cooperation of Indonesian side. And so we would like to explain the outline as follows:

(1) Physical Condition Survey

June 21 to July 24, at Bitung

The surveys such as topographic survey, sounding and current observation were conducted from June 21 through July 22, 1977.

As for boring survey, it was completed until August 24.

(2) Planning and Economic Study

June 29 to July 2, at Jakarta

Data collection from such authorities as follows and interviews with them:

- Sea Communications
- BAPPENAS
- Department of Communications

Surveys at the Port of Tg. Priok and the Port of Sunda Kelapa.

July 3 to July 12, at Bitung and Menado

Data collection from the following authorities and interviews with them:

- ADPEL
- KEDAPEL
- BAPPEDA
- Bitung City Office
- Department of Fishery
- Department of Agriculture
- Meteorological Station, etc.

Survey at Port of Bitung and study of the economic and social condition of the hinterland.

Visit to Ternate, Ujung Pandang, Ambon, for data collection with the authorities below by some of the members:

- ADPEL
- KEDAPEL
- BAPPEDA

Visit to the Port of Gorontalo including the hinterland for study and interview with the port authority by others.

July 13 to July 14, at Surabaya

Visit to ADPEL and KEDAPEL for study of the circumstances of the Surabaya Port.

July 15 to July 24, at Jakarta

Interviews with the following authorities from whom we collected some data:

- Representatives of Central Sulawesi, South-East Sulawesi
- BAPPENAS
- Department of Industry
- Department of Agriculture
- Department of Public Works
- Department of Commerce
- Department of Mining
- PERTAMINA
- Central Bureau of Statistics

July 25 to July 26, at Jakarta

Preparation for the progress report and final conference with the staffs of Sea Communications.

July 27

Departure from Jakarta.

Chapter-1 Current State of the Port of Bitung

1. Current State of the Port of Bitung

1-1. General

The Port of Bitung is located at the northeast part of Indonesia, near the northern end of Sulawesi Island. It is situated in Lat. 1°26' N and Long. 125°12' E. The port facilities are faced with the 16 km long Lembeh Strait. It is a good natural port sheltered by Lembeh Island.

The construction of the Port of Bitung was begun in the 1950s. A concrete pier (432 m in length and -10m in water depth) was completed at that time. The construction is still being continued. Concrete Piers have been extended to 582 m by the end of 1977. Facilities for vessels for domestic use are being carried out.

The port tonnage traffic (including both foreign trade and domestic trade) in 1976 was 731 thousand tons. The port tonnage traffic has been increasing rapidly during recent years. This has promoted the current drive to improve port facilities.

1-2. Administration and Operation

1-2-1. Organization

The Port of Bitung used to be under Sea Communications whose local headquarter is located at Ujung Pandang. After a subsequent reorganization, its jurisdiction was transferred to the Marine Transport Bureau VII (Kepala Daerah Pelabuhan) located in the City of Menado.

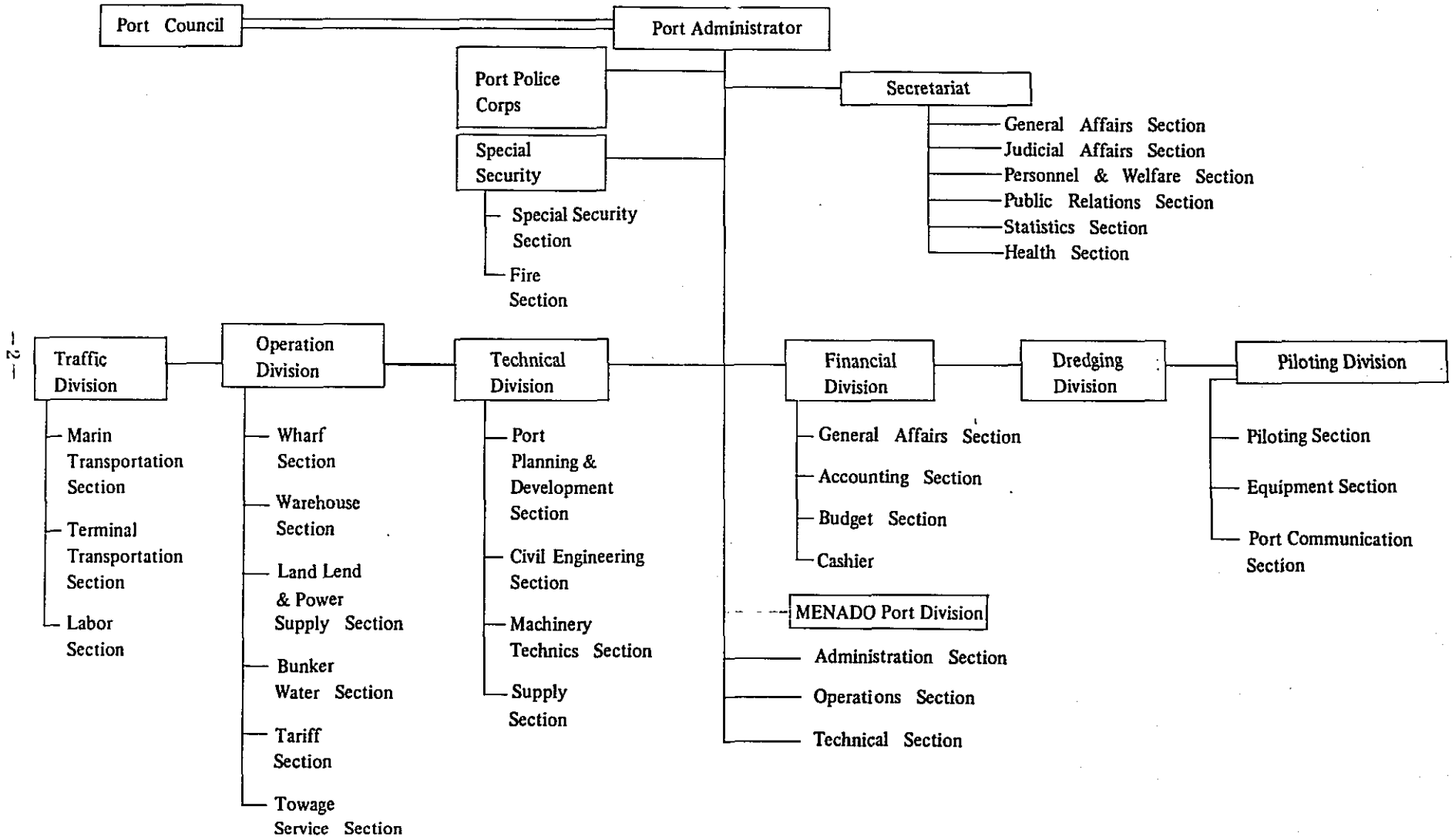
The Chief of the ADPEL OFFICE is under the control of the chief of Marine Transport Bureau VII of Sea Communications and checked by him. He reports to the Chief of the Directorate of Port and Dredging. In other words, a so-called cross-check system is adopted. The organization is shown in Fig. 1-1.

It is legally obliged to collect information and send information to the center since it maintains contact with beneficiaries. The organization is characterized by the port council and Menado Port Division. The Port Council assists the Port Administrator. The Menado Port Division is under the Bitung Port Administrator both legally and practically.

1-2-2. Employees and Workers

150 employees (as of 1976, estimates from annual report) are engaged in the administration and operation of the Port of Bitung and 725 workers (as of 1976) are employed for port operations. Workers are managed by the Manpower Administration of the Port of Bitung. There is no special problem in the supply of workers.

Fig. 1-1. Organization Chart of Port Administration of Port of Bitung



1-2-3. Port Services

The ADPEL has made efforts to improve operation and service efficiency to meet increasing demands at the Port of Bitung. For example, wooden containers etc. have been adopted. Vessels to call at the Port of Bitung are expected to increase both in quantity and size. This naturally means that cargo volume will increase. Methods for efficiently handling various types of cargo (copra, coconut oil, etc.) must be studied. Also methods for efficiently assigning berths to various types of vessels must be studied.

1-2-4. Tariff

The tariff of the Port of Bitung is roughly classified into charges for cargo and charges for vessels.

The former includes stevedoring, cargo handling and delivery charges. Charges are set according to cargo type and quantity.

The latter includes entrance charge and berthing charge. They are set according to vessel type, size and period (hours).

1-3. Facilities

1-3-1. *General*

The mooring facilities of the Port of Bitung are faced with the wide and calm Lembeh Strait (width: about 1 km; water depth: 10 - 40 m) and its anchorage is as large as 857 ha. The land area available for the port is 45 ha, including some swamps. Fig. 1-2 shows the existing facilities of the Port of Bitung.

1-3-2. Existing Major Facilities

(1) Mooring Facilities

The mooring facilities at the Port of Bitung are functionally classified as shown below. Each type of the existing facilities is as follows:

1) Concrete Pier

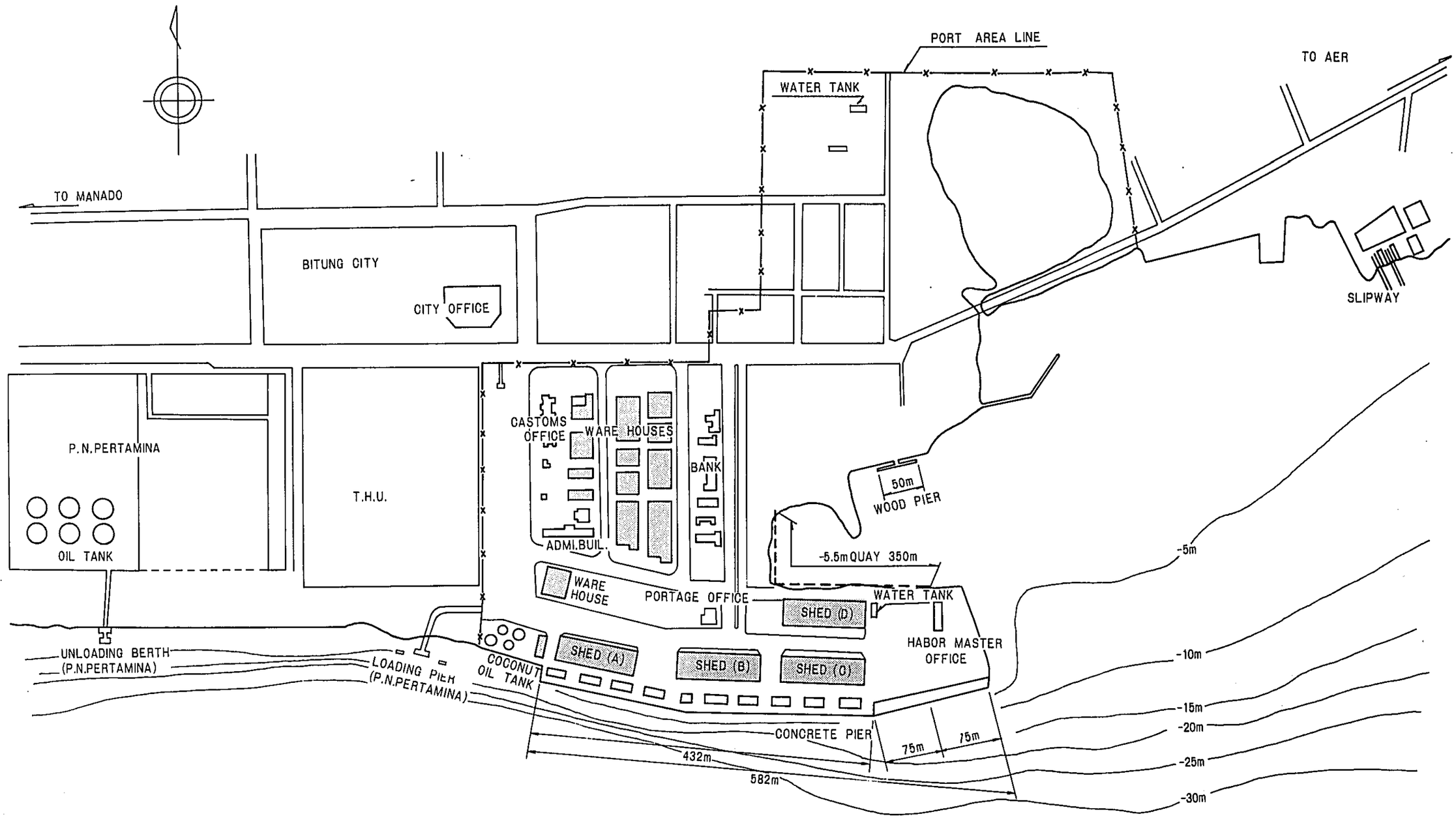
The concrete pier (water depth: -9m ~ -10m, length: 582 m) is the main berth of the Port of Bitung and is used by ocean going vessels, RLS vessels and local vessels. The maximum allowable ship size is 15,000 D.W.T.

The 75m length on the east side of the pier was newly constructed in January, 1977 and will become available from the year 1978.

The 432m length pier out of 582 m is wharf structure with piles

Fig. 1-2. Existing Facilities of Port of Bitung

Scale = 1:10,000



(width: 10m) and is connected with the revetment through access bridges. Each access bridge is 12 m wide and 12 - 16 m long and they are arranged at approximately 44 m intervals. This area shows neither differential settlement, nor cracking though it has been in service for about 20 years and is sufficiently in good conditions for continued service. However, all the wood fenders have been destroyed and tires are used instead.

The other 75 m length was constructed and completed in 1976, and has a piled wharf structure (width: 16 m) connected with the sheet pile bulkhead.

The gap between the above 432 m long pier and the revetment lowers cargo-handling capacity and not only limits the operation range of cargo handling machineries, but also raises some safety problems.

2) Wood Pier

The 3.0 m wide and 50 m long wood pier was constructed in 1975 and is used by local vessels and sailing vessels.

3) Quay for Coasting Vessels

Construction of a quay for coasting and local vessels was started in 1977 behind the east side of the concrete pier. It was planned to be 350 m long with a water depth of -5.5 m. Then the basin in front of this quay is to be dredged down to -5.5 m.

4) Other Mooring Facilities

One dolphin for oil tankers and concrete piers for loading small tankers exist on the west side of the concrete pier. They belong to P.N. Pertamina and handle oil only.

A coconut oil pipe line belonging to P.T. Bimoli is laid toward the coast on the west side of the P.N. Pertamina facilities.

(2) Sheds and Warehouses

There are three sheds (36 m x 120 m = 4,320 m^2) parallel to the concrete pier. They were constructed in 1953 - 1955 and have a brick wall structure, corrugated-galvanized iron sheet walls and corrugated-galvanized iron sheet roof covered on a steel frame.

One warehouse of the same structure and area as above also exist. All warehouses including those of private companies are located behind the sheds.

Detailed area of the warehouses and sheds are given below.

Owner	Shed (m^2)	Warehouse (m^2)
Port administration of Bitung	13,398	4,320
Private company	-	18,264
Total	13,398	22,584

The total area of the open storage yard is 26,900 m^2. (Paved area: 10,900 m^2; unpaved area: 16,000 m^2).

(3) Cargo Handling Facilities and Port Service Vessels

The cargo handling facilities and service vessels currently used at the Port of Bitung are given in the following:

List of Cargo Handling and Service Vessels

Name	Capacity	Quantity	Year of construction	Remarks
Tug boat	120 HP	1	1953	Old, but still usable
Tug boat	120 HP	1	1964	"
Barge	100 ton	1	1941	Old and damaged, not used at present
"	200 ton	1	1952	"
Pilot boat		1	1975	Good condition
Mobile crane	35 ton	1	1968	Old
"	15 ton	2	1968, 1976	
Forklift	2.5 ton	2	1971	Good condition
"	5 ton	2	1976	"

(4) Water Supply Facilities

Water has been supplied by two systems, namely, by a pipe from

Bitung City and by transportation of barges from Airperang. The former system alone is used at present because the barges are old and not in working condition.

The source of water supply in Bitung City is from natural spring water (200 - 300 l/sec.) at an altitude of 165 m in the upper stream of the Girian River located 7 km from the city.

Water from the spring is stored in a reservoir (Capacity: about 4,000 m^3), where it is sterilized by adding chlorine and then sent to Bitung City or the Port of Bitung. Water is sent to the Port of Bitung through a main pipe (Diameter: 150 mm) and to vessels through five branch pipes (Diameter: 65 mm) of the 507 m long concrete pier.

The water supply to the vessels is sufficient at present. Actually in 1976, 65,000 m^3 of water was supplied to vessels.

A water supply pipe (Diameter: 150 mm) was laid in 1976 along the face line of the new quay (-5.5 m) to be planned.

(5) Power Facilities

For illumination of the piers, roads and offices at the Port of Bitung, 60 KVA power from Bitung Sub Station of P.L.N. (National Power Corporation) is used.

(6) Oil Supplying Facilities

Tank lorries (Capacity: 4 kl) are used for supplying oil to vessels. The existing concrete piers have no oil supply pipe, therefore, P. N. Pertamina (National Oil Corporation) completely supplies the fuel oils.

(7) Navigation Aids

Light stations exist at the southwest end of Lembeh Island as aids for vessels entering into the Port of Bitung.

The principal specifications are given below.

Item \ Lamp tower	No. I	No. II
Location	Lat. 01°23'05" N. Long. 125°09'05" E.	Lat. 01°26'00" N. Long. 125°11'00" E.
Lamp color	Natural color	Natural color
Characteristics	GS(2) 10 sec.	GS(1) 5 sec.
Visibility	11 sea miles	11 sea miles
Height of tower	17 m	12 m
Elevation of lamp	W.L.+16 m	W.L.+59 m

1-4. Operation

1-4-1. Statistics

(1) Port Tonnage Traffic

The port tonnage traffic at the Port of Bitung was 731 thousand tons in 1976 (Table 1-1). It has been increasing at the rate of 13 % p.a. during the past five years. These figures indicate the recent prosperity of the Port of Bitung.

Table 1-1 Port Tonnage Traffic through Port of Bitung, 1971 – 1976

Unit: 1,000 tons

Year	Foreign Trade		Domestic Trade		Total
	Import	Export	Inbound	Outbound	
1971	131	46	144	78	399
1972	117	86	152	91	446
1973	124	66	200	120	510
1974	122	43	287	136	588
1975	87	79	306	121	593
1976	140	80	330	181	731
1977*	73*	36*	153*	78*	340*
Growth rate % p.a.	1.4	12	18	18	13

Note: * are the figures for January to May in 1977.

Source: ADPEL of Bitung

A detailed study of port tonnage traffic shows that the growth of import traffic is 1.4% p.a., that of export traffic is 12% p.a., that of domestic inbound traffic is 18% p.a., that of domestic outbound traffic is 18% p.a. Large growth is observed generally in domestic traffic rather than in foreign trading. This means that the rapid increase of port tonnage traffic during the recent years is accounted for mostly by the increase of domestic trading.

Table 1-1 shows the port tonnage traffic by commodity through the Port of Bitung. Details are given in Table 1-2. The commodities are grouped in this table to facilitate understanding.

Table 1-2 Port Tonnage Traffic through Port of Bitung by Commodity Group in 1976

Unit: 1,000 tons

Commodity Group	Foreign Trade		Domestic Trade		Ground Total		
	Discharged	Loaded	Discharged	Loaded	Discharged	Loaded	Total
Food stuffs (Rice, Wheat flour, Sugar)	56.2	–	43.2	22.9	99.4	22.9	122.3
Agricultural Products (Coconut Oil Cake, Coconut Oil,	–	71.5	43.1	72.0	43.1	143.5	186.6
Construction Materials (Cement, Asphalt, Iron)	76.2	8.0	15.2	6.1	91.4	14.1	105.5
Production Materials	–	–	0.1	0.3	0.1	0.3	0.4
Vehicles	3.0	–	8.7	0.6	11.7	0.6	12.3
Miscellaneous	4.1	0.8	70.3	12.3	74.4	13.1	87.5
Sub Total	139.5	80.3	180.6	114.2	320.1	114.5	594.6
Petroleum	0.6	–	149.6	66.5	150.2	66.5	216.7
Total	140.1	80.3	330.2	180.7	470.3	261.6	731.3

Notes: 1) The commodities in parentheses show the main commodities included in the related commodity group in these order.

2) Derived from the annual report of Adpel Bitung.

Table 1-2 shows that the same commodity group appears both in inbound traffic and in outbound traffic. This indicates that the Port of Bitung is a transit port.

The commodity groups which show more inbound traffic than outbound traffic are foodstuffs, construction materials, vehicles, miscellaneous goods and petroleum. They are consumed in the service area behind the Port of Bitung.

On the other hand, more agricultural products are shipped out than shipped in. They are produced in the service area behind the Port of Bitung.

In other words, the Port of Bitung is a base for goods distribution, which supplies foodstuffs, construction materials and petroleum to its service area and collects agricultural products.

Table 1-3 shows the figures of Table 1-2 in percentage composition. Petroleum (30%) and agricultural products (25%) account for the largest part of discharged and loaded traffic. They are followed by foodstuffs (17%), construction materials (14%) and miscellaneous goods (12%). Vehicles (2%) began to grow rapidly during recent years.

Table 1-3 Percentage Composition of Port Tonnage Traffics through Port of Bitung by Commodity in 1976

Unit : %

Commodity Group	Discharged	Loaded	Total
Food stuffs	21	9	17
Agricultural Products	9	55	25
Construction Materials	19	6	14
Production Materials	–	–	–
Vehicles	3	–	2
Miscellaneous	16	5	12
Sub Total	68	75	70
Petroleum	32	25	30
Total	100	100	100

As for discharged traffic, petroleum accounts for the largest part. It is followed by foodstuffs, construction materials and miscellaneous goods in this order. Agricultural products account for only 9%. As for loaded traffic, agricultural products account for 55%. They are followed by petroleum (25%).

Table 1-4 shows the details of cargo by destination of origin. Cargo from Surabaya and Ujung Pandang accounts for nearly 60% of the discharged traffic. They are followed by North Sulawesi, East Kalimantan and Jakarta.

Cargo destined to Jakarta accounts for a quarter of the total loaded traffic. It is followed by Surabaya, North Sulawesi, Central Sulawesi,

and North Maluku.

Table 1-4 Interregional Flow of Dry Cargo Discharged and Loaded at Bitung, 1974

Statistical Maritime Regions		Discharged (100 tons)	Loaded (100 tons)	Discharged (%)	Loaded (%)
12	Sumatra Selatan	–	–		
16	D.K.I. Jaya I	64	200	6.6	25.9
17	D.K.I. Jaya II	1	–	0.1	–
19	Jawa Tengah I	1	–	0.1	–
21	Surabaya	329	110	34.0	14.2
26	Kalimantan Selatan	7	–	0.7	
27	Kalimantan Timur I	71	–	7.3	
28	Kalimantan Timur II		–		
29	Sulawesi Utara I	110	119	11.4	15.4
30	Bitung	5	5	0.5	0.6
31	Sulawesi Utara II	68	84	7.0	10.9
32	Sulawesi Tengah I	8	20	0.8	2.6
33	Sulawesi Tengah II	33	88	3.4	11.4
34	Ujung Pandang	225	11	23.2	1.4
36	Sulawesi Tenggara	21	–	2.2	–
37	Bali	18	–	1.9	–
38	Nusatenggara Barat	2	–	0.2	–
40	Maluku Utara	6	125	0.6	16.2
41	Maluku Tengah	–	6	–	0.8
43/47	Irian Jaya	–	5	–	0.6
	Total	969	773	100	100

Note: Derived from "Interisland Sea Transport in Indonesia, 1974" by Puslitbang and I.S.T.P.

(2) Ship Call

Table 1-5 shows the transition of calling vessels at the Port of Bitung. The number of calling vessels and their D.W.T. have been gradually increasing, but the growth rate is small.

The trend of sailing vessels is completely opposite to that of general vessels. Sailing vessels have recently decreased rapidly both in the number of calls and in D.W.T., on the other hand, general vessels have been increasing both in the number of calls and in D.W.T., the number of calls has been increasing specially in the calls of general

vessels.

Table 1-5 Ship Calls to Port of Bitung, 1971–1976

Year	General Vessels		Sailing Vessels		Total	
	Calls	1000 D. W. T.	Calls	1000 D. W. T.	Calls	1000 D. W. T.
1971	1,433	1,783	1,027	9	2,460	1,792
1972	1,500	1,946	854	8	2,354	1,954
1973	1,554	1,756	691	7	2,245	1,763
1974	1,759	1,868	597	7	2,356	1,875
1975	1,806	2,208	763	8	2,569	2,216
1976	2,063	2,080	585	5	2,648	2,085

Source : ADPEL Bitung

Table 1-6 shows the number and D.W.T. of the vessels which called at the Port of Bitung in 1976 and the ratio. In 1976, 2,648 vessels (2,085 thousand tons in D.W.T.) called at the Port of Bitung. In terms of calls, inter-insular vessels account for the largest percentage (63%).

Table 1-6 Ship Calls to Port of Bitung by Type of Vessels in 1976

Type of Ships	Vessels	D.W.T.	Composition	
			Vessels	D.W.T.
Ocean Going Vessels	Vessels	1000 D.W.T.	%	%
Foreign Flag	120	768	4	37
Indonesian Flag	18	163	1	8
Tanker				
Foreign Flag	2	27	–	1
Indonesian Flag	173	411	7	20
Interinsular Vessels	1,663	711	63	34
Sailing Vessels	585	5	22	–
Others	87	–	3	–
Total	2,648	2,085	100	100

Source: ADPEL Bitung

They are followed by sailing vessels (22%). The percentage of the other types of ships is far smaller. In terms of D.W.T., ocean going vessels (45%) are followed by interinsular vessels (34%). Sailing vessels account for less than 1%.

Table 1-7 shows the port tonnage traffic through the Port of Bitung classified by types of ship. It shows that ocean-going vessels, RLS vessel and special vessels account for 30%, 31% and 34%, respectively. The total of the three exceeds 90%. Local vessels and sailing vessels account for only 3% and 2%, respectively.

Table 1-7 **Port Tonnage Traffic Discharged and Loaded at Port of Bitung, 1976**

Type of Ships	Tonnage	Composition
Ocean Going Vessels	220 1,000 tons	30 %
RLS Vessels	227	31
Special Vessels	248	34
Local Vessels	19	3
Sailing Vessels	17	2
Total	731	100

Source: ADPEL Bitung

(3) Passengers

Table 1-8 shows the transition of the number of disembarkation and embarkation passengers at the Port of Bitung. The number of passengers was 13 thousand in 1976. The general trend shows a gradual

Table 1-8 **Disembarkation and Embarkation of Passengers at Port of Bitung, 1971 – 1976**

Unit: 1,000 persons

Year	Disembarkation	Embarkation	Total
1971	7	13	20
1972	7	10	17
1973	12	10	22
1974	16	9	25
1975	11	6	17
1976	9	4	13

Source: ADPEL Bitung

decrease with considerable fluctuations.

1-4-2. Uses of Facilities

(1) Water Area

Most of the vessels entering the Port of Bitung approach Lembeh Strait from the south side. Lembeh Strait is navigable in the north-south direction, but most of the large vessels approach from the south side. A pilot boards near the pilot limit and assists berthing.

(2) Mooring Facilities

The Port of Bitung has three mooring facilities. However, the Concrete Pier alone can accommodate ocean going, RLS vessels and local vessels. Vessels of these types berth according to ADPEL's assignment. Mooring places for ocean going vessels are not distinguished from those for vessels for domestic use.

The 432 m long pier was put into services as of June, 1977. It was used as six berths (max.). The two bends of the water front seem to have restricted the assignment of berthing places.

Table 1-9 shows the traffic through Concrete Pier (per m). It was 950 t/m in 1976. It has been increasing gradually with some fluctuations in the last several years.

Table 1-9 Traffic per Meter of the Concrete Pier at Port of Bitung, 1971 – 1976

Year	Length of Concrete Pier	Traffic	Traffic per Meter of the Pier
	m	1,000 tons	t/m
1971	432	385	891
1972	432	330	764
1973	432	347	803
1974	432	403	933
1975	432	387	896
1976	507	482	950

The vessels which entered the Port of Birung in June, 1977, were analyzed to study ship congestion at the port. Forty-four vessels entered the Port of Bitung, this month. One of them berthed once and anchored at the anchorage and then, berthed again. Therefore, forty-five vessels berthed. The average berthing time was 36 hours/vessel. The average anchoring period prior to berthing was 19 hours.

This was calculated by assuming that 40 minutes are required for shifting from the anchorage to a berth. Sixteen vessels (1/3 of all the vessels) had to queue for berthing.

The considerable high average of t/m means considerable waiting on the part of vessels.

(3) Land Area

Fig. 1-3 shows the patterns of the movements of discharged cargo. It shows that 2/3 of the discharged cargo are loaded on trucks at the pier and carried to the hinterland. Most of the remaining 1/3 is stored once in transit sheds or open storage. They are shipped by trucks after some period.

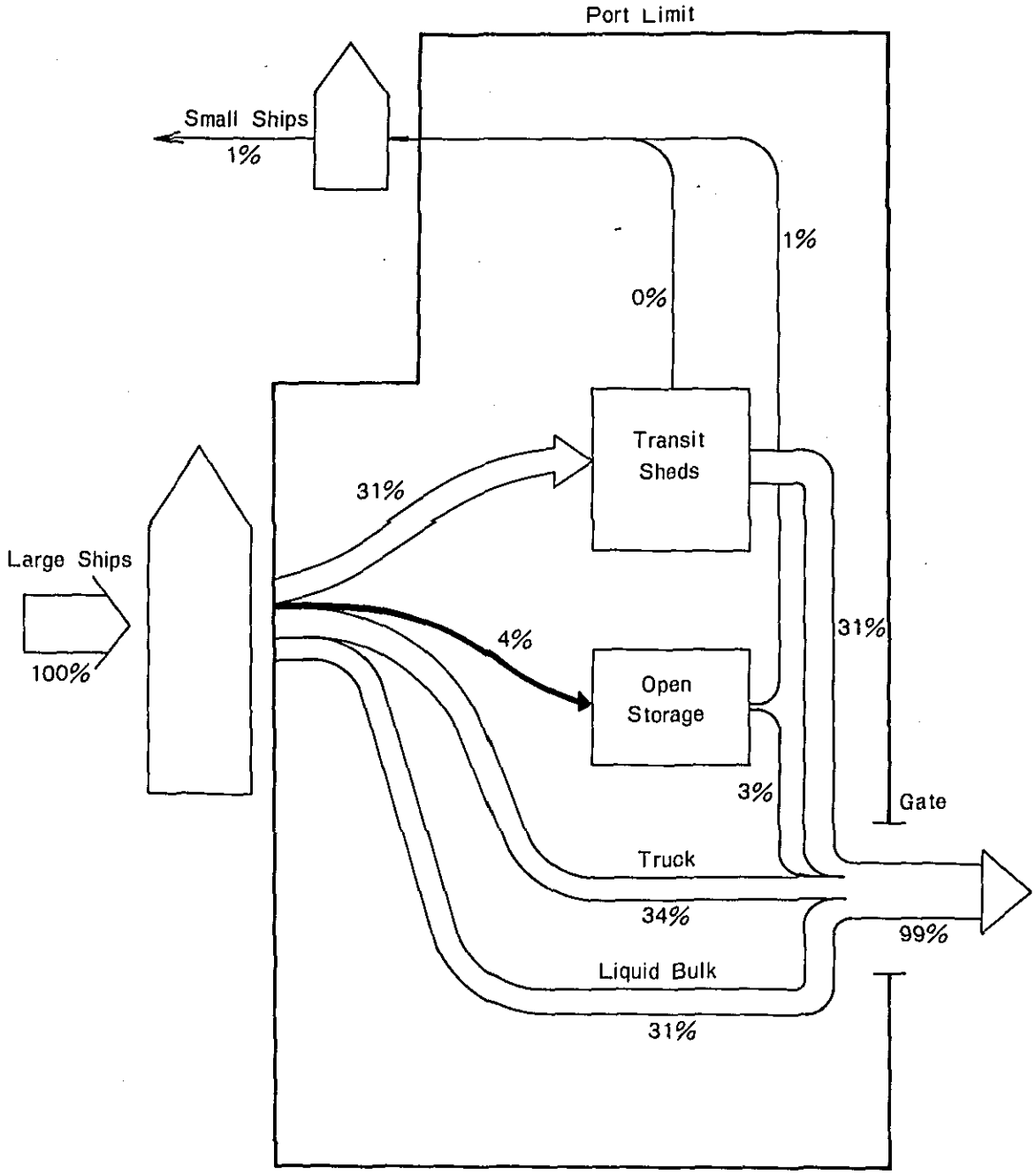
It is only a small percentage of cargo that is loaded on small vessels. The difference from the cargo statistics discussed in 1-4-1 (1) leads us to suspect that most of the cargo discharged at the Port of Bitung is stored once somewhere outside the gate and then shipped from the Port of Bitung.

Passengers walk to vessels. Vessels are moored at all the places along the Concrete Pier. Therefore, passengers must walk to their vessels, avoiding cargo-handling operations.

1-5. Role of the Port of Bitung

The role of the Port of Bitung can be summarized on the basis of 1-4 and 2 (to appear later). It is the key port for foreign and domestic trading for North Sulawesi Province, Central Sulawesi Province and North Maluku of Maluku Province. The Port of Bitung is the gateway of foreign and domestic trading for the City of Menado, Minahasa Regency and Bolaang Mongondow Regency. It is a transit port for the other areas.

Fig. 1-3. Pattern of Inbound Cargo Movement within the Port Area of Port of Bitung



Chapter-2 Economic and Social Conditions Related to the Port of Bitung

2. Economic and Social Conditions Related to the Port of Bitung

2-1. General

The present chapter is concerned mainly with the economic and social conditions of the current service area of the Port of Bitung to be discussed in Chapter 5. It covers North Sulawesi Province, Central Sulawesi Province, North Maluku Regency of Maluku Province. They will be called hereafter as North Sulawesi, Central Sulawesi and North Maluku, respectively.

The Port of Bitung is connected with its service area in various ways. It is connected with Minahasa Regency, City of Menado and Bolaang Mongondow Regency in North Sulawesi by roads. These areas are most strongly connected with the Port of Bitung. However, the Port of Bitung is connected with the other areas by sea routes. Their connection is not necessarily strong because of the characteristics of sea routes.

In terms of economic activities, the service area is divided into some subareas because of geographical conditions. However, such a divided situation is expected to change along with the development of traffic routes. For example, road construction will bring about strong influences of the Port of Bitung to the hinterland of the Port of Gorontalo.

Cities of Bitung and Menado seem to support the Port of Bitung. It is relatively recent that the Port of Bitung became an active port. The City of Bitung has not been developed enough to meet all the requirements of a port city.

The Port of Bitung will continue to be supported by the City of Menado and the City of Bitung.

2-2. Population

The population in the service area of the Port of Bitung was 3,395 thousand in 1976. The population of North Sulawesi accounts for 58%, that of Central Sulawasi accounts for 31% and that of North Maluku accounts for 11%. The average annual growth rate during the recent five years is 3.0%. The growth rate of North Maluku is the largest (Table 2-1).

Table 2-2 shows the details (by Regency and City) of the population of North Sulawesi. The population of the City of Menado, Minahasa Regency and Bolaang Mongondow Regency connected with the Port of Bitung by roads is 1,140 thousand. The pupulation of Gorontalo Regency and the City of Gorontalo connected with the Port of Bitung by sea routes is 542 thousand. The population of Sangihe Talaud Regency is 246 thousand.

Table 2-1 Population of North Sulawesi, Central Sulawesi and North Maluku, 1971 – 1976

Unit: 1,000 persons

Region	1971	1972	1973	1974	1975	1976	Growth rate per annum
North Sulawesi	1,718	1,768	1,820	1,873	1,928	1,984*	2.8
Central Sulawesi	914	943	971	997	1,024	1,051	2.8
North Maluku	307	314	322	329	340	360	3.2
Total	2,939	3,025	3,113	3,199	3,292	3,395	3.0

Note: * estimate
Source: Statistics of Provinces

Table 2-2 Population of North Sulawesi Province by City or Regency, 1975

Unit : 1000 persons

Regency or City	Population	
Sangihe Tolaud Regency	246	
City of Menado	192	1,140
Minahasa Regency	706	
Bolaang Mongondow Regency	242	
City of Gorontalo	87	542
Gorontalo Regency	455	
Total	1,928	

Source : North Sulawesi Province

2-3. GRP

Table 2-3 shows the GRP converted into the 1973 prices. The GRP in the entire service area is 214 billion Rp. in 1975. North Sulawesi accounts for 69% of the total. The annual growth rate is 11%. The growth rate of Central Sulawesi is the largest (14%).

Table 2-3 GRP of North Sulawesi, Central Sulawesi and North Maluku in 1973 Constant Price, 1971–1975

Unit : billion Rp.

Region	1971	1972	1973	1974	1975	Growth rate 1975/1971 % per annum
North Sulawesi	97	104	124	135[1)]	147[1)]	11
Central Sulawisi	27	31	35	39	45	14
North Maluku [2)]	15	16	18	21	22	10
Total	139	151	177	195	214	11

Note 1) Estimate

2) GRP for North Maluku is estimated by allocating GRP in Maluku by its population composition.

Source : Provinces.

Table 2-4 shows the recent per capita GRP and the ratio to the national total. It shows that the per capita GRP in North Sulawesi, Central Sulawesi and North Maluku is 129%, 68% and 96% of the Indonesian average, respectively. In other words, North Sulawesi is richer than the average standard, but Central Sulawesi is poorer. North Maluku is near the average standard. The data of subsequent years show that Central Sulawesi is approaching the national average.

Table 2-4 Percapita GRP of North Sulawesi, Central Sulawesi and North Maluku, 1973–1975

Region	1973	1974	1975	Ratio to the value of Indonesia 1973	1974	1975
	(1000 Rp.)	(1000 Rp.)	(1000 Rp.)	(%)	(%)	(%)
North Sulawesi	69.2	–	–	129	–	–
Central Sulawesi	36.5	38.7	44.6	68	69	77
North Maluku	51.5	58.2	58.9	96	103	102
Indonesia	53.6	56.1	57.7	100	100	100

Note : in 1973 prices

2-4. Industries

The industrial structure of North Sulawesi is shown in Table 2-5. The agricultural division accounts for approximately 41% of the regional income. It is followed by trading (about 20%), industries (8%), service (7%), transport and traffics (7%) and others (17%). It is a typically agriculture-oriented industrial structure.

The main agricultural products are rice, vegetables, coconut, clove and nutmeg. The main fishery products are tuna and shrimp for export (mainly to Japan).

Minahasa is the center of rice cultivation. Coconut is cultivated in Minahasa Kae Island, Sangihe Island and Talaud Island. Clove is produced mainly in Minahasa (85%), but also in Bolaang Mongondow and Gorontalo. Nutmeg is produced mostly in Minahasa.

Processing of agricultural products is the major industry. The industries include copra production, coconut oil production, automotive knockdown, shipbuilding, nail and wire fabrication.

2-5. Transports

2-5-1. General

The transport conditions related to the Port of Bitung is as follows.

2-5-2. Road Conditions

Among the main roads of North Sulawesi, a paved road North of Amurang (Bitung - Menado - Amurang) now exists.

The road, connecting Amurang - Inobonto - Kotamobagu - Duloduo, south of Amurang is being repaired or constructed with a loan from the World Bank. And also Amurang - Kotamobagu section of road is being repaired or constructed with a loan from Japan. The above road construction will be completed by the end of 1978. A paved road is to be constructed between Inobonto and Kuandang after 1979.

The North Sulawesi road network will be completed when these construction works are completed. Fig. 2-1 shows the location of these main roads.

(1) Menado - Bitung - Aer Tembaga

This road is the main road from the Port of Bitung to the inland and a national road of economic and administrative importance. The road is approximately 49 km long and has two traffic lanes. The alignment of the road is good. It is paved with asphalt and maintained in good condition.

Table 2-5 Composition of GRP by Industrial Origin, 1969–1973

Unit: Million Rp. (1969 constant price)

	1969		1970		1971		1972		1973	
		%		%		%		%		%
GRP	43,019.22	100	45,914.18	100	50,175.88	100	53,876.40	100	64,287.33	100
Agriculture	16,850.89	39.2	19,166.75	41.7	19,720.87	39.3	18,686.97	34.7	26,596.38	41.4
Mining	79.17	0.2	124.69	0.3	99.06	0.2	95.21	0.2	178.58	0.3
Industry	3,390.37	7.9	2,766.75	6.0	3,881.67	7.7	5,423.10	10.1	5,594.11	8.7
Building	1,248.68	2.9	1,508.41	3.3	1,773.13	3.5	1,821.83	3.4	2,043.46	3.2
Electricity & Drinking Water	143.63	0.3	158.87	0.4	180.19	0.4	176.17	0.3	170.65	0.3
Transportation & Communication	2,276.66	5.3	2,613.36	5.7	3,265.66	6.5	3,674.51	6.8	4,577.41	7.1
Trade	9,430.95	21.9	9,755.75	21.3	10,360.84	20.7	12,568.01	23.3	12,978.55	20.2
Bank & Other financial body	1,039.20	2.4	922.84	2.0	970.86	1.9	724.36	1.3	1,034.78	1.6
House Hiring	1,251.36	2.9	1,291.92	2.8	1,327.44	2.7	1,363.94	2.5	1,401.44	2.2
Gov. & Army	2,927.93	6.8	3,276.95	7.1	3,908.26	7.8	4,517.79	8.4	4,733.00	7.3
Services	4,374.38	10.2	4,327.89	9.4	4,687.90	9.3	4,824.51	9.0	4,978.97	7.7

Source: Pendapatan Regional Daerah Tingkati Sulawesi Utara

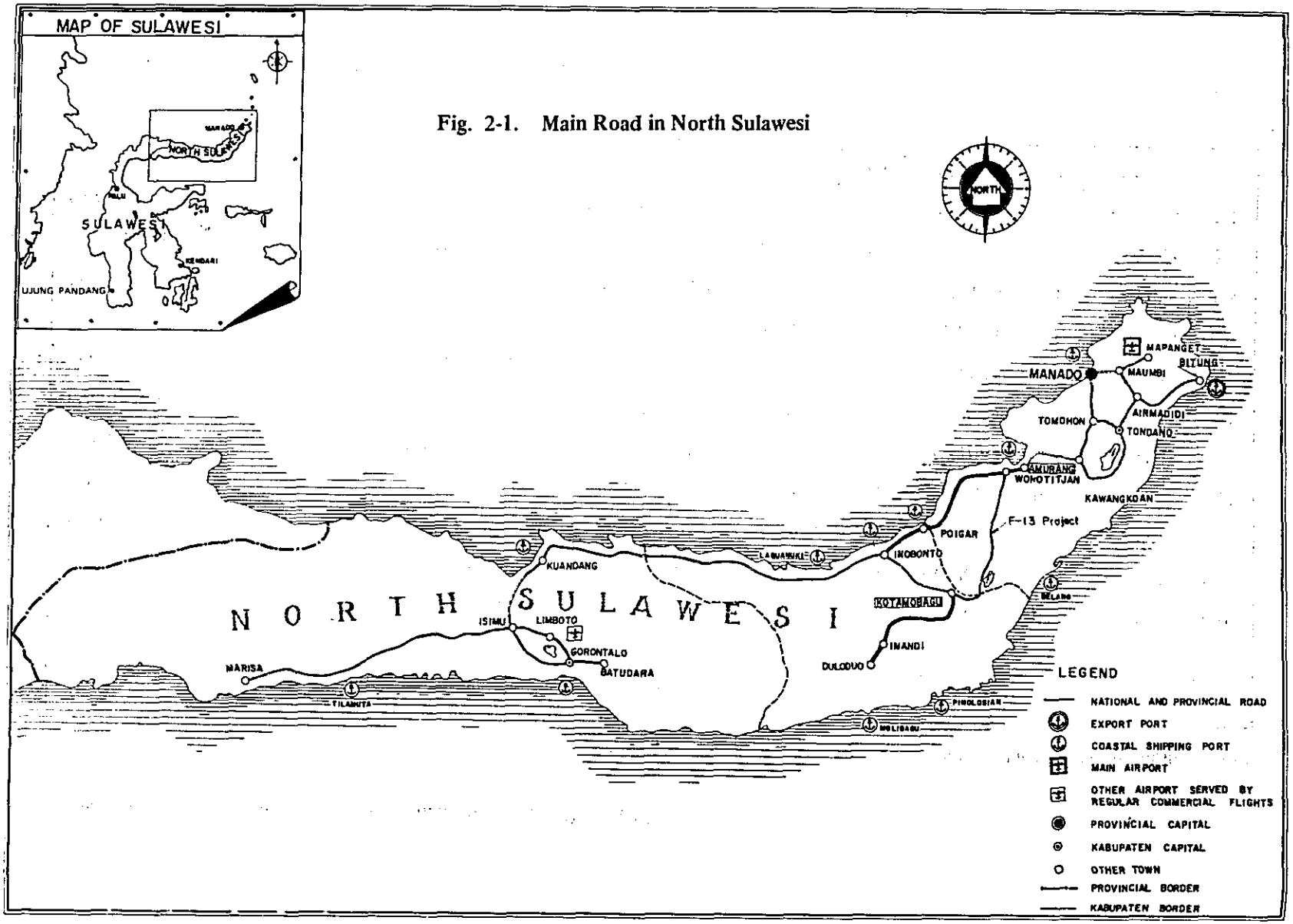


Fig. 2-1. Main Road in North Sulawesi

(2) Menado - Amurang

This road passes through Tomohon (altitude 700 m) and many mountains. It is a 84 km long national road with two traffic lanes. It is paved with asphalt and its slope and alignment conditions are relatively good in comparison with the other mountain roads.

(3) Amurang - Inobonto - Kotamobagu - Duloduo

The road of Amurang - Poigar - Inobonto is a newly constructed two traffic lane road, 94 km long and passes both flat areas (about 70%) and mountain areas (30%). It is still under construction, but will be completed in 1978.

The area between Inobonto and Kotamobagu is a 35 km long one-lane national road passing mostly through mountains. The existing road is under improvement construction at present, and will be completed in 1978.

Kotamobagu - Duloduo

This road passes mainly through flat areas except for the mountain area neighboring Kotamobagu. A 54 km long one-lane road is under construction at present and will be completed in 1978.

(4) Amurang - Kotamobagu

The 97 km long road between Worotijnn and Kotamobagu (located 9 km in the south of Amurang) runs mostly through mountains. Pavement repairing (4.5 m wide) and bridge replacement are planned in 1977/1978.

(5) Inobonto - Kuandang - Gorontalo

The road between Inobonto and Gorontalo is 201 km long. The road from Kuandang to Gorontalo (60 km) has been paved. Though the road between Inobonto and Kuandang is not paved at present, the pavement work will be performed by the Indonesian Public Works after 1979.

2-5-3. Air Transport

Sam Ratulangi Airport is located near the City of Menado. A trip between the airport and the Port of Bitung takes about one hour by car.

One daily flight (Garuda's DC9) is available as of August, 1976. Garuda flies nonstop from Menado to Ujung Pandang. Flights to Ambon, Sorong, Surabaya and Jakarta are available from Ujung Pandang.

Many local flight services are available. They connect Menado with the major cities in the service area.

Table 2-6 shows the number of passengers at Sam Ratulangi Airport. In 1975, 76,000 persons used the airport. This is four times as large as the number of passengers through the Port of Bitung. The number of airport users has been increasing at an average rate of 13% per year. This is good contrast from the number of port-using passengers which seems to be steady.

Table 2-6 Passengers through Sam Ratulangi Air Port, 1971 – 1975

Unit: 1,000 persons

Traffic	1971	1972	1973	1974	1975	Growth rate 1975/1971
						%
Embarkation	23	24	29	42	33	9
Disembarkation	23	24	29	43	42	16
Transit	–	–	–	1	1	–
Total	46	48	58	86	76	13

Source : Bappeda of Menado

This airport is subject to the influences of the mountainous topography so that aircraft is often prohibited from taking off or landing in stormy weather.

2-5-4. Marine Transport

The Port of Bitung is used by ocean going vessels (tramp vessels alone, at present), RLS vessels, special vessels, local vessels and sailing vessels (Refer to Table 1-4).

The routes of domestic transport are RLS routes and local routes. The Port of Bitung is used also for pioneer routes. Table 2-7 shows the number and codes of domestic routes which call at the Port of Bitung. Fig. 2-2 shows the areas that are directly connected to the Port of Bitung by means of marine routes.

The RLS routes calling at the Port of Bitung are Trunk Routes, Singapore Routes and Special Routes. The Singapore Routes connect the Port of Bitung with the area from West Irian and to Singapore by way of Tg. Priok and Surabaya. The Trunk Routes connect the Port of Bitung with the four provinces of Sulawesi, North Maluku, Surabaya and Tg. Priok. The Special Routes extend the connection even to East Kalimantan in addition to that of Trunk Routes.

The Local Routes connect the Port of Bitung directly with North Sulawesi, Central Sulawesi and North Maluku.

Table 2-7 *Sea Routes Related to Port of Bitung*

Kinds of Routes	Number of Routes	Codes of Routes
R.L.S. Route		
Trunk Route	6	T5, T6, T22, T23, T24 & T25
Singapore Route	2	(S17) & S18
Special Route	2	C1, C6
Local Route	7	L. VII a1 ~ L. VIIa7
Pioneer Route	3	

Source : Directorate General of Sea Communication and KEDAPEL of Manado.

In other words, this route system connects the Port of Bitung with Tg. Priok and Surabaya and makes it the center of North Sulawesi, Central Sulawesi and North Maluku. It also connects the Port of Bitung with West Irian and Singapore.

Among the ports within the service area of the Port of Bitung, those with relatively large port tonnage traffic are listed in Table 2-8. It shows that the Ports of Ternate and Donggala are active next to the Port of Bitung.

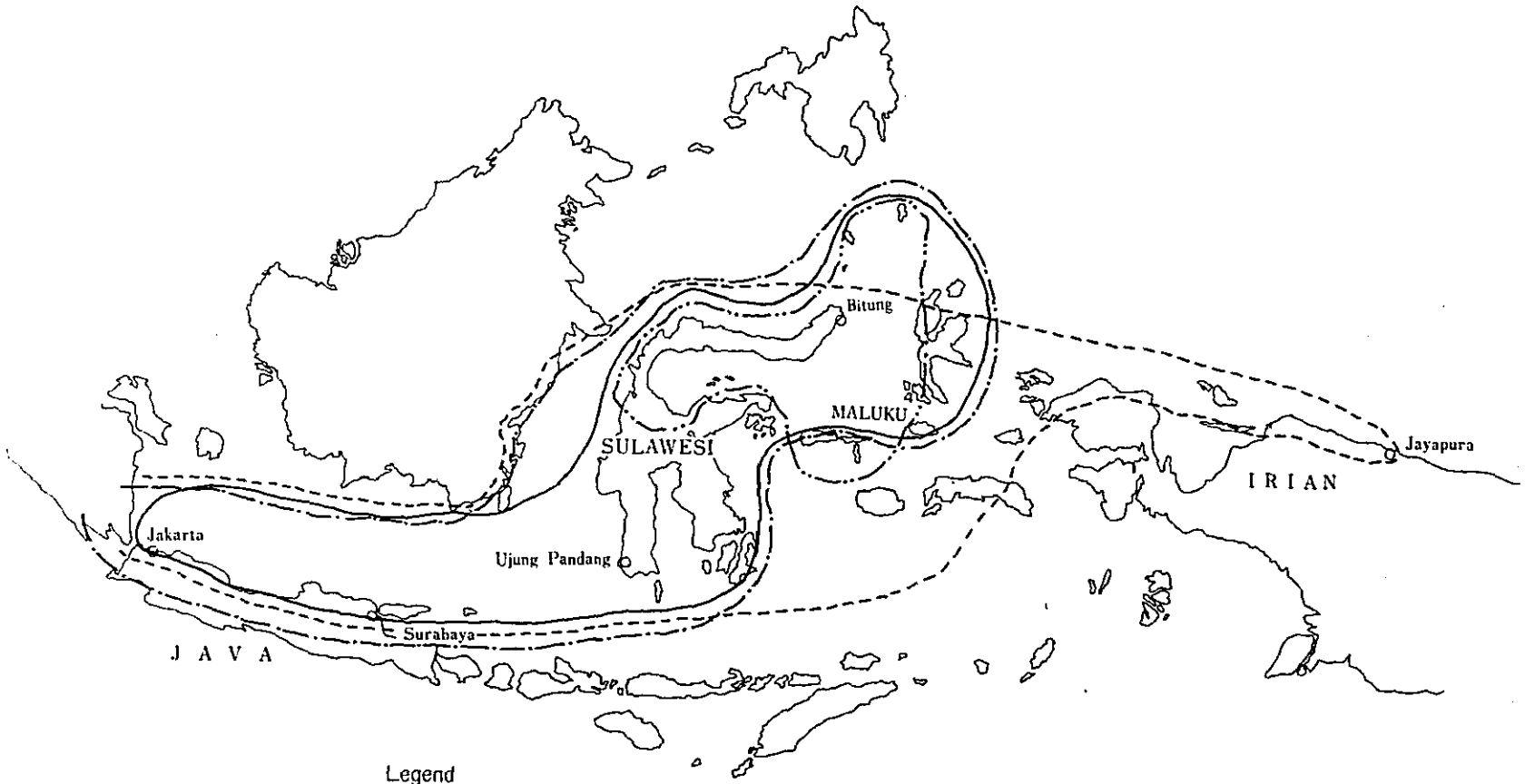


Fig. 2-2. Range of Shipping Routes Related to Port of Bitung

Table 2-8 Traffic through Main Ports in North Sulawesi, Central Sulawesi and North Maluku, 1975

Unit : 1,000 tons

Ports	Traffic
North Sulawesi	
Bitung	593
Menado	27
Gorontalo	80
Tahuna	27
Siau	14
Central Sulawesi	
Toli-Toli	46
Donggala	198
Parigi	14
Posso	20
Ampana	18
Luwuk	84
Pagimana	11
Banggai	10
North Maluku of Maluku	
Ternate	468
Labuna	14

Note : Data on the ports whose traffic was more than 10 thousand tons.

Source 1) Ports of North Sulawesi: Bappeda of North Salawesi

2) Ports of Central Sulawesi : Central Bureau of Statistics

3) Ports of North Maluku of Maluku: Census and Statistical Office of Maluku

Chapter-3 Natural Conditions of the Port of Bitung

3. Natural Conditions of the Port of Bitung

3-1. General

The Port of Bitung is located on the southeast coast at the north end of the Sulawesi Island, at 1°26' North Latitude and 125°12' East Longitude, facing to the Lembeh Strait. (Refer to Fig. 3-1.) This Lembeh Strait is 1 to 2 km in width and about 16 km in length running from northeast to southwest direction between the Lembeh Island and Sulawesi Main Island.

The Lembeh Island is a narrow island 1 to 5 km in width and approximately 23 km in length, and hills with an altitude of about 200 to 450 m run through the middle of the island.

At the portion of the Sulawesi Island along the strait, volcanic mountains of Mt. Duasudara with an altitude of 1,351 m and Mt. Batuangus with an altitude of 1,109 m are located inland at a distance of 7 to 8 km from the coastline.

Thus, the flat land behind the Port of Bitung is located between these mountains and the coast, and therefore is very narrow.

3-2. Climate

The weather in this area is a tropical climate with high temperature and high humidity. Also the mountains run in all directions in Sulawesi creating a complicated topography so that the weather greatly differs depending upon the locality.

The climate in the peninsula North of Sulawesi is generally characterized by much rainfalls and the monsoon blowing in the northeast direction from December to March, and the rainfall is less during the southeast monsoon from June to September.

The weather station in the Port of Bitung was opened in February 1977, and weather observations are being performed.

Another weather station nearest to the Port of Bitung is the Mapanget station in the Menado airport.

3-2-1. Temperature and Humidity

The records of air temperature and relative humidity for the last 5 years in Mapanget are shown in Table 3-1.

From these records, the monthly mean temperature throughout the year

Table 3-1 Climatic Table

Station: Mapanget in North Sulawesi

Item \ Month	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	NOV	DEC	Aver-age
Mean Temperature (°C)	25.2	24.6	25.2	25.8	26.0	25.6	25.8	26.2	25.8	26.2	25.8	25.9	25.7
Mean Maximum Temperature (°C)	29.1	28.9	29.5	29.9	30.8	30.2	31.0	31.5	31.4	31.7	30.1	29.7	30.3
Mean Minimum Temperature (°C)	22.0	21.7	22.0	22.0	21.8	21.8	21.3	21.0	21.1	21.3	22.1	21.9	21.7
Extreme Maximum Temp. (°C)	31.4	31.2	32.0	32.6	33.0	33.6	34.0	34.2	34.9	35.0	33.6	32.0	35.0
Extreme Minimum Temp. (°C)	19.9	18.9	19.8	20.0	20.0	19.0	18.6	17.5	17.4	18.2	20.2	20.2	17.4
Mean amount of Precipitation(mm)	325	377	225	294	251	214	186	115	224	260	451	372	3294 (Total)
Mean Relative Humidity (%)	87	87	84	82	83	77	77	74	76	79	84	85	81
Minimum R. Humidity (%)	53	53	50	50	33	45	37	36	32	33	52	48	32

Remarks: Period of Record: January 1972 – July 1977.

Fig. 3-1 Location of Bitung

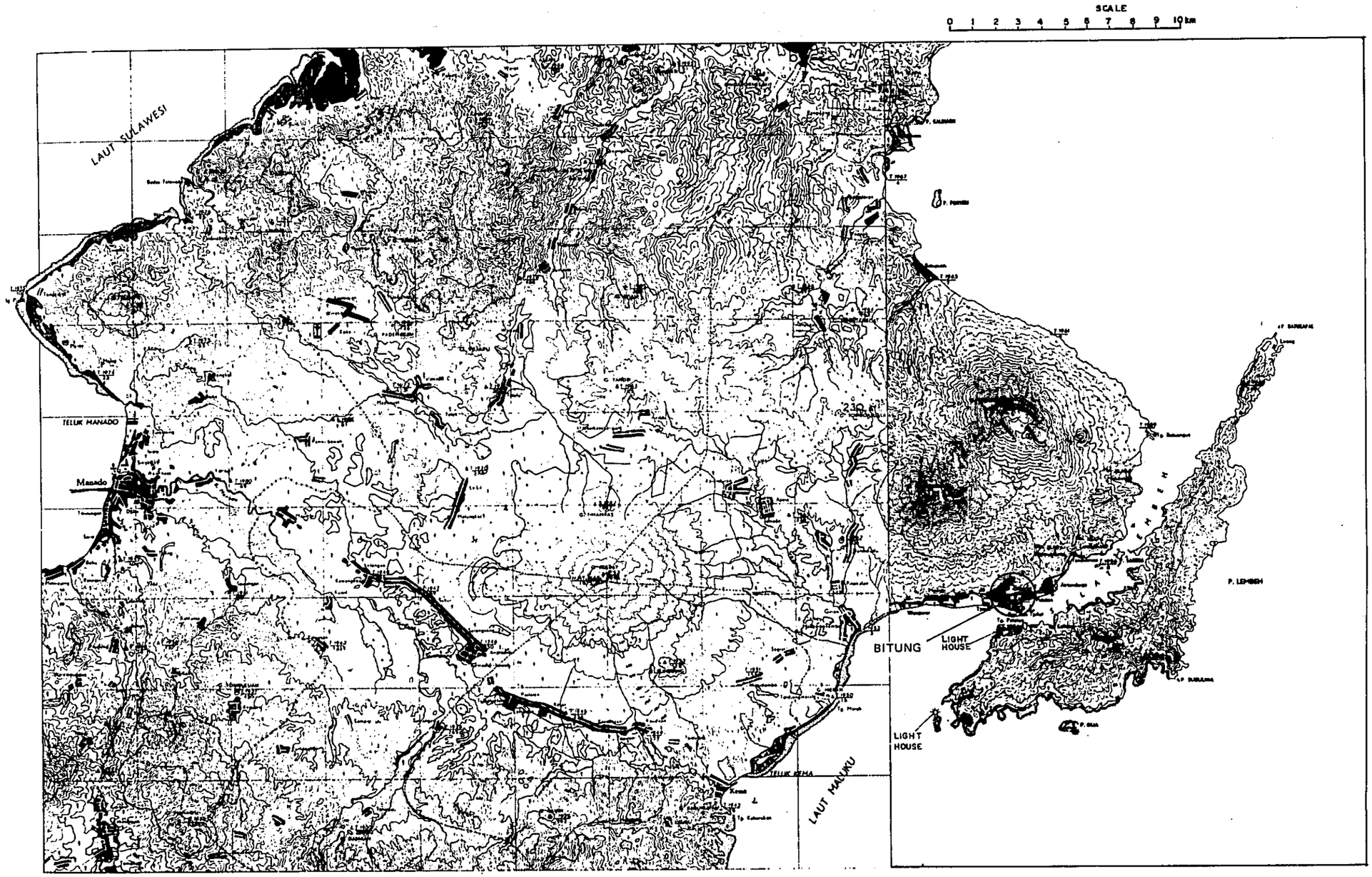


Fig. 3-2 Wind Rose (Bitung)
(February–July 1977)

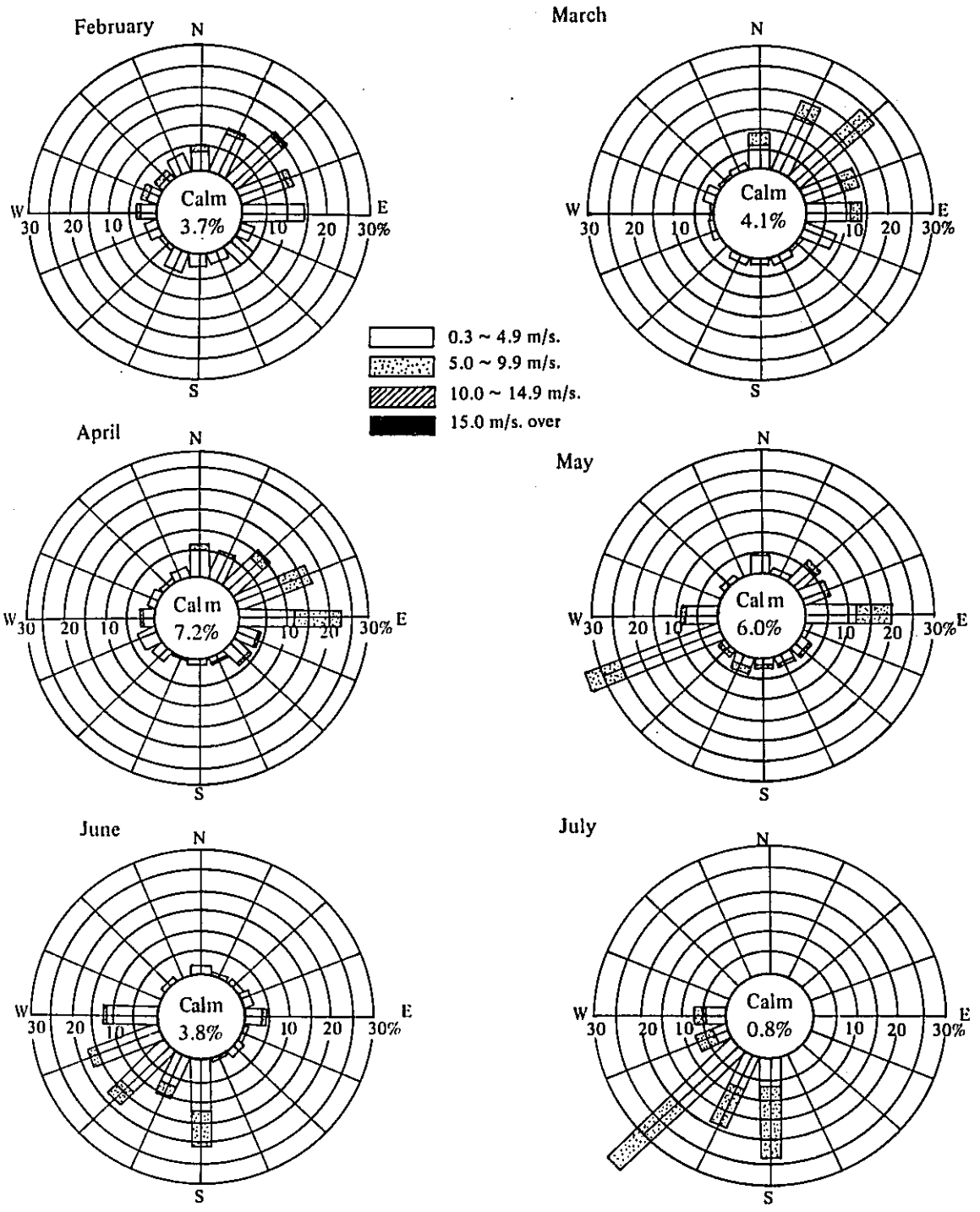


Fig. 3-3 Wind Rose (Bitung)

(August – October 1977)

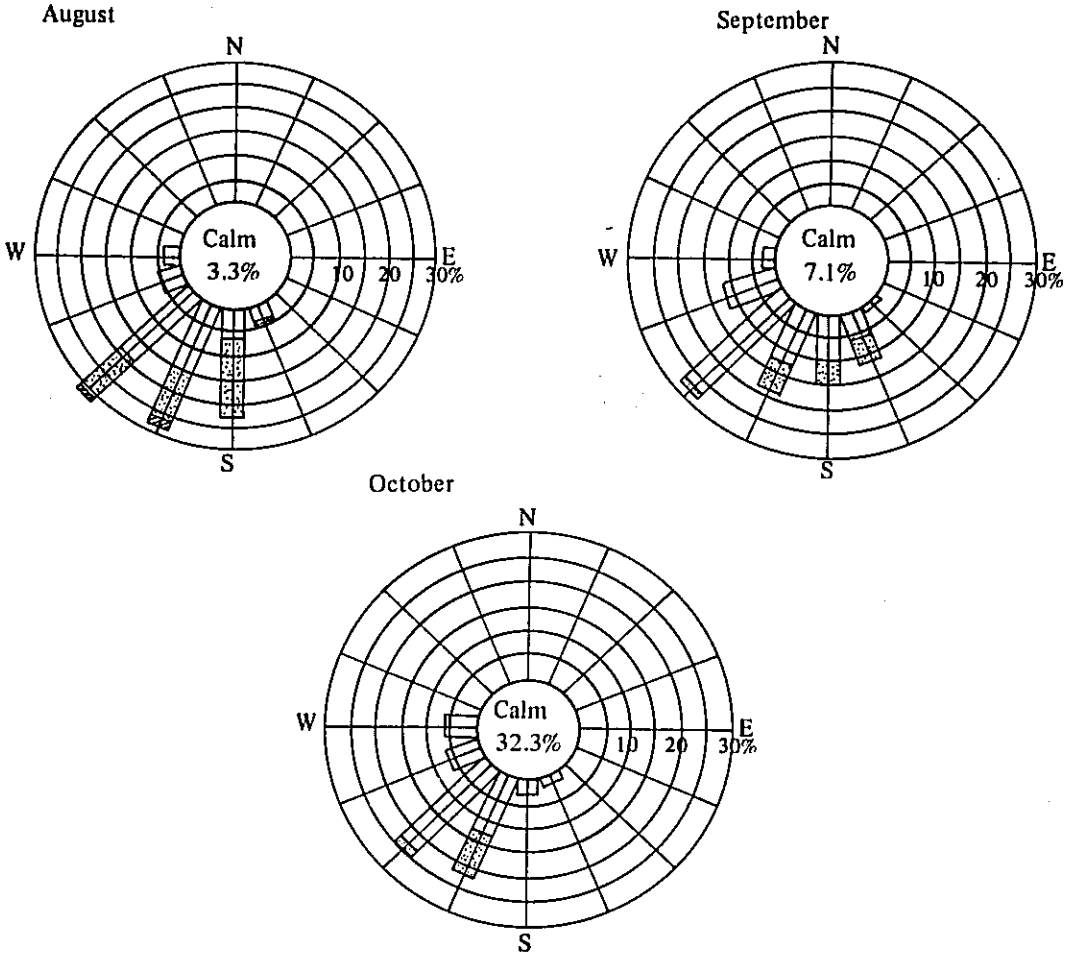
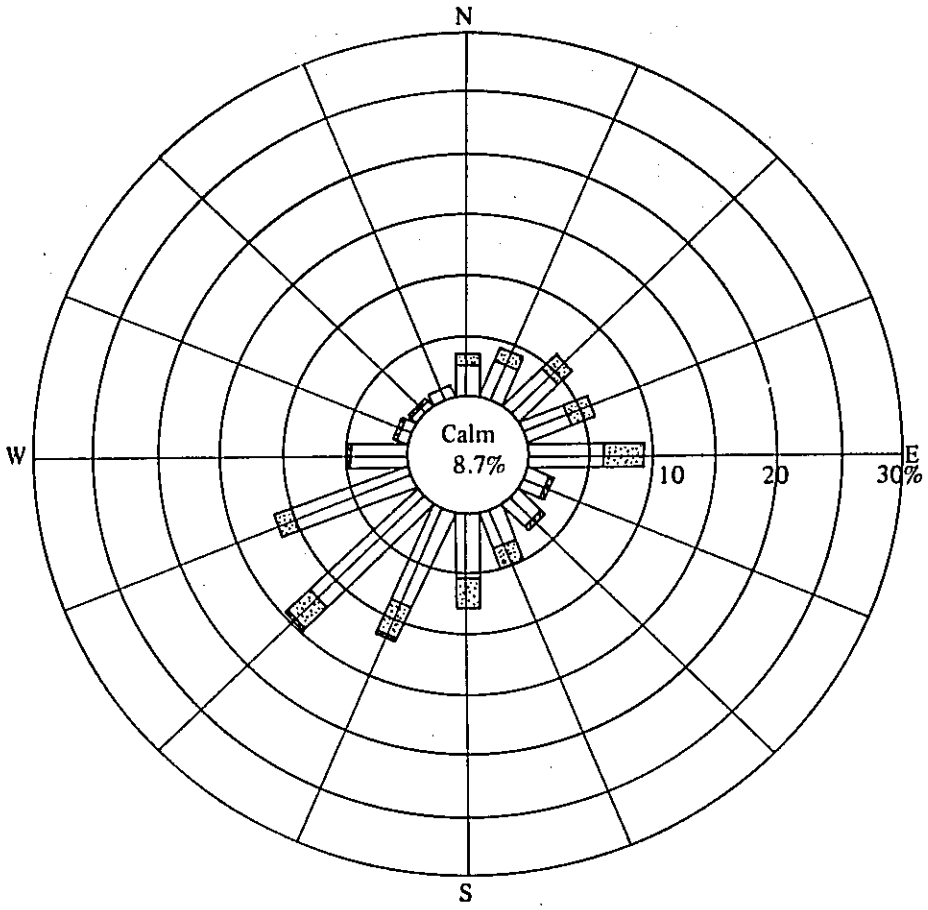
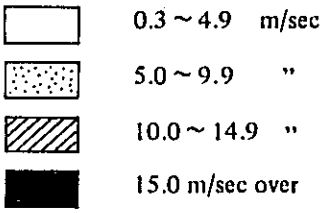


Fig. 3-4 Wind Rose (Bitung)

(February–October 1977)

February–October





is about 25°C to 27°C and the yearly variation is approximately 2°C. The monthly average of the daily maximum temperature is within the range of 29°C to 31°C, the monthly averaged highest mean extreme temperature is 31.7°C, the monthly averaged lowest mean extreme temperature is 21.0°C, and the daily variation is 6°C to 8°C.

The humidity is generally high and the monthly mean relative humidity is 76% to 87% and the monthly minimum relative humidity is 32% in September.

3-2-2. Rainfall

The records of rainfall for the last 5 years in Mapanget are shown in Table 3-1. From this table, the yearly total rainfall is 3,294 mm.

Generally, the rainfall is less in the dry season between June and October, and the minimum value of the monthly mean rainfall is 115 mm. There is much rainfall in the rainy season between December and March. And especially the monthly rainfall from December to February is greater than 325 mm. The rainfall in the rainy season is generally squally and concentrated within one or two hours.

3-2-3. Wind

The records of the wind in the Port of Bitung are available for 9 months since February 1977. These records are shown in Figs. 3-2, 3-3, and 3-4.

From the records in the Port of Bitung and also weather maps and records of Mapanget for the period from November to January for which records are not available in Bitung station.

In the months between November and March, north or northeast winds are more predominant due to the influence of the northeast trade winds with velocity of 5 to 8 m/sec and occasionally 9 to 10 m/sec winds also occurs.

In the months between May and October, south or southeast winds are predominant due to the influence of the southeast monsoon and its velocity is about 7 to 12 m/sec especially from June to August but occasionally a velocity of 15 m/sec will also occur. This wind blows from sea to land so that it occurs in the afternoon in many cases.

3-3. Maritime Conditions

3-3-1. Tide

Examples of the tidal level records are shown in Fig. 3-5. The tide in the Port of Bitung is a semidiurnal tide and H.W.L. is 1.9 m above sea level datum.

Fig. 3-5. Tide Record at Port of Bitung

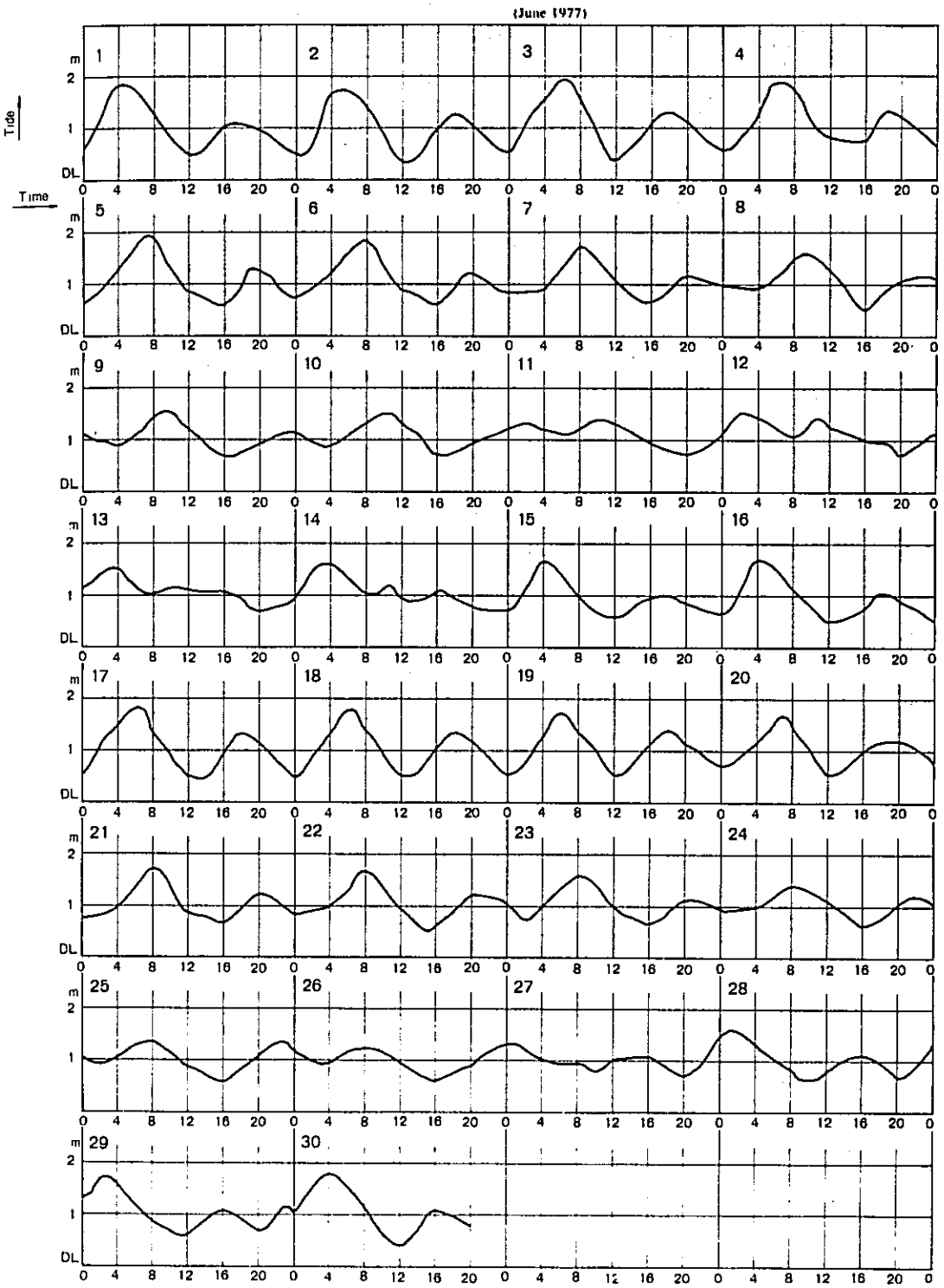


Fig. 3-6. Location of Current Survey
Scale = 1: 20,000

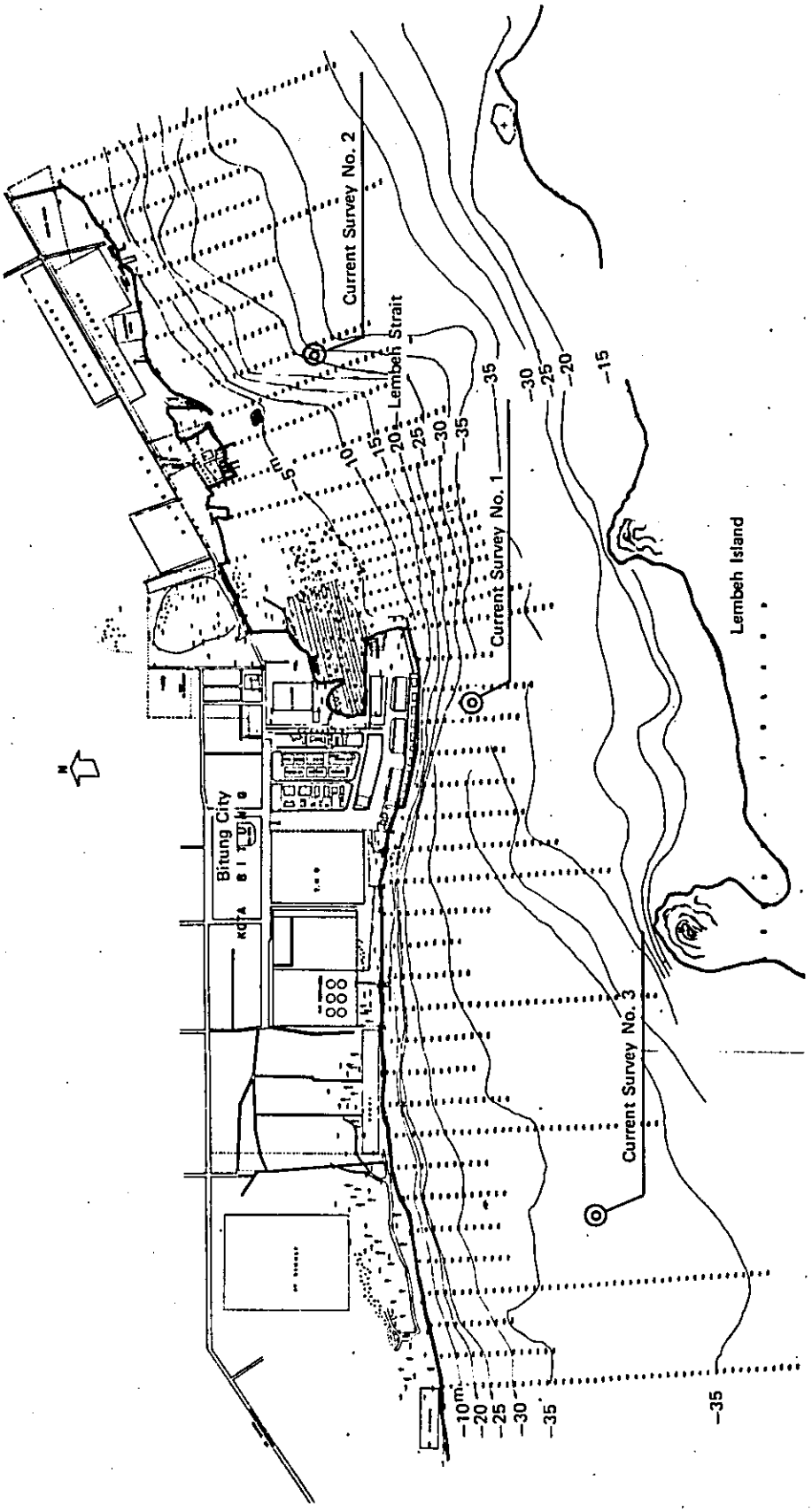
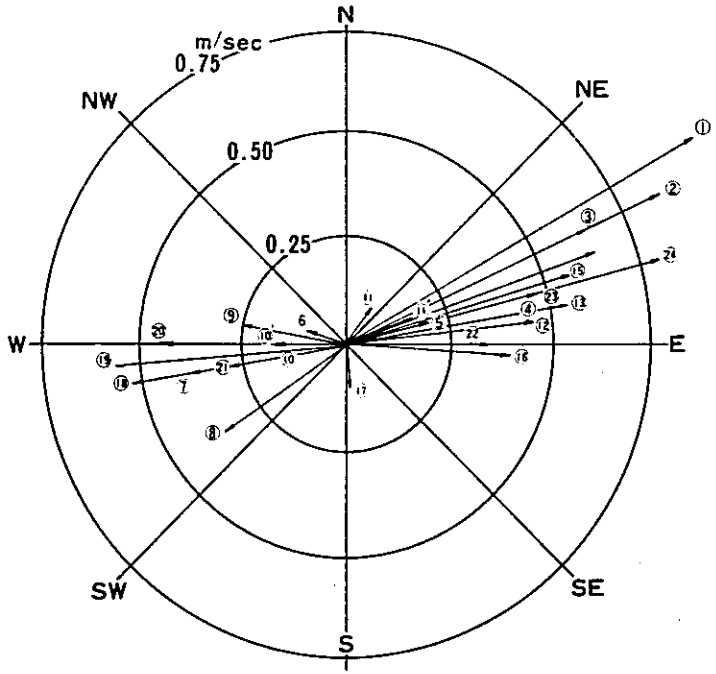
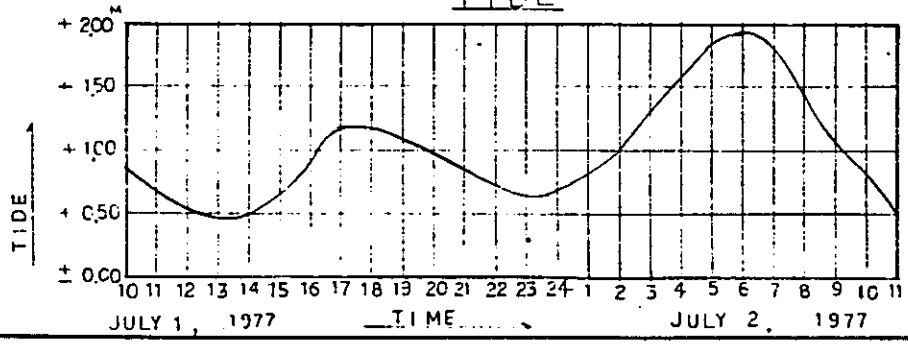


Fig. 3-7. Current Observation (No. 1, −3m)





OBSERVED DATE: JULY 1 – 2 1977

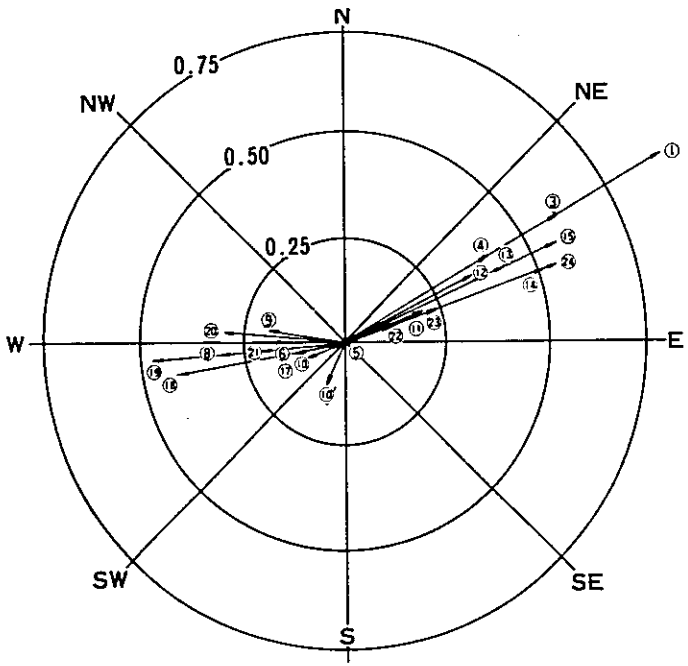
LOCATION : NO. 1 (Infront of Existing Berth)

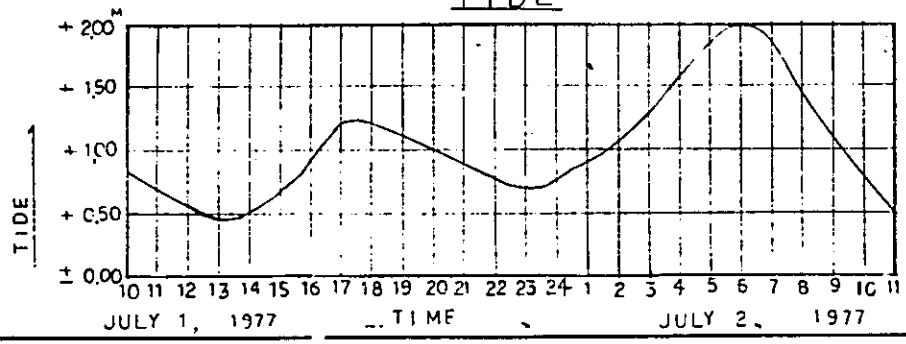
OBSERVED DEPTH: −3M

OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10	10:04	0.16(m/sec)	265 (°)
11	11:02	0.10	37
12	12:02	0.47	83
13	13:01	0.55	80
14	14:02	0.65	70
15	15:03	0.58	73
16	16:01	0.40	93
17	17:02	0.11	172
18	18:02	0.53	260
19	19:02	0.57	265
20	20:02	0.45	270
21	21:02	0.28	260
22	22:02	0.35	90
23	23:02	0.53	80
24	24:12	0.80	75
1	01:02	0.98	60
2	02:02	0.85	65
3	03:03	0.65	68
4	04:02	0.48	75
5	05:05	0.20	75
6	06:01	0.10	290
7	07:02	0.38	260
8	08:01	0.36	235
9	09:02	0.26	280
10'	10:02	0.17	270
11'	11:02	0.17	68

Fig. 3-8. Current Observation (No. 1, –30m)





OBSERVED DATE: JULY 1 – 2 1977

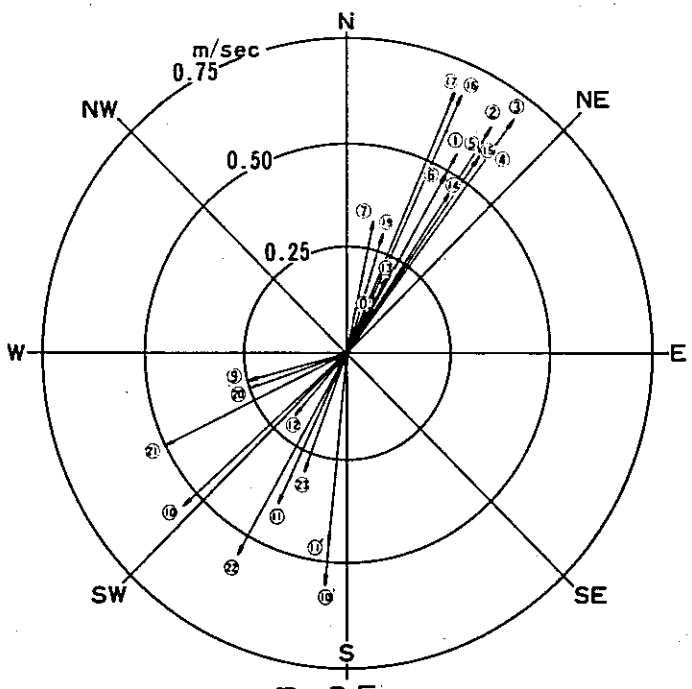
LOCATION : NO. 1 (Infront of Existing Berth)

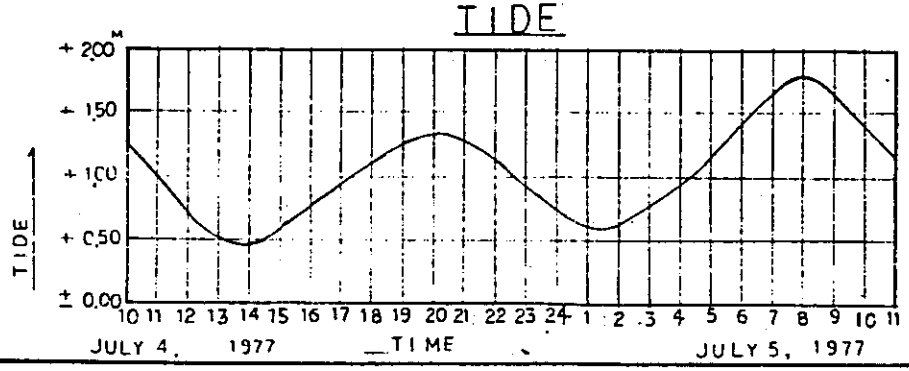
OBSERVED DEPTH: –30M

OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10'	10:16	0.09(m/sec)	205 (°)
11	11:07	0.18	70
12	12:17	0.35	63
13	13:13	0.43	65
14	14:17	0.52	70
15	15:17	0.57	65
16	16:16	0.17	68
17	17:26	0.12	260
18	18:22	0.43	260
19	19:23	0.48	265
20	20:17	0.30	275
21	21:22	0.20	265
22	22:18	0.10	70
23	23:20	0.35	70
24	24:28	0.55	70
1	01:18	0.90	60
2	02:22	0.80	55
3	03:22	0.60	60
4	04:20	0.40	60
5	05:28	0.00	90
6	06:13	0.18	270
7	07:18	0.35	360
8	08:15	0.31	265
9	09:18	0.18	280
10	10:23	0.10	250

Fig. 3-9. Current Observation (No. 2, −3m)





OBSERVED DATE: JULY 4 – 5 1977

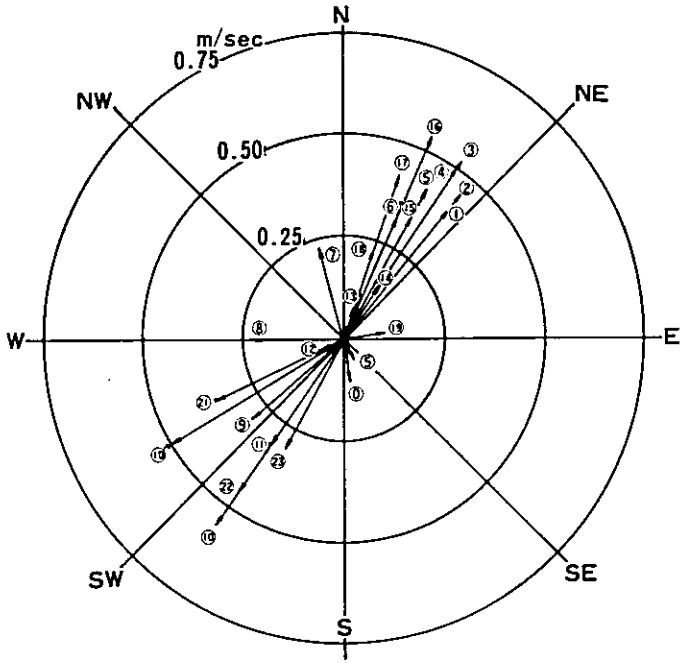
LOCATION : NO. 2 (North from Berth)

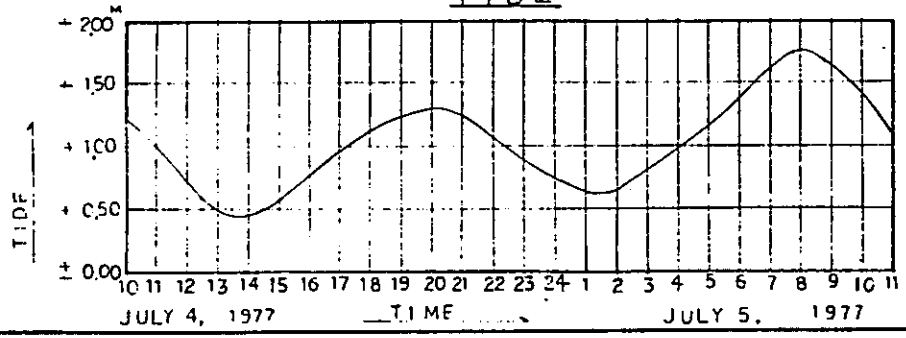
OBSERVED DEPTH: −3M

OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10	10:01	0.55(m/sec)	228 (°)
11	11:01	0.40	205
12	12:02	0.20	220
13	12:59	0.20	30
14	14:01	0.45	33
15	14:58	0.57	35
16	16:00	0.68	25
17	17:01	0.68	23
18	18:01	0.45	23
19	19:01	0.30	19
20	20:01	0.26	210
21	21:02	0.51	245
22	22:01	0.55	210
23	23:02	0.30	200
24	24:01	0.15	30
1	01:02	0.55	30
2	02:02	0.65	33
3	03:03	0.70	36
4	04:01	0.60	35
5	05:03	0.55	30
6	06:01	0.49	30
7	07:01	0.32	12
8	08:02	0.10	340
9	09:02	0.25	255
10'	10:02	0.55	185
11'	11:03	0.45	185

Fig. 3-10. Current Observation (No. 2, −30m)





OBSERVED DATE: JULY 4 – 5 1977

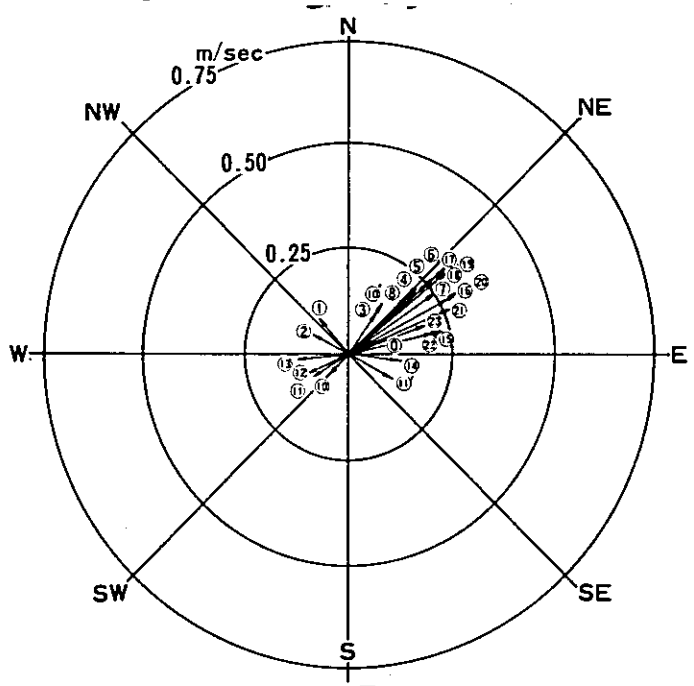
LOCATION : NO. 2 (North from Berth)

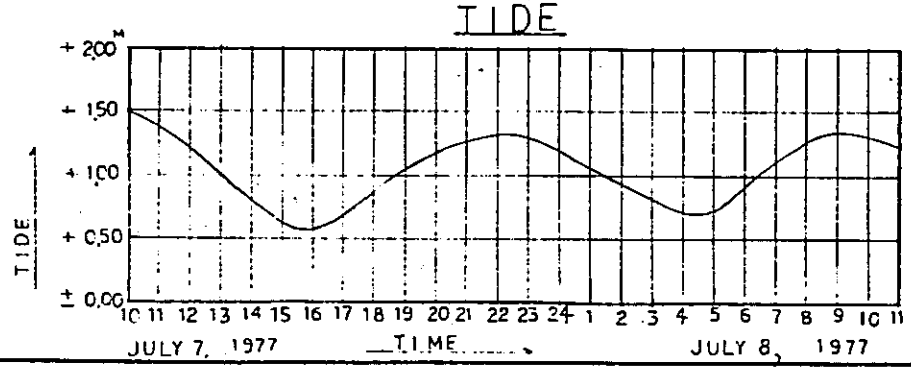
OBSERVED DEPTH: −30M

OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10	10:06	0.55(m/sec)	215 (°)
11	11:08	0.30	215
12	12:08	0.06	240
13	13:04	0.08	20
14	14:05	0.16	35
15	15:02	0.33	30
16	16:05	0.54	25
17	17:13	0.43	20
18	18:07	0.23	20
19	19:09	0.10	80
20	20:07	0.05	160
21	21:09	0.35	245
22	22:08	0.45	215
23	23:13	0.31	210
24	24:08	0.10	170
1	01:13	0.40	40
2	02:13	0.45	40
3	03:15	0.53	35
4	04:09	0.50	35
5	05:25	0.42	30
6	06:08	0.32	25
7	07:07	0.23	345
8	08:13	0.23	270
9	09:13	0.30	230
10'	10:16	0.50	240

Fig. 3-11. Current Observation (No. 3, –3m)





OBSERVED DATE: JULY 7 – 8 1977

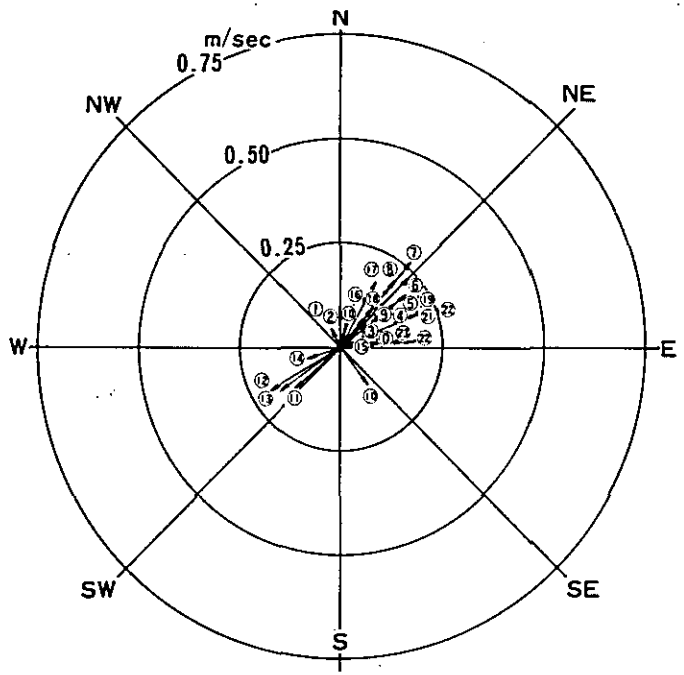
LOCATION : NO. 3 (South from Berth)

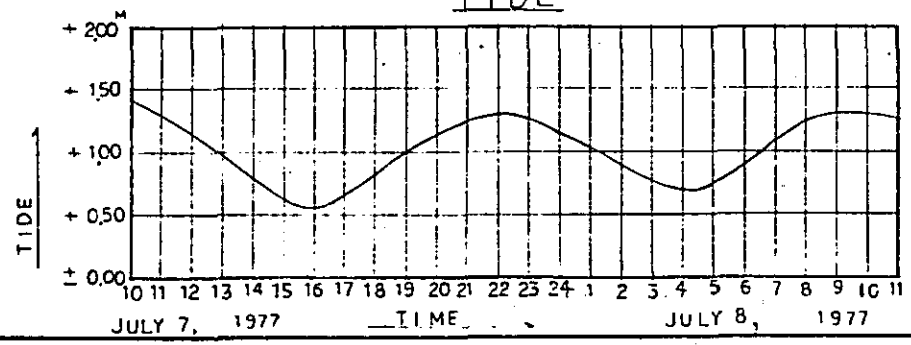
OBSERVED DEPTH: –3M

OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10	10:01	0.05(m/sec)	225 (°)
11	11:01	0.10	235
12	12:01	0.10	240
13	13:02	0.13	265
14	14:02	0.13	95
15	15:02	0.22	75
16	16:02	0.30	65
17	17:02	0.31	50
18	18:01	0.30	60
19	19:02	0.30	60
20	20:02	0.30	60
21	21:01	0.27	65
22	22:01	0.20	75
23	23:02	0.18	70
24	24:01	0.08	65
1	01:01	0.08	320
2	02:01	0.10	300
3	03:02	0.13	40
4	04:02	0.20	50
5	04:56	0.25	50
6	06:01	0.26	50
7	07:01	0.25	55
8	08:01	0.22	48
9	09:01	0.21	50
10'	10:01	0.15	40
11'	11:01	0.12	120

Fig. 3-12. Current Observation (No. 3, –30m)





OBSERVED DATE: JULY 7 – 8 1977

LOCATION : No' 3 (South from Berth)

OBSERVED DEPTH: –30M

OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10	10:09	0.10(m/sec)	140 (°)
11	11:09	0.14	235
12	12:10	0.20	240
13	13:11	0.17	238
14	14:14	0.08	250
15	15:14	0.05	60
16	16:11	0.12	40
17	17:13	0.18	30
18	18:09	0.19	40
19	19:12	0.19	50
20	20:14	0.20	65
21	21:09	0.20	65
22	22:11	0.18	85
23	23:13	0.14	85
24	24:09	0.08	80
1	01:09	0.04	320
2	02:09	0.05	340
3	03:12	0.12	50
4	04:14	0.16	50
5	05:08	0.20	50
6	06:09	0.28	45
7	07:09	0.26	40
8	08:10	0.20	40
9	09:11	0.14	45
10'	10:11	0.07	40

3-3-2. Tidal Current

Results of tidal current observation performed in June and July, 1977 are shown in Fig. 3-6 to Fig. 3-12 and are as follows.

(1) At No.1 and No.2 points, current flowed almost in the east and northeast direction along the strait during flood tide and its maximum velocity was 0.7 to 0.9 m/sec. During ebb tide, the current flowed in the west and southwest directions and its maximum velocity was 0.55 to 0.57 m/sec.

(2) Flow direction for both surface current and bottom current is almost the same at No.1 and No.2 points and the velocity at the bottom is about 0.8 to 0.9 times of that of the surface current.

(3) At No.3 point where the strait faces the Open Sea, the current velocity is smaller than that observed at Nos. 1 and 2 points. The velocity is 0.3 m/sec maximum in the northeast direction during flood tide, and 0.2 m/sec maximum in the west or southwest direction during ebb tide.

(4) Velocity of the bottom current during flood tide at No.3 point is about 0.6 times of that of surface current, and during ebb tide is the same or larger than that of surface current.

3-3-3. Waves

The Port of Bitung has no records of wave observation.

Hence, the estimation of wave condition was conducted by the wave forecasting method based on records of meteorological observations.

Results of wave forecasting show that the sea in front of Bitung is rough in southeast monsoon season - in May to September -, and generally calm in other seasons.

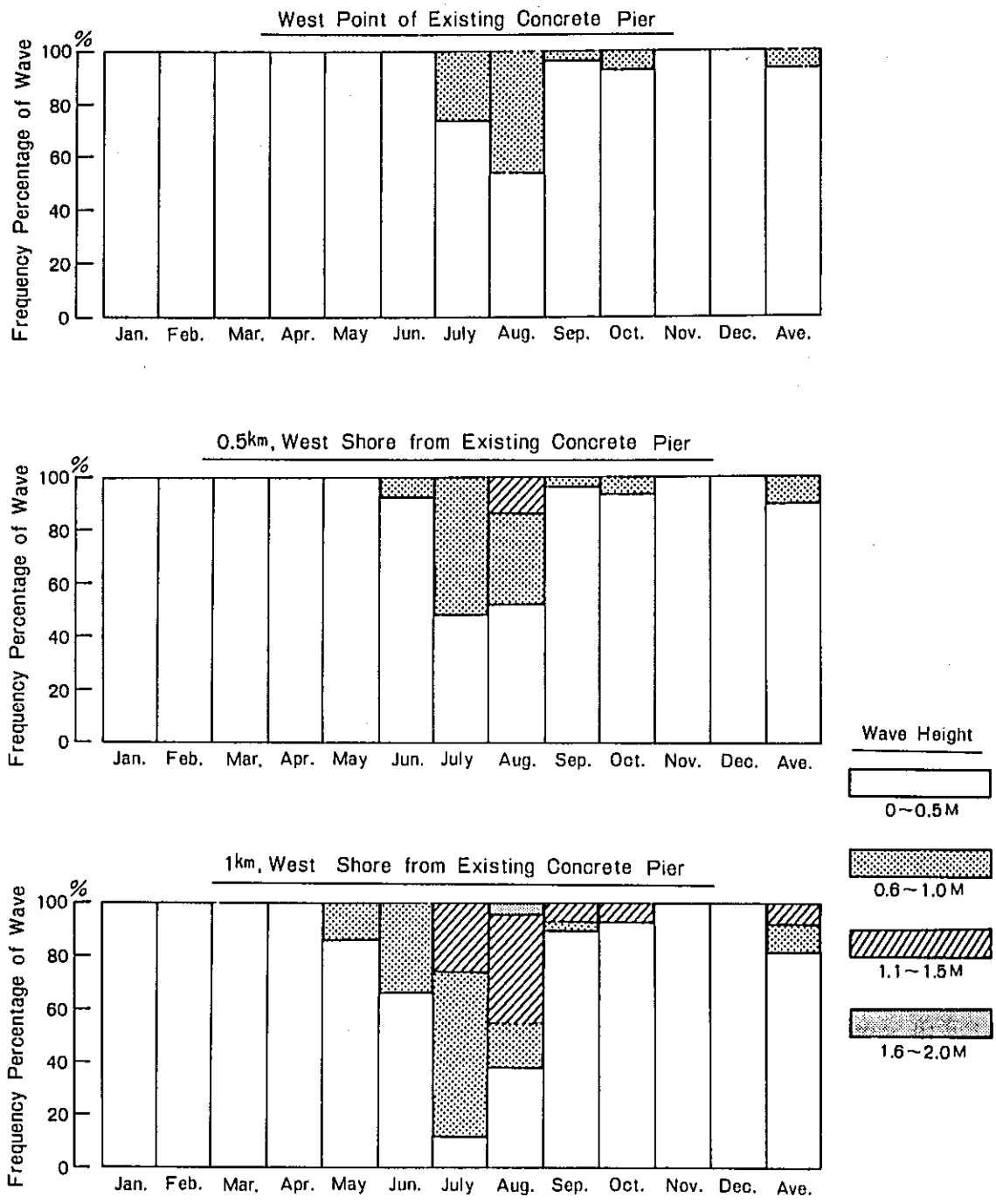
The forecast height of deep-water waves ranges from 2 to 3 meters in May to September, and in July and August it often reaches 3 m.

These waves reach to the coast of Lember mainly from the southerly direction.

The sea area in front of the existing concrete pier, however, is sheltered by the Lembeh Island, hence these waves do not come to the present port area.

Waves from the west side of the Lembeh Island will come directly to the west coast of the Port of Bitung, but a part of them diffracts and scatters toward the Port of Bitung.

Fig. 3-13. Calculated of Monthly Frequency Percentage of Wave Height



Note: Estimated waves were calucleted at the rate of one time/day.

The estimated wave heights at the area of the existing concrete pier and the west coast of a composite of the scattered waves and wind waves occurring in front of the Port of Bitung are shown in Fig. 3-13 and their brief explanation is as follows.

(1) Waves at west end of existing concrete pier

Waves with a height of 0.6 m - 1.0 m occur for 8 to 10 days during July and August in this area and similarly 0.6 m - 1.0 m waves occur for a very short period of time in September and October. This area is generally very calm in other months.

(2) Waves at the coast 0.5 km away to the west from existing concrete pier

Waves higher than 0.5 m will hit this area from June to October. Wave with a height of 0.6 m - 1.0 m occur slightly in June but for about 16 days in July. In August, waves higher than 0.6 m will occur for approximately 15 days and 4 days of those will be 1.1 m - 1.5 m high waves. Waves 0.6 m - 1.0 m in height will slightly occur during September and October.

(3) Waves at the coast 1 km away to the west from existing concrete pier

Waves in this area excel from May to October. In May and June, 0.6 m - 1.0 m waves occur for 4 - 10 days approximately. In July, waves higher than 0.6 m will occur almost every day and waves 1.1 m - 1.5 m in height will occur for about 8 days.

In August, waves higher than 0.6 m will occur for about 20 days and 12 days of this will be 1.1 m - 1.5 m high waves and 2 to 3 days of this will be 1.6 m - 2.0 m high waves. In September and October, waves 0.6 m - 1.5 m high will occur for a very short period of time.

3-3-4. Water Depth

The results of soundings performed during June and July in 1977 are shown in Fig. 3-14 and are as follows.

(1) Coast 2 km away to the west from existing concrete pier

The water depth is about -2m and the slope of the seabed is 1:10 - 1:15 in the area of 20 - 30 m off from the coast. For about 50 m offshore, the sea bottom becomes deeper up to -18 m to -27 m in depth with slopes of 1:2 to 1:3, and the front of this portion is up to -37 m to -38 m in depth with a slope of 1:10 - 1:20.

Fi

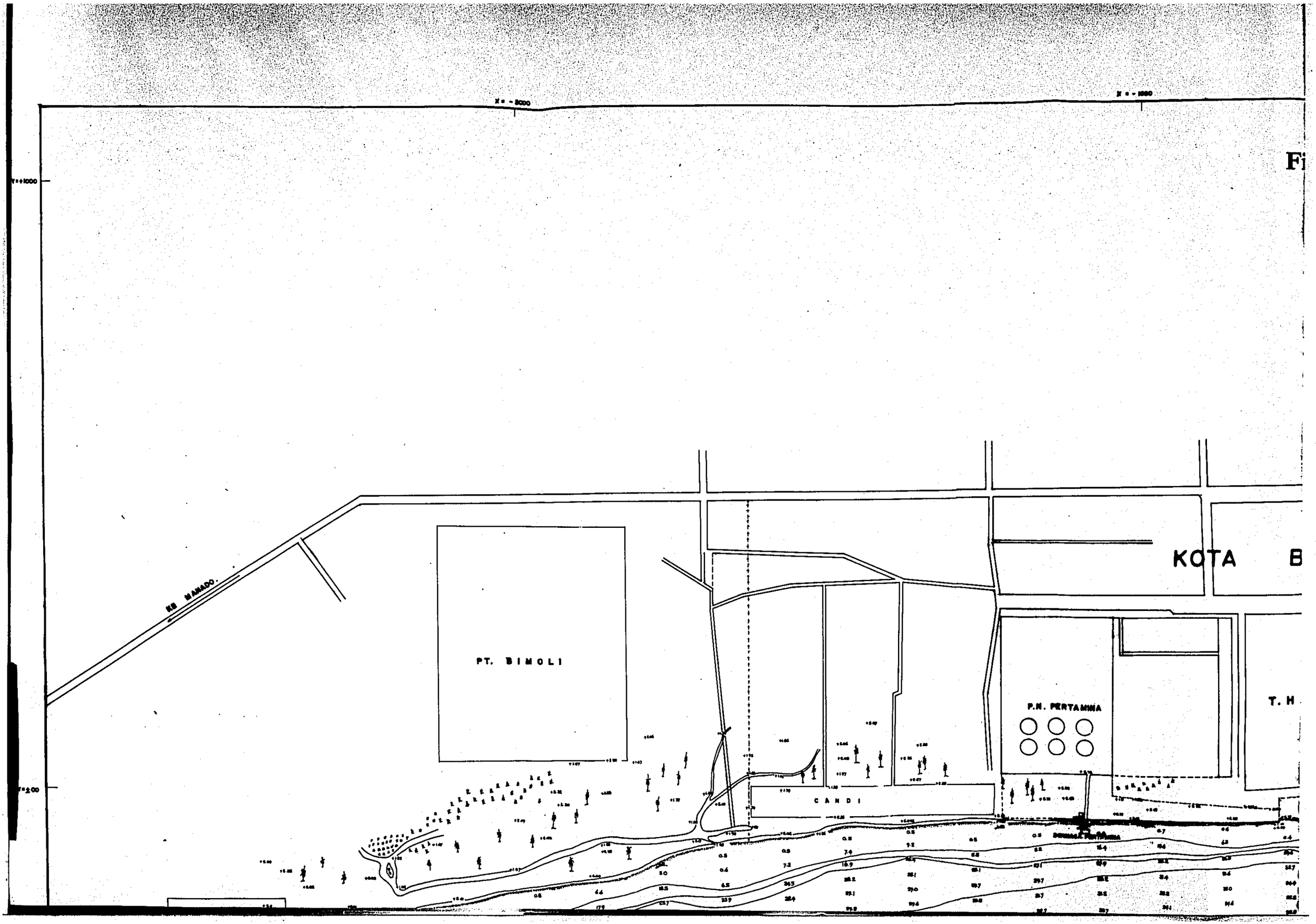
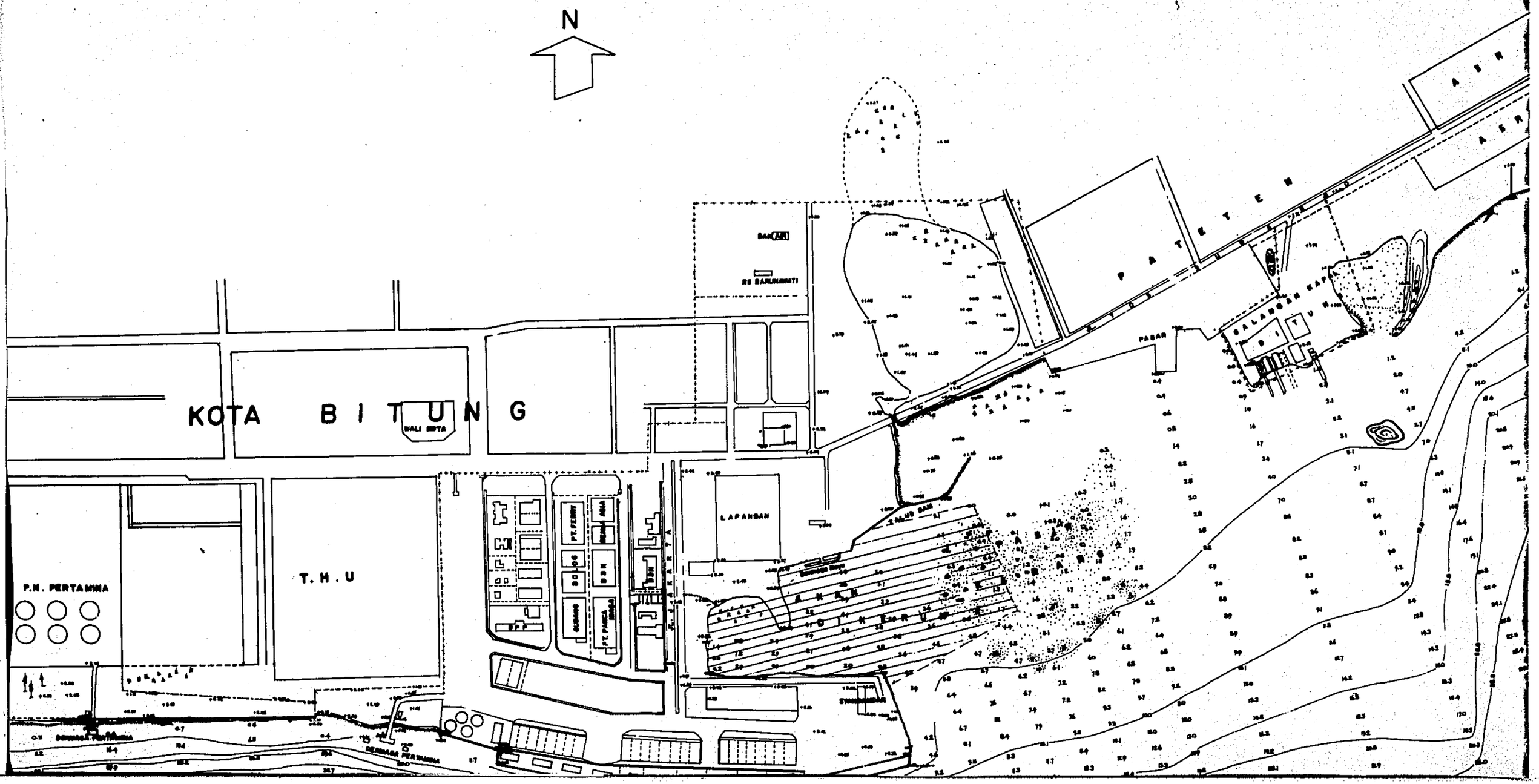

X = -8000
X = -6000
Y=+1000
Y=±0.00
JL. MANADO
PT. BIMOLI
CANDI
P.N. PERTAMINA
KOTA
T. H

Fig. 3-14 Topographic and Sounding Map



X ± 00

X = +1000

Y = +800

Y = ± 00

AER TEMBAGA

AER TEMBAGA

KOMPLEX PEMBAM

PENAMPUNGAN UDANG

GALANGAN KAPAL SURYAM

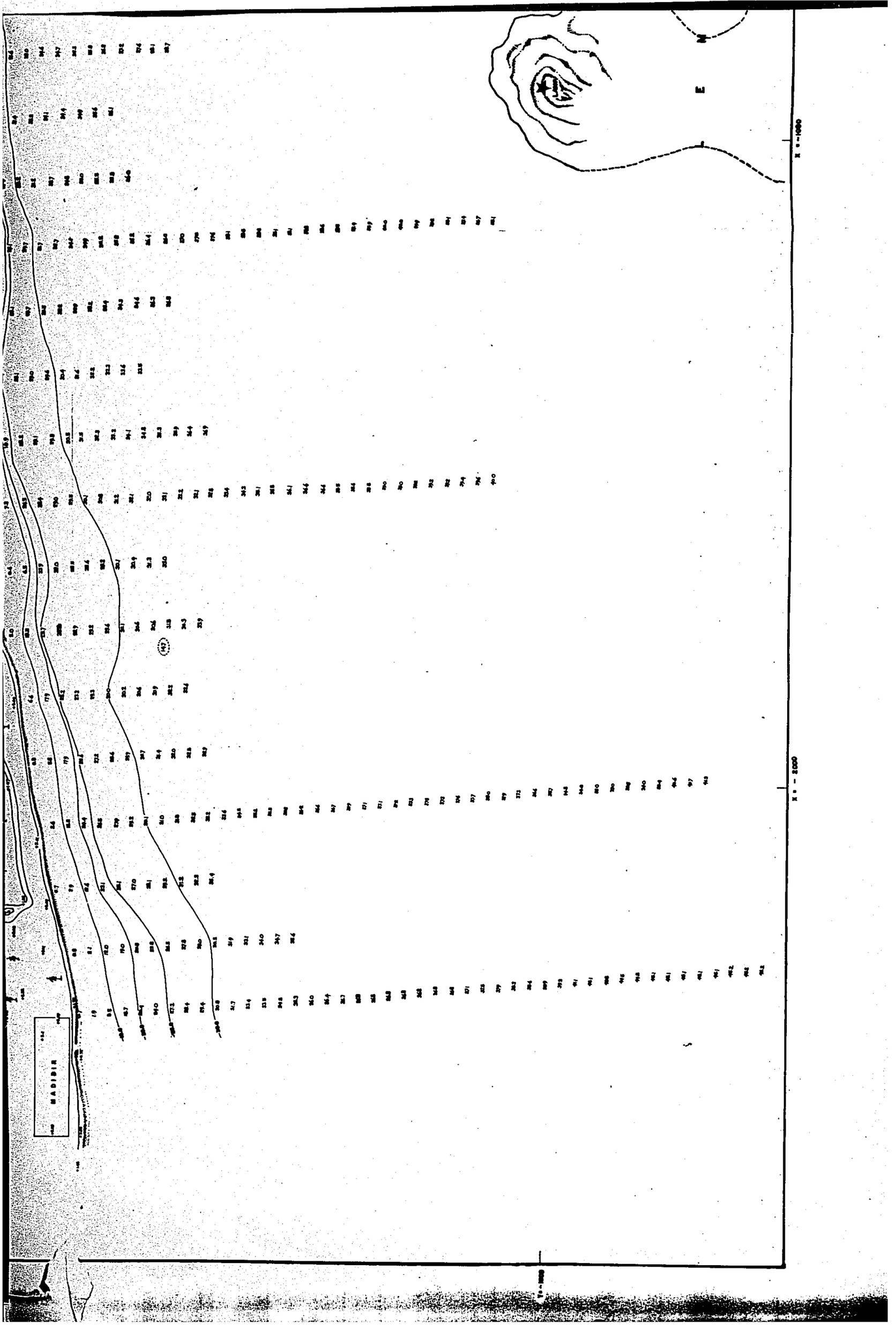
PENGAIR

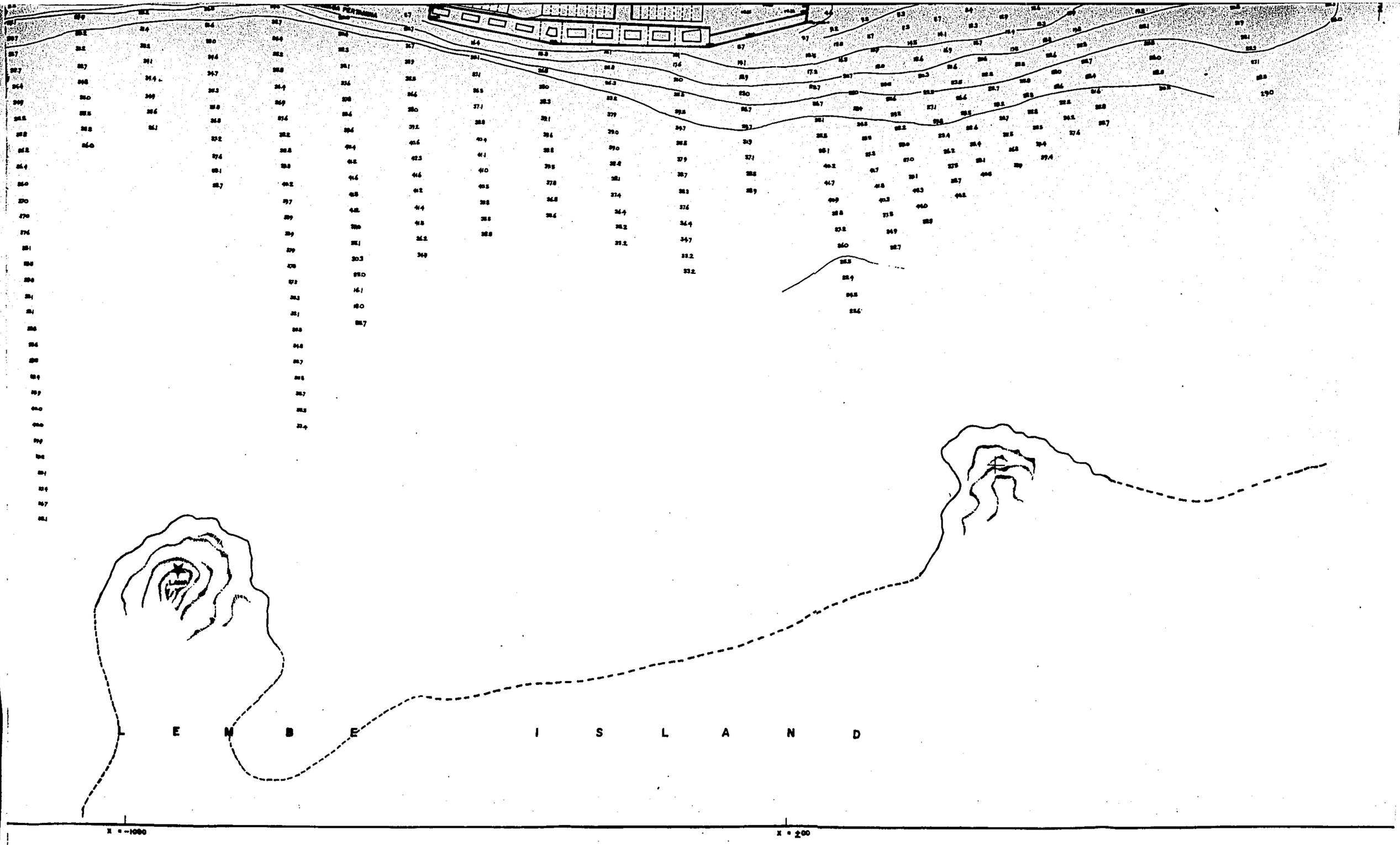
PATETEN

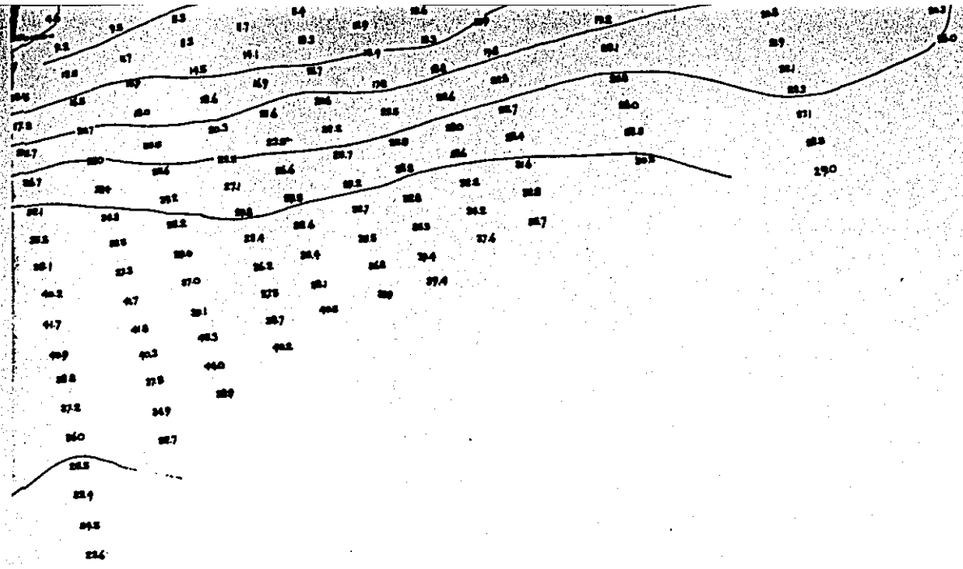
GALANGAN KAPAL

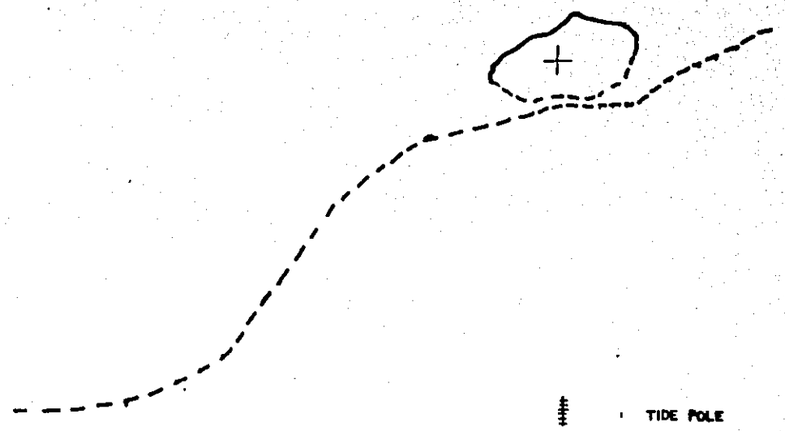
PASAR

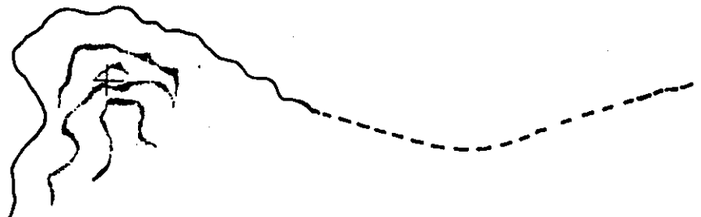
JALAN DARI


MADIBIA


L E M B E I S L A N D
x = -1000
x = ±00







: TIDE POLE

: AKAN DIKERUK SAMPAI KEDALAMAN – 5,5 m LWS DIP. '77 / 78.

: BATAS DAERAH PELABUHAN.

REMARK :

SOUNDING DEPTH WAS SHOWN BELOW BASIC LEVEL IN BITUNG PORT.
ELEVATION BENCH – MARK AT WHARF IS + 3 m ABOVE BASIC LEVEL

SCALE = 1 : 2,500

0 100 200 300 400m

BITUNG PORT FEASIBILITY STUDY

DRAWING : PLAN OF TOPOGRAPHIC AND SOUNDING

SCALE : 1 : 2500

DATE : JUNE – JULY 1977.

SURVEYED : JICA TEAM.

D

Y = -1000

X = +1000

(2) Existing concrete pier

The water depth at the front of the existing concrete pier is -8 m to -9 m with a slope of about 1:6 to 1:8, and the depth gradually increases up to -38 m - -48 m at the center of the strait.

(3) Bay in the east of existing concrete pier

The water depth at the north end of the bay is +1.0 m with a gentle slope of 1:80 to 1:110 and gradually deepens toward the center of the bay and the depth is about -5 m to -6 m at the baymouth.

Construction of a berth for domestic ships is planned for the fiscal years of 1977 and 1978 at the west side of the bay, and this area of 400 m x 200 m is to be dredged up to -5.5 m.

(4) Coast 2 km away to the east from existing concrete pier

The sea bottom becomes deep with a slope of 1:5 in an area of 50 m from the shoreline. In front of the area a longshore bar with a depth of -10 m exist and the sea bottom behind the bar becomes deeper up to -34 m - -38 m with a slope of 1:4 to 1:30 toward the center of the strait.

3-3-5. Littoral Drift

(1) Bottom materials

Results of bottom material investigation performed in July, 1977 are shown in Figs. 3-15, 3-16 and 3-17 and described below.

1) Bed materials at the east and west sides (point C and point B) are coarse sand with 0.1 to 4 mm grain size mixed small gravel, but medium sand is dominant in the bay (point A). That is, the grading component of the east and west side coast greatly differs from that of the bay where small grain size is outstanding. This probably indicates that small grain sand has been transported by tidal current or waves to the bay and deposited there.

2) The grain size of bed materials at the west coast is uniform compared to other areas. And the grain size is coarse and the slope of the sea bottom in the breaker zone is steep. This indicates that the transport of the littoral drift in the west coast is more outstanding compared to that in the east coast and bay.

Fig. 3-15. Location of Soil Sampling of Seashore
Scale = 1: 20,000

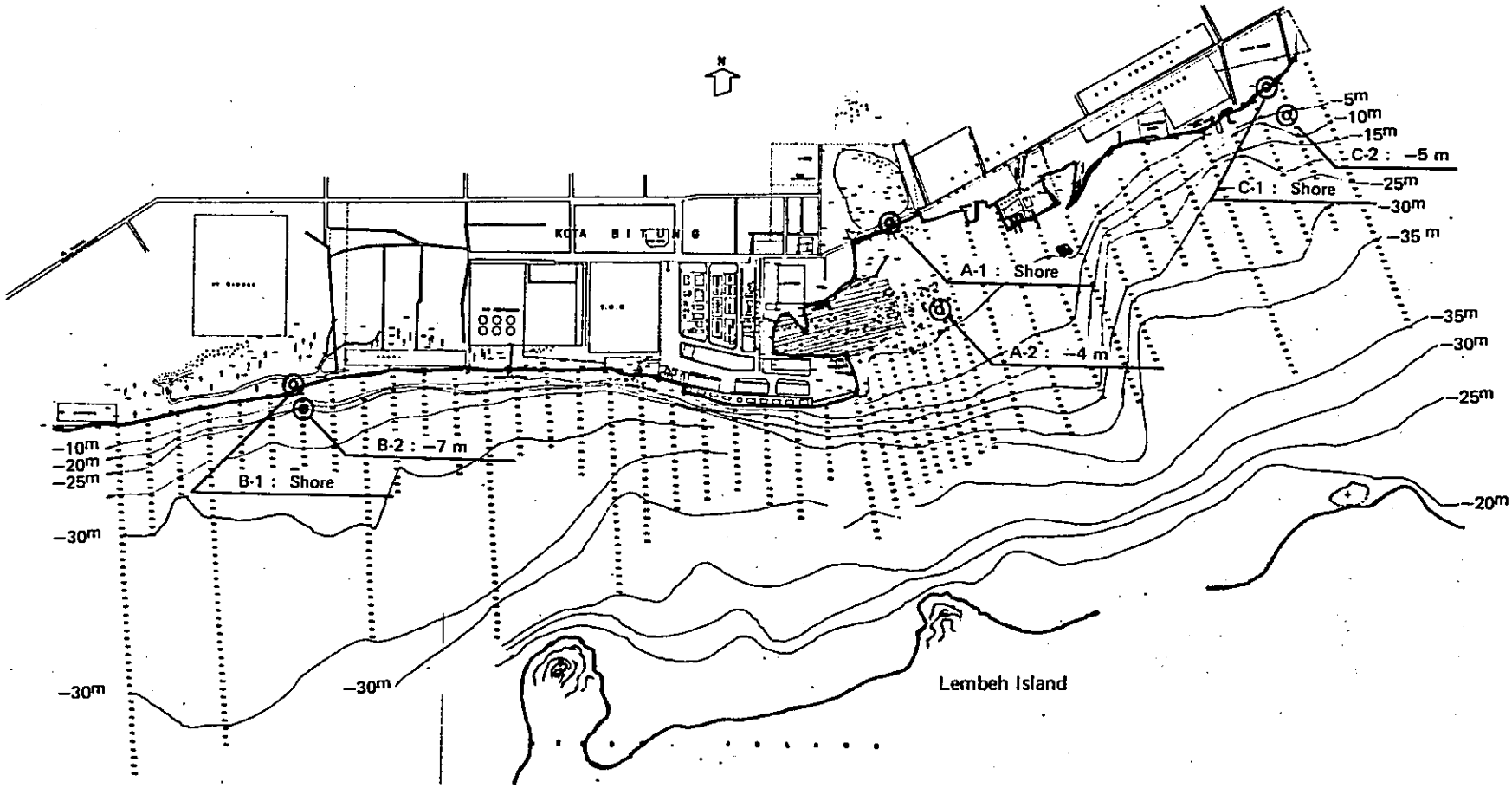
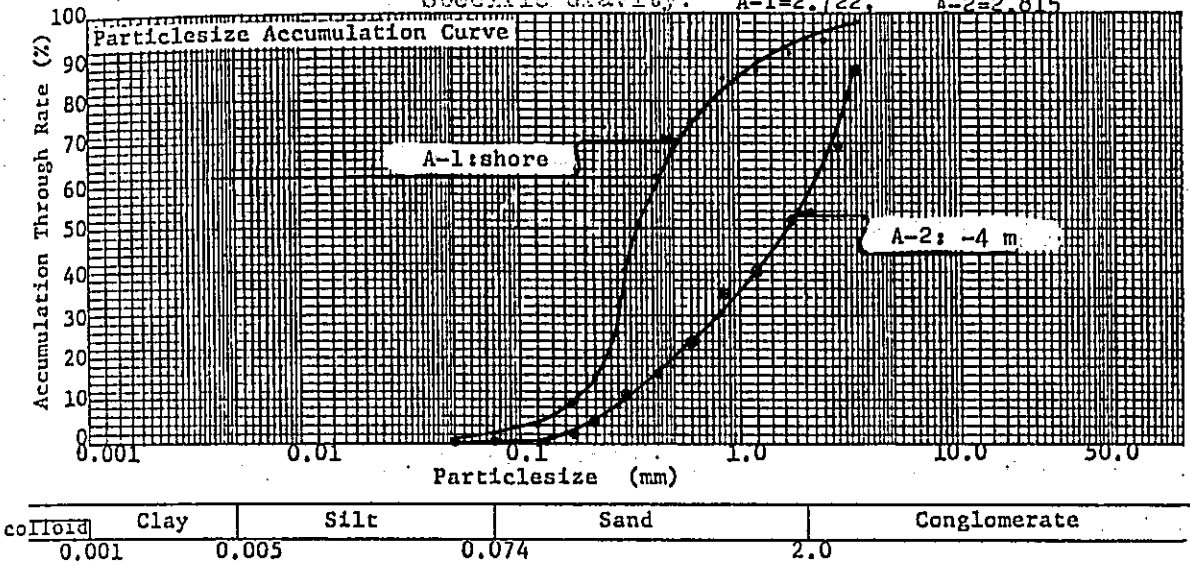


Fig. 3-16. **Particlesize Accumulation Curve of Material of Seashore**

A-1:Shore in bay
Sampling Location: A-2: Seabed of -4m

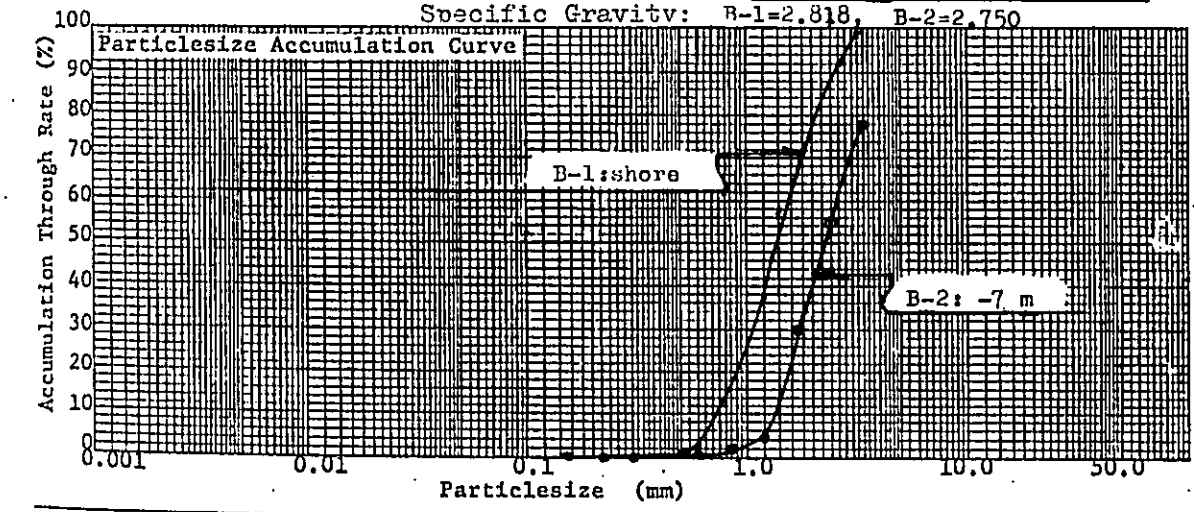
Date: July 16, 1977
Tested by PHR. Laut

Soil Classification: Gravely Sand
Soil Constituents: Gravel= 6%, Sand=92%, Silt= 2%
Gravel=43%, Sand=56%, Silt= 1%
Specific Gravity: A-1=2.722, A-2=2.815



B-1: Shore
Sampling Location: B-2: Seabed of -7m

Soil Classification: B-1=Gravely Sand, B-2=Sandy Grave
Soil Constituents: Gravel=22%, Sand=78%, Silt= 0%
Gravel=63%, Sand=37%, Silt= 0%
Specific Gravity: B-1=2.818, B-2=2.750



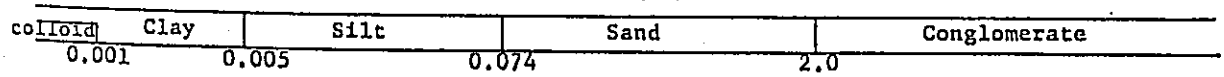
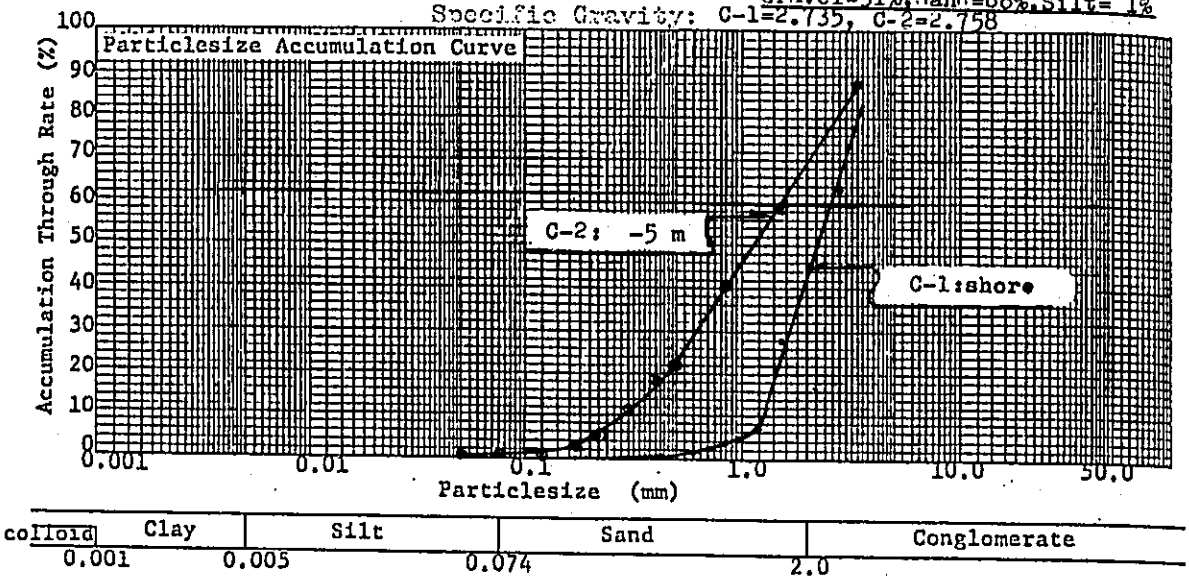


Fig. 3-17. Particlesize Accumulation Curve of Material of Seashore

C-1: Shore
Sampling Location: C-2: Seabed of -5m
Date: July 16, 1977
Tested by PHB. Laut
Soil Classification: C-1=Sandy Gravel, C-2=Gravely Sa
Soil Constituents: Gravel=58%, Sand=42%, Silt= 0%
Gravel=31%, Sand=68%, Silt= 1%
Specific Gravity: C-1=2.735, C-2=2.758



(2) Littoral Drift

From the results of site investigations and hearing, it is found that the coastline approximately 2 km away to the west from the existing concrete pier repeats erosion and sedimentation by 1 m to 2 m depending upon the season and the sea bottom at the west end of the existing concrete pier is seasonally changed and shallowed to the depth of -3 m from May to October and deepened to -8 m in other seasons.

From the bed materials and facts stated above, it is assumed that the beach sand at the west side of the existing concrete pier is transported, as littoral drift, toward the existing concrete pier by the waves during May to October.

Since there is no large-scale eroded and deposited shore in this area, it is also considered that some part of the sand transported during May - October to the west end of the existing concrete pier will be return to the west coast by the waves during the calm season between November and April, and other parts of the sand are transported toward the bay by the waves and current.

(3) Amounts of Littoral Drift in the area of the existing pier and bay

In estimating the amount of littoral drift, a report indicates that the sea bottom in the area of the existing concrete pier was shallowed by 2 m to 2.5 m for 10 years from 1957 to 1966 and a total of 30,000 m^3 was deposited. (Note)

Also the amount of littoral drift is estimated in comparison with the sounding map surveyed by Dinas Hidrografi Tni Al in January and February, 1976 and the sounding survey performed in June and July, 1977.

When comparing these sounding survey maps, the front area (150 m long, 20 m to 30 m wide) of the east side pier constructed in 1975 and 1976 has been shallowed by 1 m to 2 m for about 1.5 years. This means that about 3,000 - 4,000 m^3 has been deposited per year. The area of 200 m x 100 m in the bay has been shallowed by 1.5 m to 2.0 m. That is, about 20,000 to 30,000 m^3 of sand has been deposited annually. However, these estimated volumes of deposits should be considered as very rough values since measured spots of 1976 were few, and the places of deposit and erosion had no relation to each other in those surveys and test dredging was partially performed in June, 1977.

The annual rate of sedimentation is estimated to be about 20,000

to 30,000 m^3. Such siltations, however causes no serious hazard to the port operation.

Note: "Survey Reports on Modernization Plan for Bitung Port and Road Improvement Plan for South and North Sulawesi States" by Overseas Technical Cooperation Agency of Japan.

3-3-6. Tsunami

Volcanic activities in Indonesia occur not only in the area north of Sulawesi and the Sangihe Island but also in the Halmahera Island. Most of the epicenters that occurred in the past are in the Maluku Sea. Fortunately, however, no damage due to Tsunami has so far been experienced in and around the Port of Bitung.

Since a number of epicenters has been noted in the Maluku Sea, the occurrences of Tsunami in the Bitung Area is conceivable. In this connection, further studies should be made on Tsunami.

3-3-7. Marine Meteorology of Neighboring Waters of the Port of Bitung

According to a pilot chart issued by the Maritime Safety Agency, the outlines of the marine meteorological conditions in the Maluku Sea Area and Sulawesi Sea Area are as follows.

1) Ocean Current

The North Sulawesi area lies on the equator and the ocean current on the eastern waters is differing from that on the western waters. The current of the Maluka Sea flows in a certain direction either north or northwest all the year round, and the velocity is about 1 m/sec maximum. The current of Sulawesi Sea flows from the southwest. One current flows through Makkasar Strait and another flows in circulation and then diverts toward Kalimantan and east northeast through the Sangihe Islands. The velocity is about 0.5 - 1 m/sec. and occasionally increases to 1.0 - 1.5 m/sec. during the December/May period.

So far as the ocean current is concerned, there seems to be no effect on the navigation of vessels on both the Maluka Sea and Sulawesi Sea.

2) Wind

The ocean winds blowing in the region of the equator to 5° N over the Maluku Sea and Sulawesi Sea are somewhat different in direction and velocity from month to month but not so much generally. In Fig. 3-18 is illustrated a diagram of wind roses over the Sulawesi Sea. From June through October, southeast and southwest monsoons are predominant. In July to August, the wind force is about 4 average, but a value of 5 - 6 is recorded. From December through February, the wind changes to winter monsoon of the northeast and northwest. During this period, there is a strong wind with a force of 7 or higher, but it is only about 1% of the whole.

3) Waves

Table 3-2 shows wave data in the past of Sulawesi Sea and Maluka Sea between the equator and 5°N. The direction of waves during October/April is north/northeast and north and waves of the west southwest occur during June/September. Especially in winter from December through February, waves as high as 2 m or more are often recorded and cautions must be taken for the navigation of small freighters and sailing vessels.

3-4. Soil Conditions

The results of soil investigation performed during June - August, 1977 are shown in Fig. 3-19 and are as follows.

The bottom stratum in this area is comprised mostly of volcanic sand and gravel, and partially of soft cohesive soil.

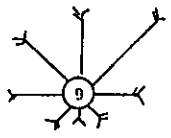
1) Soil properties of the bay area east of the existing concrete pier

In the area from the central part of the mooring basin to the existing shipyard, the bottom stratum consists of relatively soft soil and a coarse layer of sand and gravel with N = 5 - 10. A small amount of silt is present to the depth of about -30 m to -42 m. Beneath the layer is sand or mudstone with N = 50 or greater which is strong enough as a structural foundation. In some parts of such a coarse sand layer is found a relatively hard sand layer of N = 20 - 30, but its quantity is very limited.

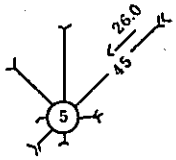
On the other hand, in the area from the east end of the existing concrete pier to the existing wooden pier, relatively hard sandy soil is present.

Fig. 3-18 Wind Rose of Sulawes Sea

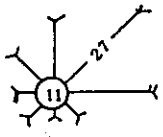
January



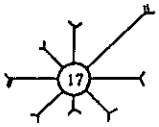
February



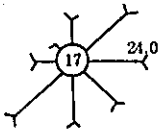
March



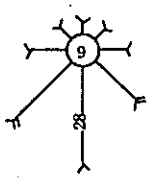
April



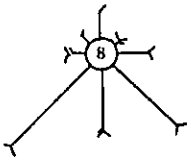
May



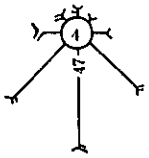
June



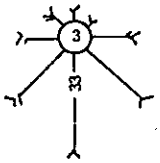
July



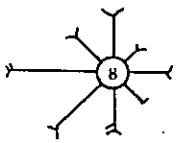
August



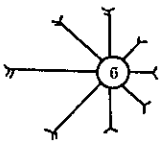
September



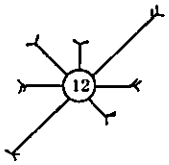
October



November



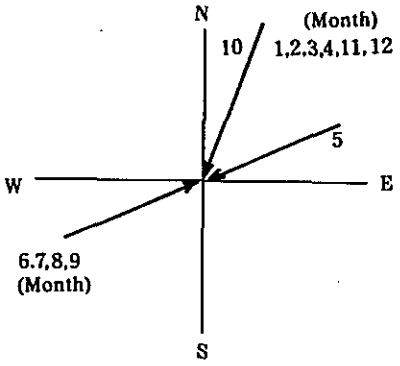
December



Notes 1) The figure within the circle gives the percentage of calms.
2) Arrow fly 1 = wind force 1
3) Scale of frequency wind 0 10 20 30 %
4) Source: Pilot chart by Hydrographic Department of Maritime Safety Agency, Jr

Table 3-2 Monthly Frequency Percentage of Waves in Sulawesi and Maluku Sea

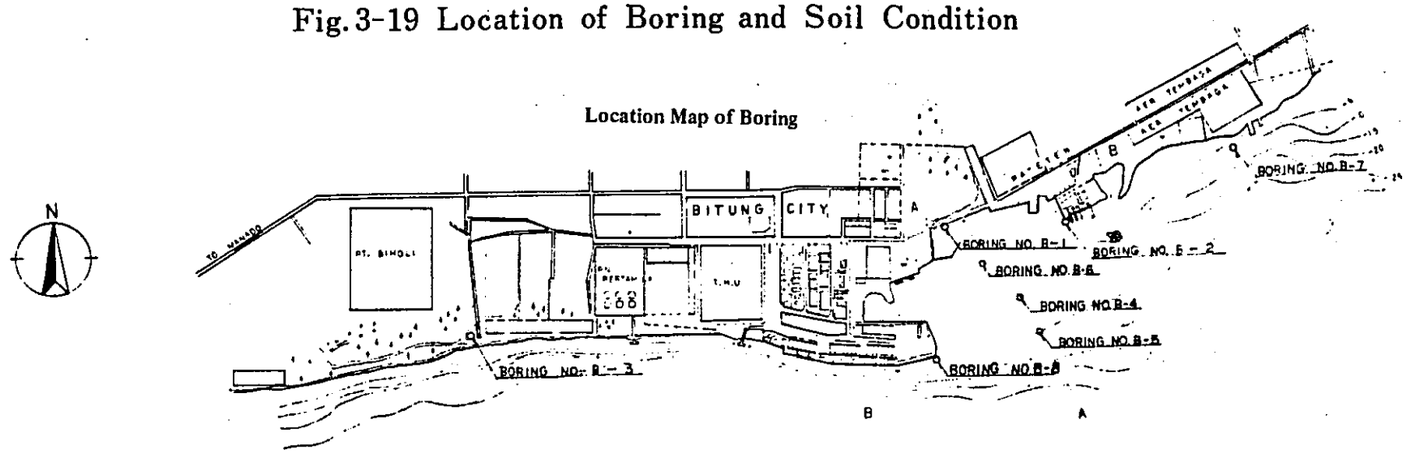
Wave Height (m) \ Month	JAN. (%)	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	Aver-age (%)
0 ~ 0.75 m	25.8	26.5	35.9	48.7	58.7	35.4	34.0	35.8	39.8	46.2	28.1	31.2	37.2
0.75 ~ 1.75	38.7	40.9	47.0	32.2	25.0	41.6	44.6	41.0	43.2	31.7	46.9	35.8	39.1
1.75 ~ 2.75	22.1	24.3	11.5	4.2	4.7	13.1	14.6	18.1	9.4	11.3	12.1	15.9	13.4
2.75 ~ 3.75	9.6	4.4	1.4	1.0		2.6	1.7	1.5	0.8	1.7	3.1	7.8	3.0
3.75 more	2.8	2.3	0.6	0.6		1.3	0.5	1.3	0.6		3.0	3.4	1.4
Average of Wave Height (m)	1.6	1.4	1.1	0.7	0.6	1.1	1.1	1.2	0.96	0.9	1.2	1.4	1.1 m
Average of Period (sec.)	7.4	6.5	5.9	6.0	5.5	5.8	5.4	5.8	5.6	5.6	6.2	7.3	
Predominant Direction (Secondary Predominant)	NNE	NNE (ENE)	NNE (ENE)	NNE (ENE)	ENE (WSW)	WSW (SW)	WSW (SW)	WSW	WSW	N (NNE)	NNE	NNE	



Notes 1) Scope of ocean between equantorial and about long 5° N.
2) Source: Pilot chart by Hydrographic Department of Maritime Safety Agency, Japan

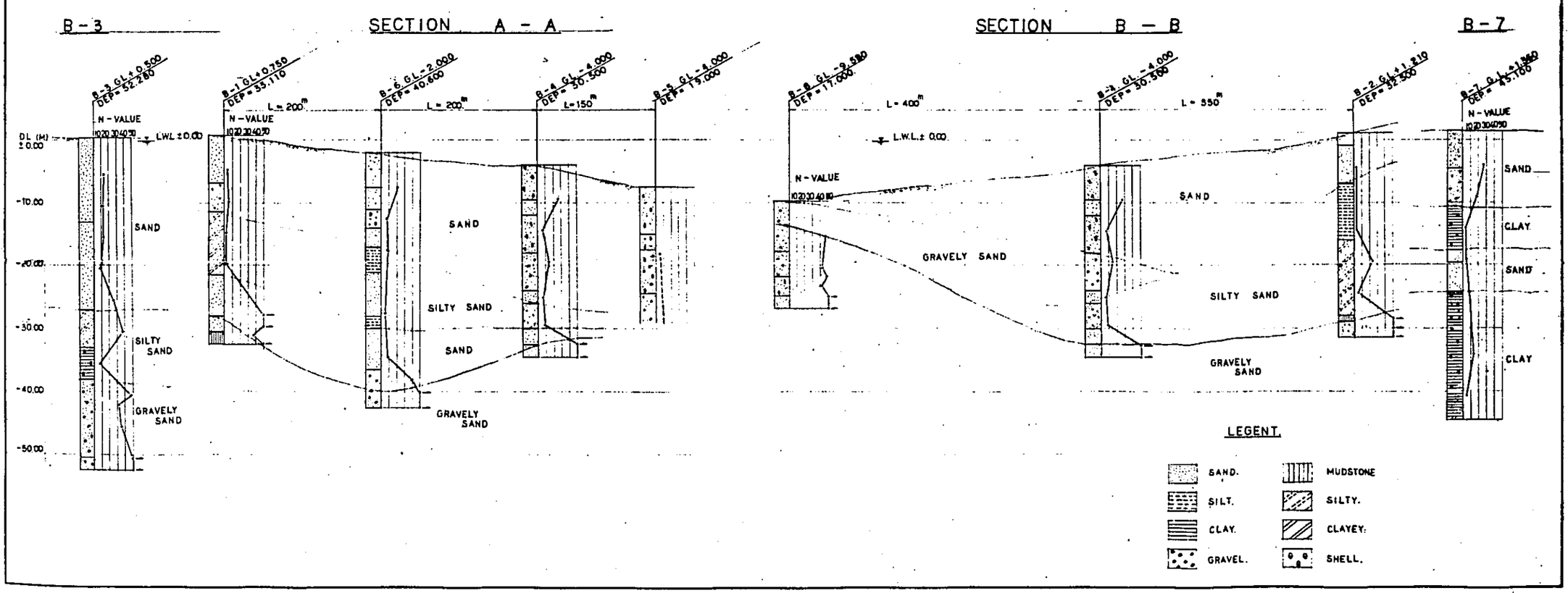
Fig. 3-19 Location of Boring and Soil Condition

Location Map of Boring



Soil Condition

SCALE. H = 1 : 2,500
V = 1 : 200



For example, a hard sand layer with N = 47 is found to a depth -17 m, at the east end of the existing concrete pier (No.8 point).

2) Soil properties at the west coast 1.2 km away from the existing concrete pier

At this point the bottom stratum consists of a sand layer of about N = 10 - 12 from the surface to -20 m. While there is a clay layer of about N = 8 present at -33 m - -38 m, a relatively hard sand layer of N = 25 - 50 is continuous for -20 m - -52 m. At greater depth is a hard sand layer of N = 50 or more.

3) Soil properties at Aer Tembaga

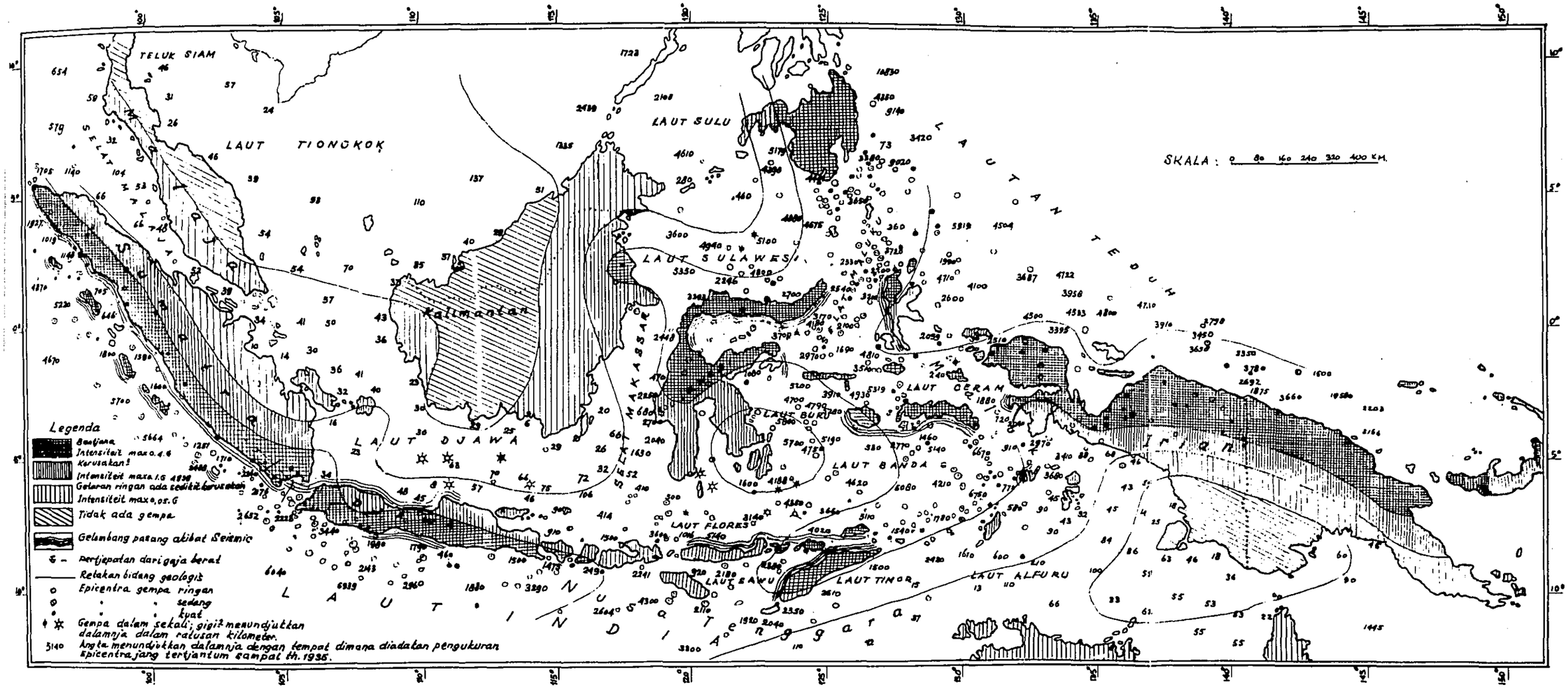
The sand stratum with N = 19 - 28 is found from the ground surface to the depth of -11 m. The stratum from the depth of -11 m to -46 m consists of cohesive soil with N = 4 - 12 and this stratum is interposed by a loose sand layer from depth of -21 m to -24 m.

3-5. Earthquakes

The North Sulawesi area belongs to the Pacific Volcanic Belt and has frequent occurrences of earthquakes. In the area from the northern part of Sulawesi to the Sangihe Islands, volcanos are presently active, and under the influence of such volcanic activity, earthquakes are occurring from time to time in the area in the vicinity of Bitung.

The intensity of earthquakes by area of Indonesia is illustrated in Fig. 3-20. As seen, the seismic acceleration in the vicinity of Bitung is about 0.07 g - 0.15 g. For the design of port facilities, therefore, it will be required to take a horizontal seismic coefficient of about k_h = 0.15 into consideration.

Fig. 3-20 Map of Seismic Part in Indonesia



Source : Perencanaan Bangunan TAHAN GEMPA DIREKTORAT PENYELIDIKAN MASALAH

Chapter-4 Basic Conception of Planning

4. Basic Conception of Planning

4-1. General

In this chapter the basic conception in the planning of the Port of Bitung will be dealt with. After the explanation of the necessity of planning, the problems involved in planning and the plan of study of these problems will be explained.

4-2. The Necessity of Planning

The Port of Bitung is the key point of physical distribution whose service area extends towards both sea and land. Together with the development of not only marine transportation but also of air transportation, the prospects are bright for this area to bear stronger characteristics of a key point in the future.

Demands for improvements of the Port of Bitung may be listed as follows:

(1) Coping with increased traffic through the port

Reviewing the trends over the past several years, it was noted that the usage of the Port of Bitung had expanded greatly. This reflects the sharp increase in population and economic activities in the service area of the Port of Bitung. Port improvements must also be carried out in the future to cope with increase in traffic through the port which may occur with changes in the service area.

(2) Promotion of Regional Development

As the service area of the Port of Bitung is located far remote from the centre of Indonesia, it lacks its own energy for development. Attention should rather be paid to the political importance of this service area in Indonesia, and to the necessity of promoting regional development. Viewed from the scope of the population and industry, it will be difficult to develop this service area in the self-sufficient economy. Vigorous development is only possible by introducing external economic societies into the economic framework of Indonesia. The port is one of the important tools in promoting regional development by contributing to closer interchange externally.

On one hand, how is the Port of Bitung responding to these demands? First, although 20 years have elapsed since the construction of the existing facilities, since they were of very sturdy construction, they are still capable of giving many years of service with some reinforcement work. Due to the excellent initial selection of the site, this port is blessed with natural conditions and is convenient to use. Partial expansion work is currently being carried out. Its administration

system is also well set up.

On the other hand, however, the facilities initially installed have now become unable to cope with growth in port traffic. This is indicated by port congestion in the past several years. Also, the mixed use of the berthing facilities by oceangoing and interinsular vessels and by cargo and passenger ships instead of their original purpose, reveals the delay in corrective measures.

Additional berthing facilities are now being constructed in the Port of Bitung. This is an intelligent counterplan for resolving the difficult problems that may arise several years from now. As conditions in the Port of Bitung will probably continue to change in the future, quantitative and qualitative problems must be met. It will also be necessary to adjust any conflicts without strain with the various related activities that arise during the process of coping with these problems. For example, while the growth of the City of Bitung and the activity of the Port of Bitung are in complementary relations functionally, as they are in conflict spatially, it will be necessary to form adjustment plans initially within a wide framework.

It will be highly significant to carry out further studies in detail, particularly in view of the fact that the Government of Indonesia is going to find out the future direction (*footnote) of the port development of Bitung.

4-3. Planning Problems and Process of Study

In port planning, it is important that studies be carried out efficiently and on an unbiased basis from both the socioeconomic and technical viewpoints. It will be necessary to carry out the planning work in stages in accordance with the characteristic requirements of both socioeconomic and technical studies.

(1) Ranking the Port of Bitung in the marine transportation of Indonesia

To study this problem, the marine and land service area of the Port of Bitung should be examined.

(2) Study of the necessity of the Port of Bitung

This is a subject relating to the establishment of a target plan for the Port of Bitung. For this reason, the forecasts of population and economic activities in the service area must be carried out. Next, the forecasts of the traffic through the Port of Bitung must be carried out as closely as possible to the economic activity. Since the quali-

* Gubernur Kepla Daerah Tingkat I Sulawesi Utara and BAPPEDA Tingkat I Sulawesi Utara, Urgensi Pengembangan Pelabuhan Bitung, Manade, 10 July. 1976

tative and quantitative traffic through the Port of Bitung may be forecasted at this stage, it will be possible to set the characteristics and scale of the Port of Bitung in the future.

(3) Coordination between the Port and the Region around the Port

To resolve this problem, it will first be necessary to select a construction site for the new port. This selection will be carried out from both the socioeconomic and technical standpoints. Also, as it will be necessary for the site selection to be made as widely as possible within the limits where the previous studies on the necessity of a port will not become meaningless, the entire area of North Sulawesi is studied.

Next, the means of coordinating the port and the region around the port will be considered. This is a process in which the basic policy of determining coexistence and coprosperity of the port and the region is established. This is an essential process in the long-range plan of the port.

(4) Project planning

Project planning commences with a long-term plan. For this, studies on plans for the layout of principal facilities will be conducted by taking into consideration the results of the studies carried out on the problems and the more detailed technical information. Medium term plans are facility plans for immediate realization and are prepared in relation to all port facilities. Construction plans will also be studied in relation to medium term plans and, in these studies, technical studies such as design and construction and cost estimates will also be conducted. In addition, an administration and operation plan will be established to cope with the increased port activities.

(5) Assessment

The studies on the soundness of the project planned above from an economic and financial standpoint will be conducted as well as the studies on the influences that the project will have on the environment.

Chapter-5 Determination of the Service Area

5. Determination of the Service Area

5-1. General

The service area of the Port of Bitung will be discussed in this chapter. Generally the term "service area" may include all traffic origins and destinations related to a particular port but the term "service area" will be defined here as areas where influences by the Port of Bitung are especially outstanding, in the analysis described hereinafter. In other words, the service area means the area which has the Port of Bitung as its distribution center.

The service area for the Port of Bitung must be defined in both land and sea directions since the Port of Bitung has the role of not only as being the gateway to the inland but also as a transit port as described before (section 1-5. Roles of the Port of Bitung).

5-2. Service Area on the Land

The service area on the land of the port is greatly governed by the conditions of land transportation. Presently, road conditions west of the City of Bitung are poor, with paved roads less than 50% of all roads so that driving by car to the City of Gorontalo is very difficult. Thus the land service area of the Port of Bitung is presently limited to an extremely narrow area which include Minahasa and a part of Mongondow, and this port is also separated from the service areas from other neighboring ports.

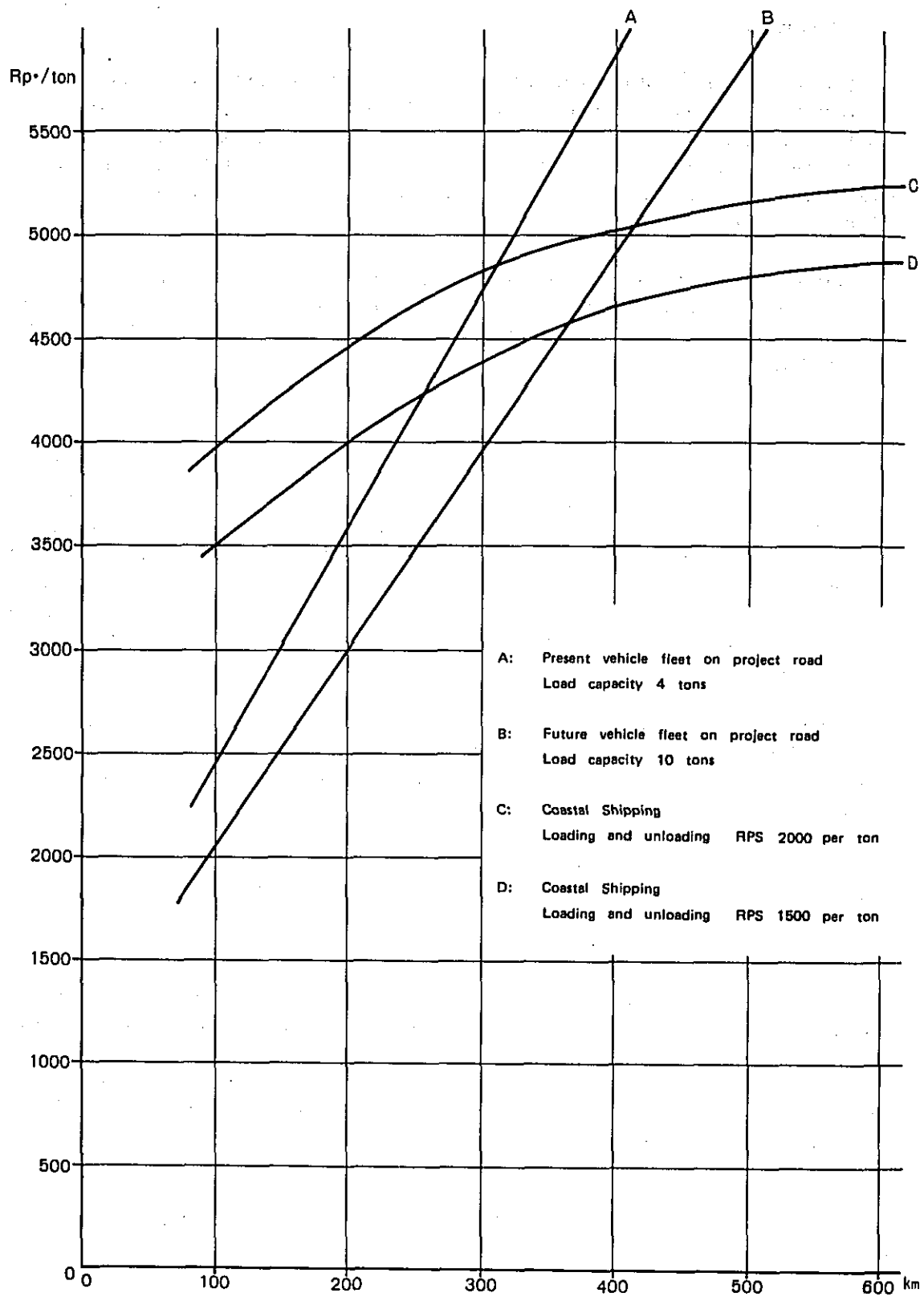
In considering the future land service area, the Feasibility Study conducted under UNDP and carried out by the World Bank in 1970 can be used as a convenient reference since it has been proven to be right even though inflation actually occurred after the survey (Refer to Fig. 5-1).

According to this study, it is said that a new major port should not be provided within a 300 km distance by ship transport from an unimproved port if 4-ton trucks are used for land transportation and within 400 km by ship transport from an improved port if 10-ton trucks are used for land transportation.

The traffic improvements expected for the future in the North Sulawesi Province are the completion of roads (420 km) from the City of Bitung to the City of Gorontalo through Kuandang, road from Kuandang to Kotamobagu, road from Inobonto to Kotamobagu, road from Kotamobagu to Duludo and so forth in the 1980's so that the road network in North Sulawesi Province will be completed, thus connecting the Gorontalo City service area with the Bitung City service area.

From the analysis made heretofore, it is considered that the service area of the Port of Bitung will be enlarged in the future to the neighboring area of Gorontalo.

Fig. 5-1. Estimated Transport Cost per ton by Road and Coastal Shipping



5-3. Service Area on the Sea

5-3-1. General

The appropriate service area presently in the direction of the sea will be discussed and determined in this section. For this purpose, the degree of dependent rate of cargo to the Port of Bitung will be calculated from the O.D. tables, and the method for determining the service area on the sea in the future will be described and the results will be shown.

Then, these results will be coordinated with the previously made analysis, and finally, alternatives for the service area on the sea will be selected and commented upon.

5-3-2. Present Service Area

In order to understand the range of the present service area on the sea, the dependent rate on the Port of Bitung by "X" port for commodity "Y" will be defined by

$$D_{XY} = \frac{Q_{BY}}{Q_{XY}} \times 100\ (\%)$$

where D_{XY} : Dependent rate on the Port of Bitung for Commodity Y by X area (in %)

Q_{BY} : Amount of cargo (tons) for Commodity Y related to the Port of Bitung in X area

Q_{XY} : Total amount of cargo (tons) for Commodity Y in X area

Table 5-1 indicates the dependent rates on the Port of Bitung for dry cargo as calculated from "Interisland Seatransport in Indonesia, 1974". From this table, the areas which are considered to have relatively high dependent rates on the Port of Bitung are Sulawesi Utara I, Sulawesi Utara II, Sulawesi Tengah II and Maluku Utara.

Table 5-2 indicates the dependent rate on the Port of Bitung for mineral oils. The dependent rate for mineral oils seems to be higher than that for dry cargo. This tendency is especially outstanding for Irian Jaya.

Table 5-1 Dependent Rate on Bitung of Dry Cargo Flow by Region, 1974

Unit: %

Statistical	Maritime Regions	Traffic from Bitung	Traffic to Bitung
12	Sumatra Selatan	–	–
16	D. K. I. Jaya I	2	2
17	D. K. I. Jaya II	–	–
19	Jawa Tengah I	–	–
21	Surabaya	2	3
26	Kalimantan Selatan	–	–
27	Kalimantan Timur I	–	–
28	Kalimantan Timur II	–	–
29	Sulawesi Utara I	17	21
30	Bitung	–	1
31	Sulawesi Utara II	27	18
32	Sulawesi Tengah I	3	–
33	Sulawesi Tengah II	19	5
34	Ujung Pandang	1	7
36	Sulawesi Tenggara	–	4
37	Bali	–	2
38	Nusatenggara Barat	–	–
40	Maluku Utara	26	1
41	Maluku Tengah	1	–
43/47	Irian Jaya	1	–

Note : Derived from "Interisland Seatransport in Indonesia, 1974".

Table 5-2 Dependent Rate on Bitung of Mineral Oils by Region, 1974

Unit: %

Statistical	Maritime Regions	Traffic from Bitung	Traffic to Bitung
12	Sumatra Selatan	–	–
16	D. K. I. Jaya I	–	1
17	D. K. I. Jaya II	–	–
19	Jawa Tengah I	–	–
21	Surabaya	–	–
26	Kalimantan Selatan	–	–
27	Kalimantan Timur I	–	4
28	Kalimantan Timur II	3	–
29	Sulawesi Utara I	35	9
30	Bitung	–	–
31	Sulawesi Utara II	89	40
32	Sulawesi Tengah I	19	–
33	Sulawesi Tengah II	37	5
34	Ujung Pandang	5	3
36	Sulawesi Tenggara	–	–
37	Bali	–	–
38	Nusatenggara Barat	–	2
40	Maluku Utara	27	16
41	Maluku Tengah	2	–
43/47	Irian Jaya	13	–

Note : Derived from "Interisland Seatransport in Indonesia, 1974".

Fig. 5-2 shows the dependent rates on the ports of Bitung, Ujung Pandang and Ambon in relation to dry cargo. This figure also shows the dependent rate on rts for each maritime region in relation to discharging and loading. In addition, the larger of these two dependent rates of each maritime region was further classified and indicated in this figure by shading. The dark areas indicate particularly close relations between the subject port and the maritime region, while the light areas indicate there is some relation and the unshaded

areas indicate no relation. It may, therefore, be considered that the shading in this figure shows the service area of the subject port divided into two ranks.

From this figure it may be discerned that the service areas for the Port of Bitung are practically confined to Sulawesi and North Maluku and that, even in Sulawesi, practically none of its southern portion can be included. In contrast to this, it may be noted that Ujung Pandang has a much wider service area which extends to East Kalimantan, Nusa Tenggara, Sulawesi, Maluku and Irian. It has particularly great influence on the latter 3 areas. Although Ambon's service area is limited to Maluku, its influence on North Maluku is smaller than that of Bitung.

Fig. 5-3 shows the dependent rates on Bitung. Ujung Pandang, and Ambon in relation to mineral oils. This figure shows that Bitung's service area extends to East Kalimantan, Sulawesi, North Maluku and Irian and covers practically the entire northern part of East Indonesia. It may also be noted that its influence on Sulawesi and North Maluku is greater than in the case of dry cargo. Ujung Pandang's service area is narrower in the case of dry cargo and its area of competition is declining in relation to Bitung. Ambon's service area is wider in relation to dry cargo and includes Irian as well as Maluku in its area of influence. Its influence on Irian, however, is lower than that of Bitung.

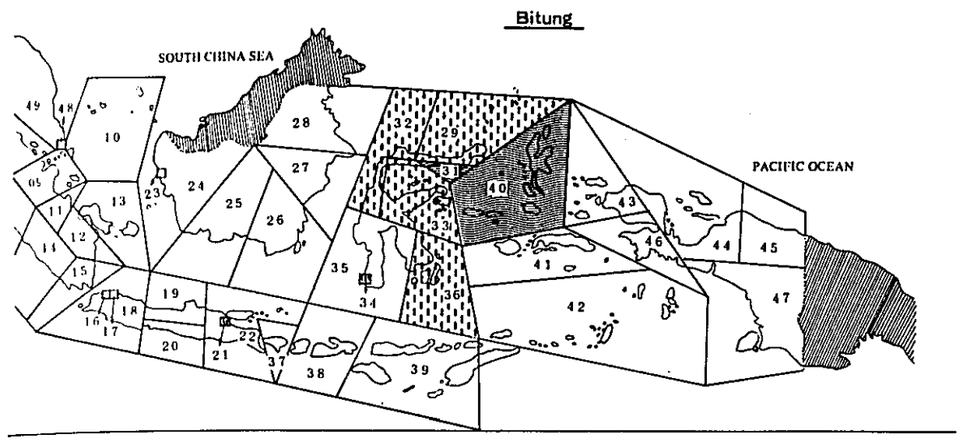
However, will the foregoing analysis, which was based on data of 1974, continue to be appropriate even when based on later data? To answer this question, verification using the data prepared at Ternate and Gorontalo must be carried out.

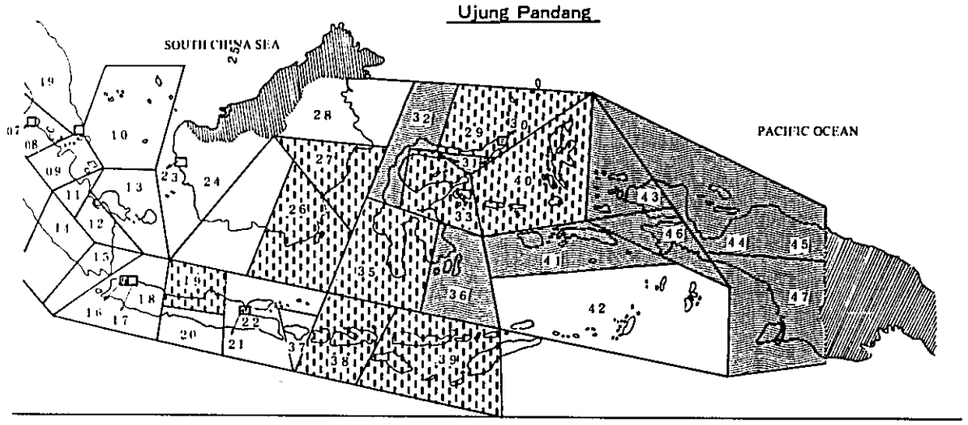
Ternate is the principal port in Maritime Region 40. Maritime Region 40's dependent rate on the Port of Bitung for dry cargo is from 0.01 to 0.26 (Fig. 5-2) whereas Ternate's dependent rate for general cargo in 1976 was between 0.24 and according to data on origin and destination. It may be said that these rates are very closely matched.

Gorontalo is the principal port in Maritime Region 31. The dependent rate of Maritime Region 31 on the Port of Bitung for dry cargo is 0.27 and 0.18 (Fig. 5-2) and for mineral oils is 0.89 and 0.40 (Fig. 5-3). On one hand, according to origin and destination data in relation to the total cargo of the Port of Gorontalo for 1976, the dependent rate is 0.56 and 0.36. These 1976 values are between the dry cargo and mineral oils for 1974 and tendencies are that they will be the same as the 1974 figures.

Therefore, the analysis of the service area of the Port of Bitung based on 1974 data will still be appropriate for 1976.

Table 5-3 indicates the dependent rate on the Port of Bitung for commodities which are relatively large in quantity and convenient for observing the distribution functions of the Port of Bitung. In the bottom row of the table, the ratios between cargo sent from each of 6 different areas and total cargo handled in the Port of





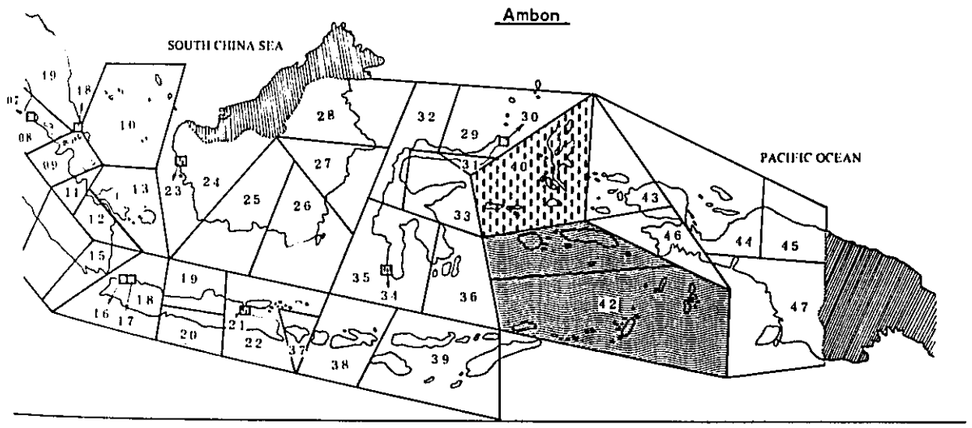
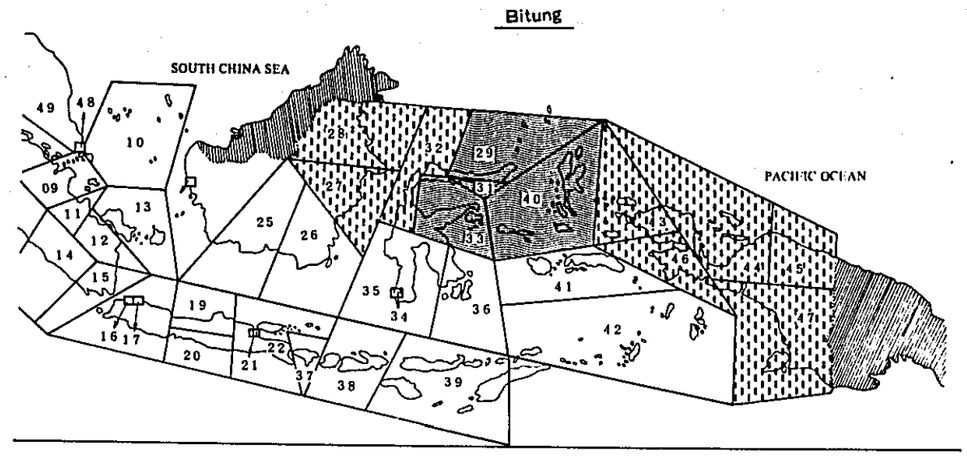
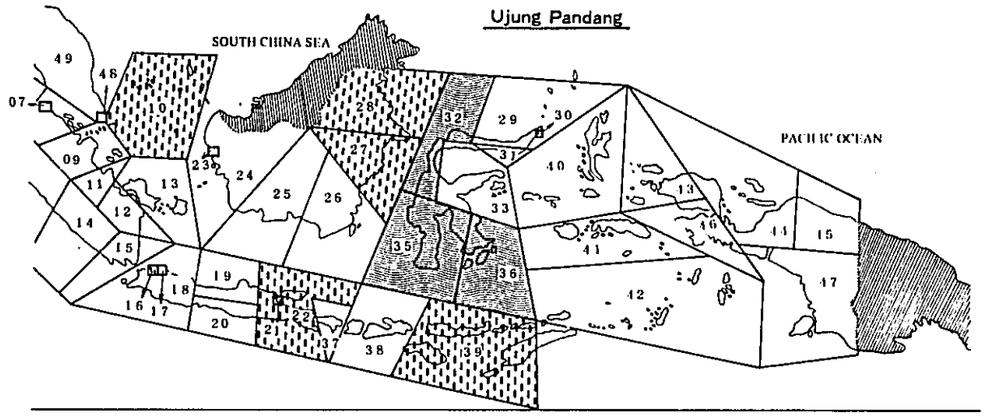


Fig. 5-2. Dependent Rate on Bitung, Ujung Pandang and Ambon, 1974 (Dry Cargo)

Remarks: The discription in 29(17-2) in the figure of Bitung presents "The 29th Maritime Region has the dependent rate on Bitung 0.17 and 0.02 in discharging and loading, respectively".

Legend
- $D \geqq 0.2$
- $0.03 \leqq D < 0.2$
- $D < 0.03$





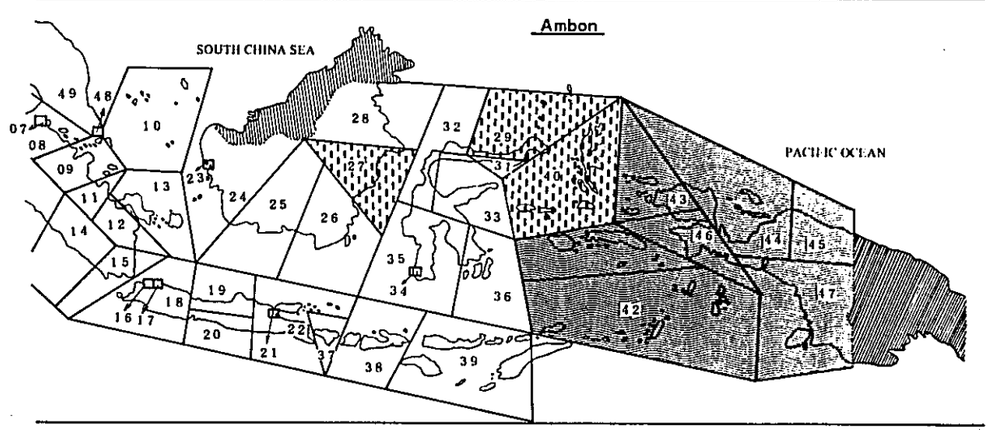


Fig. 5-3 Dependent Rate on Bitung, Ujung Pandang and Ambon, 1974 (Mineral Oils)

Remarks: The discription 29 (35-9) in the fugure of Bitung presents "The 29 th Maritime Region has the dependent rate on Bitung 0.35 and 0.09 in discharging and loading, respectively."

Legend
- $D \geqq 0.2$
- $0.03 \leqq D < 0.2$
- $D < 0.03$

Table 5-3 Dependent Rate of Selected Commodity on Bitung by Region

Unit : %

Area	Traffic from Bitung			Traffic to Bitung
	Rice	Cement	Mineral Oils	Copra
Sulawesi Utara I	58	13	35	36
Bitung	20	20	–	13
Sulawesi Utara II	45	13	89	20
Sulawesi Tengah I	10	5	19	–
Sulawesi Tengah II	75	8	37	–
Maluku Utra	80	10	27	2
(Traffic from/to Above-quoted Regions) / (Traffic to/from Bitung) (%)	99	94	57	99

Note: Derived from "Interisland Sea-transport in Indonesia, 1974

Bitung are indicated in percent. These values show that the amount of rice loaded, amount of cement loaded and amount of copra discharged are all high, exceeding more than 90% so that these 6 areas are considered to be the major service area on the sea. On the other hand, the value for the mineral oils loaded is only 57%. This indicates that the mineral oils have a wider distribution area other than these 6 areas.

In the previous explanations in relation to marine transportation as a part of the economic and social conditions of the Port of Bitung, the areas that are directly connected to the Port of Bitung by means of marine routes were indicated in Fig. 2-2.

By taking into consideration Fig. 2-2, 5-2, 5-3 and Table 5-3, there can be no great mistake in considering that the service area of the Port of Bitung includes North Sulawesi, Central Sulawesi and the northern part of Maluku. The definition of the service area of the Port of Bitung considered here is that the influence of the Port of Bitung is relatively greater in these areas than the influence of other ports.

5-3-3. Service Area in the Future

(1) Future Service Area

In determining service area in the direction of the sea for the Port of Bitung in the future, the following two prerequisites were taken into consideration:

1) The Port of Ujung Pandang and Port of Ambon will continue their important activities as shipping bases in the future as they are today.

2) The present shipping system such as RLS and local ship operation in Indonesia will not be drastically changed in the future.

If such prerequisites are made and maintained, the only determining factor of the service area will be the marine transport costs. This means that the service area will be determined mostly by marine transport distances.

Thus, the service area on the sea of the Port of Bitung may be expressed by area surrounded by a curve, on which the points having marine transport distance to the Port of Bitung being equal to the marine transport distance to the Port of Ujung Pandang or the Port of Ambon have been plotted.

When considering this service area boundary in association with the administrative jurisdictional boundary, the service area of the Port of Bitung thus determined will contain North Sulawesi Province, Central Sulawesi Province and North Maluku of Maluku Province. This area will coincide with the present service area for dry cargo.

(2) Alternatives

Other alternatives which can be considered may be either wider or smaller in area than that stated in (1).

The range of area established in (1) will coincide with the present service area. However, this service area is a product of the present marine transport system and port system. Therefore, for newly defining a service area which differs from the present service area, some changes in the present two systems stated above must be expected.

For justifying a wider service area as an alternative, the relative drop of influential forces by the Port of Surabaya and the Port of Tanjung Priok to the eastern part of Indonesia must exist as a prerequisite, but this prerequisite will not be met under the present situation especially when considering present mutual dependency between Java Island and other islands.

However, if the marine transport system and port system are modified

by the enforcement of new policies by the Indonesian Government, a much wider service area could be requested since the Port of Bitung has geographically better conditions.

In such a case, however, changes in policies, if they occur, will be naturally supported by outstanding economic growth in Maluku Province and West Irian Province. However, such growth will not come soon in consideration of present conditions in these two provinces, but as forecasted, it will come probably in the years between 1985 and 2000, most likely in the last part in this period.

On the other hand, the ability to accept new port construction by the Port of Bitung is naturally limited so that the range of service area covered by the port is limited accordingly. Thus, at a time when the service area is increased, enlargement and improvement of other ports such as Ternate and Ambon will also become necessary to respond to the wider demand for the ports.

Thus, this alternative cannot be selected under present conditions but the Port of Bitung may probably need to respond to a new situation depending upon the changes of various environments after 1985. In such a case, however, the Port of Bitung will be required to flexibly respond to a new situation, maintaining mutual relations with the Port of Ternate and Port of Ambon.

On the other hand, an alternative with a narrower service area may be necessary if one of the ports in the neighboring area is further improved and performs port functions which were previously done by the Port of Bitung. This will be likely occur depending upon the government policies on the port system and marine transport system for North Sulawesi, Central Sulawesi and North Maluku. However, a transport system which allows only a narrow service area for the Port of Bitung is considered to be disadvantageous since the excellent locational condition of the Port of Bitung cannot be fully utilized if such a system be employed.

Chapter-6 Prospect for Regional Activities

6. Prospect for Regional Activities

6-1. General

Population, regional income (GRP) and industries in the service area of the Port of Bitung in 1985 and 2000 will be projected in this chapter. These projections will be the prerequisites for the traffic forecast through the port described in the following chapter. These items are normally used as a basis for the regional development plan and they are furnished as given conditions for all works for determining each project.

Future conditions of the service area of the Port of Bitung may not be fully utilized as given conditions so that new assumptions have been made. However, the data prepared by Indonesian authorities have been utilized as much as possible in the projection and the adherence to the present trend has been carefully maintained.

First, the service area was divided into 6 areas as indicated in Table 6-1 and in Fig. 6-1 for the convenience of traffic forecast through the Port of Bitung. In dividing this area, the areas which can be combined as a unit to the Port of Bitung in view of transport conditions at present and in the future, were considered as a group.

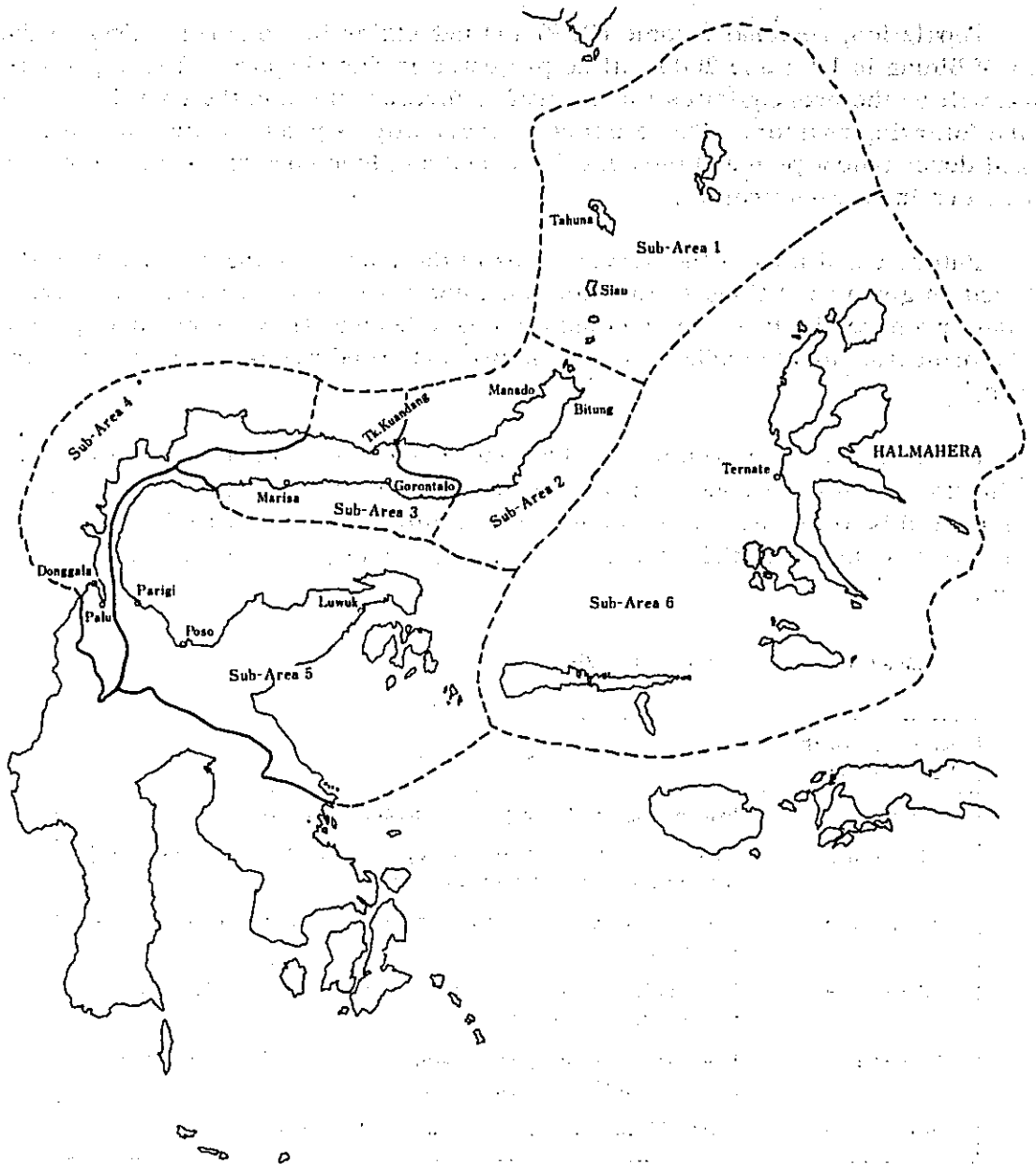
Table 6-1 Service Area of Port of Bitung

Sub-area of the Service Area	Sphere of the Sub-area
Sub-Area 1	Sangihe Talaud Regency in North Sulawesi Province
Sub-Area 2	City of Menado, Minahasa Regency and Bolaang Mongondow Regency in North Sulawesi Province
Sub-Area 3	City of Gorontalo and Gorontalo Regency in North Sulawesi Province
Sub-Area 4	Toli-Toli Regency and West Coast of Donggala Regency in Central Sulawesi Province
Sub-Area 5	Poso Regency, Banggai Regency and East Coast of Donggala Regency in Central Sulawesi
Sub-Area 6	North Maluku Regency of Maluku Province.

Characteristics of each sub-area in relation to the degree of dependence on the Port of Bitung are indicated below.

(1) The area presently tied to the Port of Bitung by roads is Sub-Area 2. A part of Sub-Area 3 may also be included to this in the future. These areas are the most strongly tied with the Port of Bitung.

Fig. 6-1 Service Area of Port of Bitung



(2) Areas tied to the Port of Bitung by marine transport are Sub-Area 1, 3, 4, 5 and 6. A part of Sub-Area 3 will be tied to the Port of Bitung by roads in the future. The ties between these areas and the Port of Bitung are not as strong as that of areas shown in (1).

6-2. Population

In forecasting future population, the yearly growth rate of 2.9% employed in planning for the area other than Java Island in Pelita II was applied in assuming future population for each province. Then, the forecasted population for each province was subdivided into populations for several Sub-Areas considering the trends in the past. The forecasted population is generally indicated in Table 6-2.

Table 6-2 Projection of Population in the Service Area of Port of Bitung

Area	1975	1976	1985	2000	1985/1976	2000/1976
	(1,000)	(1,000)	(1,000)	(1,000)		
Sub-Area 1	246	250*	290	370	1.2	1.5
Sub-Area 2	1,140	1,179*	1,580	2,520	1.3	2.2
Sub-Area 3	542	556*	700	1,000	1.3	1.8
Sub total	1,928	1,985*	2,570	3,940		
Sub-Area 4	512*	526*	670	1,040	1.3	2.0
Sub-Area 5	512*	525*	670	1,040	1.3	2.0
Sub total	1,024	1,051	1,340	2,080		
Sub-Area 6	340	360	470	760	1.3	2.1
Total	3,292	3,396	4,380	6,780	1.3	2.0

Note : * are estimates

According to this table, the total population in the service area will be 4,380,000 in 1985 and 6,780,000 in 2000 which are 1.3 times and 2.0 times respectively, compared to that in the year of 1976.

6-3. GRP

In making the perspective of GRP for each Sub-Area in the service area, the target of per capita GRP for each province was set first and the perspective of GRP was derived by multiplying this value by the population assumed for each area

in Section 6-2.

When comparing existing per capita GRP to per capita GDP, the difference between these two values will considerably vary depending upon the province (Section 2-4.) The ratio between per capita GRP for each province and per capita

Table 6-3 Projection of Percapita GRP in the Service Area of Port of Bitung

Unit : 1000 Rp.

Province	1985	2000
North Sulawesi (Area 1, 2 and 3)	135	268
Central Sulawesi (Area 4 and 5)	79	208
Maluku (Area 6)	105	208
Indonesia	105	208

Note : in 1973 price

Table 6-4 Projection of GRP in the Service Area of Port of Bitung

Unit: billion Rp.

Area	1975	1976	1985	2000	1985/1976	2000/1976
Sub-Area 1	19	21	40	100	1.9	4.8
Sub-Area 2	87	94	210	700	2.2	7.4
Sub-Area 3	41	45	90	260	2.0	5.8
Sub total	135	160	350	1,060	2.2	6.6
Sub-Area 4	23	25	50	220	2.0	8.8
Sub-Area 5	22	24	50	210	2.0	8.8
Sub total	45	49	100	430	2.0	8.8
Sub-Area 6	22	24	50	160	2.0	6.7
Total	202	233	500	1,650	2.1	7.1

Note: GRP in 1975 and 1976 are estimates based on the latest data on each province.

GDP in 1973 was 1.29 for North Sulawesi, 0.68 for Central Sulawesi and 0.96 for Maluku. According to the latest data for Central Sulawesi and Maluku, the ratio to per capita GDP is gradually approaching "1" in these provinces. The target for the ratio between per capita GRP and per capita GDP for North Sulawesi, Central Sulawesi and Maluku is respectively determined as 1.29, 0.75 and 1.0 for the year 1985 and 1.29, 1.0 and 1.0 for the year 2000. In this case, the target value of per capita GDP was established assuming on 8.5% increase rate for GDP by 1985 and 7.5% by 2000. The results of the prespective of per capita GRP are indicated in Table 6-3. By multiplying per capita GRP thus obtained by the forecasted population for each area, the GRP for each area is obtained as indicated in Table 6-4.

6-4. Industries

6-4-1. General

North Sulawesi Province has a typical agriculture oriented industrial structure as stated previously. The industrialization in this district is slower in its progress than South Sulawesi Province, which is also in the same Sulawesi Island. And its government is also very active in promoting industrialization, especially the processing of the agricultural products as planned by Pelita II.

In the field of processing of agricultural products, processing of copra is one of the important objects and increase in production and the copra is considered to be very effective for the growth of the industrial sector. Due to the increase in the production of coconuts and the increase in production capacity for copra and related products, an increase in production is expected in the future.

Other industries are manufacturing metal products such as nails and wires, knockdown factories for automobiles, shipbuilding and repairing factories. Increases in shipbuilding capacities are particularly expected in the future due to the increases in domestic demand.

As far as the mining industry is concerned, this area is the production center for kaolin and limestone but copper and nickel are being investigated at present.

In the fishery industry, fishing for bonitos is very active in the vicinity of the City of Bitung and its development as an export center to Japan is being expected in the future.

As far as North Maluku and Central Sulawesi, which are related to the Port of Bitung, are concerned, the increase in processing factories for copra and coconut related products and the increase in processing of consumer related materials are expected in the future as well as for North Sulawesi Province. However, for other sectors of industries, the City of Bitung and the City of Menado will function as centers of accumulation and supply for industries.

6-4-2. Agriculture

Provinces included in the service area of the Port of Bitung have identical agricultural configurations. However, North Sulawesi Province is the most important of these three provinces in the service area and the agricultural future of this province will be described here.

Table 6-5 shows the types of crops, production, farm land area, and the yield rate for 1975 in North Sulawesi. The crops are roughly divided into food crops and estate crops. Of the food crops, the major production consists of wet land paddy, maize and cassava and these constitute approximately 60% of the food crop production. In addition, other crops such as dry land paddy, sweet potatoes, beans, vegetables and fruits are also harvested. From the viewpoint of farm land area, maize is No. 1 followed by wetland paddy. Crops of high yield rate are tubers such as cassava and sweet potatoes, paddy, vegetables and fruits.

Table 6-5 Agriculture in North Sulawesi, 1975

Kind of Crops	Production (A)	Area (B)	Yield Rate (A) (B)
Food Crops	1,000 tons	1,000 ha	tons/ha
Wet Land Paddy	298	73	4.0
Dry Land Paddy	40	34	1.2
Maize	127	115	1.1
Cassava	106	13	8.2
Sweet Potato	50	11	4.5
Beans	11	17	0.6
Vegetables	40	13	3.1
Fruits	34	12	2.8
Sub-Total	706	288	-
Estate Crops			
Coconut	176	228	0.8
Clove	4	25	0.2
Nutmeg	8	18	0.4
Koffee	1	3	0.3
Sub-Total	189	274	-
Total	895	562	-

Source: BAPPEDA, "Gambaran Umum Sulawesi Utara, Tahun 1975."

On one hand, the most important estate crops from the point of view of production and farm land area are coconuts. Although clove and nutmeg constitute a considerable percentage of the farm land area, since their yield rate is small, they are not very important in relation to production.

The total production was 895,000 tons of which 70%, or 706,000 tons, are food crops and the remaining 30%, or 189,000 tons, estate crops. On one hand, from the standpoint of farm land area, there are 562,000 ha in total which is divided equally between food crops and estate crops.

Typical agricultural projects underway in North Sulawesi Province is a project being performed in Dumoga of Bolaang Mongondow Regency and the other being performed in Marisa of Gorontalo Regency. These projects are mainly for paddy growing, but soybeans, coconuts and corn will also be raised in a manner suited to steep land peculiar to the North Sulawesi Province. Also, a project for raising cattles in the existing coconut farms is being considered. These projects suggest by themselves that the various kinds of agricultural products in the future may be very similar to those which are available now.

Major agricultural activities which may have a possibility of influencing the forecast of traffic through the Port are the production of these foods.

Of the food stuffs carried to the service area through the Port of Bitung at the present time, amounts of rice, wheat flour, sugar and salt are relatively large each year. And also in the future, wheat, sugar and salt may be dependent upon the products made in other areas. But efforts for increasing rice production within the service area are being made now and this will continue in the future. Increase in production is achieved by increasing the area of agricultural land and improving the productivity of the land. However, the topography of North Sulawesi is mountainous so that production increase only by increasing the agricultural land area is not advantageous and, therefore, use of fertilizer and introducing new species may be employed in parallel with area increase.

Another agricultural product which affects the port cargo next to the commodities stated above, is coconuts. Coconuts are also shipped to the Port of Bitung from other neighboring areas, though the increasing rates of coconut-growing land area and its productivity are stagnant in recent years. However, new coconut species which has a land productivity several times higher than the conventional species, is being introduced according to the Ministry of Agriculture. Therefore, it was assumed that this new species would be introduced also to North Sulawesi in the early 1980's. However, the flow of cargo related to the marketing of this new coconut species may occur after the year 1986.

When the livestock project is developed, demand for feeds will be increased accordingly. Cassava is one of the important feeds and its excess will be processed and shipped.

Cloves and nutmegs are also important products of North Sulawesi but the

amounts of these cargo shipped through the Port of Bitung are relatively small and therefore not stated here.

Table 6-6 shows the forecast of the farm land area in North Sulawesi. These figures are the forecast.

Table 6-6 Forecast of Farm Land Area in North Sulawesi

Unit: 1,000 ha

Kind of Crops	1969	1975	1985	2000
Food Crops				
Wet Land Paddy	37	73	130	220
Dry Land Paddy	23	34	55	85
Maize	52	115	120	120
Cassava	14	13	22	38
Sweet Potato	10	11	10	10
Beans	3	17	30	60
Vegetables	11	13	15	30
Fruits	10	12	15	30
Sub-Total	160	288	390	570
Estate Crops				
Coconut	193	228	228	228
Clove	15	24	40	60
Nutmeg	10	18	30	50
Koffee	3	3	3	3
Sub-Total	221	274	301	341
Total	381	562	691	911

Taking into consideration growth trends by crops for the past several years. Although the results indicate that the growth in food crops exceeds the growth of estate crops, this matches trends in the past. Practically no growth could be observed in the past 3 years particularly in relation to coconuts and it may be assumed therefore that there will be no expansion in farm land area in future.

6-4-3. Manufacturing Industries

Industries are important cores in the development plan for the North Sulawesi area. During the execution of the 1st 5-year plan, the industries grew tremendously with an average increase of 16% each year. Nevertheless, with such growth, this has not reached 10% of total production.

Table 6-7 Industry in North Sulawesi (number of factories)

	Type of Industry	North Sulawesi	Indonesia
1.	Slaughtering, Preparing and preserving of meat	1	33
2.	Manifacture of dairy products	5	428
3.	Process & Preserving of fish & other seaproducts	1	110
4.	Manufacture of coconut oil	21	384
5.	Rice mills	52	6,109
6.	Manufacture of macaroni, noodle and other kind of noodles	2	373
7.	Manufacture of backery products	5	488
8.	Manufacture of Ice cube	8	247
9.	Manufacture of other food products	4	335
10.	Manufacture of soft drinks and car bonated waters	1	170
11.	Manufacture of wearing apparels	4	111
12.	Saw mills and other woodsmills	-	1,090
13.	Manufacture of furniture and furniture primarily of wood	1	373
14.	Manufacture of paper	1	33
15.	Manufacture of paper boad, fibreboad	-	39
16.	Printing, publishing & allied Industries	11	669
17.	Manufacture of drugs & Medicine except native medicines	1	89
18.	Manufacture of native medicines	1	33
19.	Manufacture of soap, detergent and cleaning preparations	3	224
20.	Manufacture of smoked sheet rubber	1	214
21.	Manufacture of bricks	1	425
22.	Manufacture of cutlery, nail, bolts and other similar products	1	147
23.	Repair & painting of ship	2	12
	Total	128	12,136

Source: Statistic Indonesia 1975

Industries in the North Sulawesi area have been developed mainly for processing of agricultural products such as copra and are mostly producing daily necessities or foods in small-scale factories. According to the survey made in 1972 (Table 6-7), the number of enterprises is 21 for coconut oil factories and 52 for rice mills and these amount to more than half of all factories. The number of average workers per enterprise is 20 which is small in scale and more like a household industry.

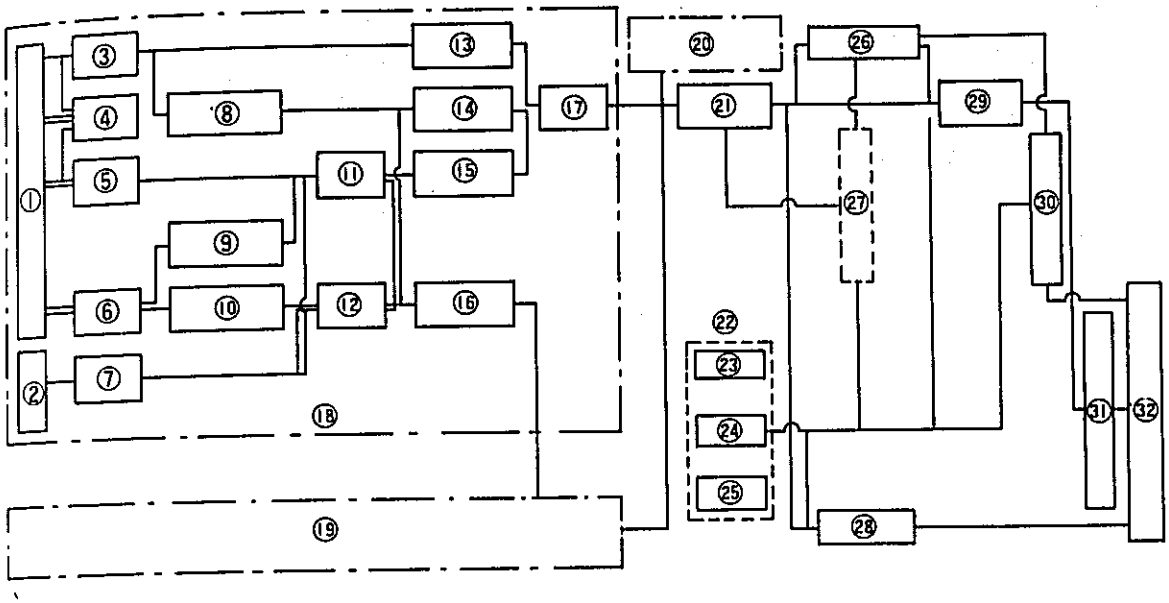
The purpose of industrial development in Indonesia seems to be the creation of employment opportunities and thus development of labor-intensified industries may have been expected. The types of industries that can be started in the North Sulawesi area are stated in Table 6-8.

Table 6-8 Possible Types of Manufacturing Industries in North Sulawesi

Area	Characteristics	Types of Manufacturing Industries
Area along coast	Area is relatively narrow but is transit base of marine transport for nearby islands and a part of North Maluku.	Shipbuilding, Feed processing, Manure processing, Food processing, Vegetable oil processing, Burlap-bag manufacturing.
Mountainous area	Climate is relatively warm and rich with water and natural resources (kaolin and lime)	Ceramic industry, Textile industry, Earthern ware industry Cement industry.

Due to increase in demand for shipbuilding in the future, shipbuilding and related repairing industries may be increased in shipyards. As far as the scale is concerned, ships of the 10,000-ton class may be built and fabrication of land facilities such as steel frame structures, bridge girders and water gates may become also possible (Refer to Fig. 6-2).

Fig. 6-2. Vessel Production Flow Chart



(1) Steel plate storage yard (including shoot blast cleaning)
(2) Shapes storage yard
(3) Flame planer
(4) Butt welding
(5) NC flame cutter
(6) NC drilling equipment
(7) Fabrication of shapes
(8) Bending of bilge and gunnel (1,000 t press)
(9) Bending of face (300 t Bending machine)
(10) Parallel cutter
(11) Piece fabrication
(12) Assembly of longitudinal number
(13) Automatic one side welding machine
(14) Assembly of bildge and gunnel
(15) Frame fabrication assembly (Longitudinal number fixing device)
(16) Cold bending of longitudinal member
(17) Block assembly
(18) Drawing board block shop
(19) Bending outside plate block shop
(20) Assembly of accommodation block
(21) Painting (pickling)
(22) Rig parts
(23) Storage warehouse
(24) Pallet assembly
(25) Pipe manufacture
(26) Block turn over equipment
(27) Rigging for living quarter
(28) Unit assembly
(29) Block Rigging
(30) Space erection of accommodation block
(31) Block storage and pre erection
(32) Building dock

Chapter-7 Forecast of Traffic through the Port

7. Forecast of Traffic through the Port

7-1. General

Forecast of traffic through the port for the years of 1985 and 2000 will be described in this chapter. The traffic being forecasted here is port tonnage traffic, ship calls and passengers.

7-2. Port Tonnage Traffic

7-2-1. General

A macroscopic forecast is first made for the port tonnage traffic through the Port of Bitung for 1985 and 2000. Forecasts are then made by commodity, which will be checked against the value obtained from the macroscopic forecast. The port tonnage traffic by type of ships is further calculated from the forecast made on commodities. Lastly, the port tonnage traffic through public wharves which will be used for port facility planning is calculated.

7-2-2. Macroscopic Forecast

Future port tonnage traffic through the Port of Bitung is forecast based on the correlation of port tonnage traffic and GRP. In the case of the Port of Bitung, two ways of forecasting are considered depending on the available data.

(1) Forecast 1

Forecast 1 uses the correlation of traffic through the Port of Bitung and GRP of the service area of the port (the whole area from Sub-Area 1 through Sub-Area 6).

1985 On a graph, the correlation line of the past traffic and GRP is drawn and a target of GRP for 1985 is applied. In this way, the traffic through the Port of Bitung is determined at 1,500 thousand tons.

2000 The following formula is used.

(Traffic through the Port of Bitung) = (Growth of GRP in service area) x (modulus of elasticity)

$$\text{(modulus of elasticity)} = \frac{\text{(Growth of traffic through the Port of Bitung)}}{\text{(Growth of GRP in service area)}}$$

For these years, the modulus of elasticity has been 1. With the growth of economy in the service area after 1985, the modulus of elasticity will somewhat drop. Assuming the modulus of elasticity is 0.9, traffic through the Port of Bitung in 2000 is determined at 4,500 thousand tons.

(2) Forecast 2

First, using the correlation of port tonnage traffic and GRP in North Sulawesi Province, the future port tonnage traffic of North Sulawesi Province is derived. The traffic through the Port of Bitung is derived by multiplying the traffic of North Sulawesi Province with the rate of the traffic through the Port of Bitung in that of North Sulawesi Province.

1985 On the graph, the port tonnage traffic of North Sulawesi Province is determined at 1,600 thousand tons by using the correlation of GRP of North Sulawesi Province. The percentage of the port tonnage traffic through the Port of Bitung in that of North Sulawesi Province was 68 % in 1969, 80 % in 1975 and gradually increasing each year. Then it is assumed that the rate will increase to 85% in 1985. Based on this assumption, the traffic through the Port of Bitung in 1985 is forecast at 1,400 thousand tons.

2000 The following formula is used to obtain the port tonnage traffic of North Sulawesi Province in 2000.
(Port tonnage traffic of North Sulawesi Province)
= (Growth of GRP of North Sulawesi Province) x (Modulus of elasticity)
(modulus of elasticity) =

$$\frac{\text{(Growth of traffic of North Sulawesi Province)}}{\text{(Growth of GRP of North Sulawesi Province)}}$$

Table 7-1 Forecast of Traffic through Port of Bitung by Macro-scopic Method

Unit : 1,000 tons

Method	1985	2000
Method 1; using the correlation between traffic through Bitung and GRP in the Service Area	1,500	4,500
Method 2; using the correlation between traffic through the ports in North Sulawesi and GRP in North Sulawesi and also the ratio Bitung to North Sulawesi	1,400	4,300

Considering the modulus of elasticity has been 1 for these years, it is assumed that the modulus of elasticity is 0.9 in 2000. Based on this assumption, the port tonnage traffic of North Sulawesi Province is determined at 4,800 thousand tons.

The rate of traffic through the Port of Bitung in that of North Sulawesi Province, judging from the past trend, will be much higher in the year 2000 than in 1985. Assuming it will be 90%, the traffic through the Port of Bitung in the year 2000 is forecast at 4,300 thousand tons. The results of these forecasts are shown in Table 7-1. The values of the forecasts are somewhat different by the method used. However, these differences remain in the range of 10% of the total forecasts. The accuracy of forecast within 10% difference is considered good in macroscopic forecasts where several values of which adequacy is difficult to prove in the process of forecast are used.

Further, it is desirable to use values derived from macroscopic forecasts only as a guideline or to check the forecasts made on more detailed data. Therefore, the forecast values in Table 7-1 have only secondary significance compared with the future port tonnage traffic under the forecast by commodity as described hereinafter.

7-2-3. Forecast by Commodity

Forecast by commodity is the most important subject in this clause. The port tonnage traffic by type of ships and the port tonnage traffic through public wharves in the following sections are derived by the forecast by commodity. The macroscopic forecast mentioned in the preceding section has a meaning as a guideline or a check in making forecast by commodity.

There are three factors to be considered for forecast by commodity.

1) Supply and demand of cargo by Sub-Area:

For each sub-area of the service area of the Port of Bitung, to forecast the volume of cargo either produced or consumed by commodity.

2) Dependent rate on the Port of Bitung by Sub-Area:

Concerning cargo movement, to forecast the degree of dependency of each area on the Port of Bitung by main commodity.
The definition of the dependent rate on the Port of Bitung was given in 5-3 Service Area on the Sea.

3) The classification of the traffic through the Port of Bitung by foreign trade or domestic trade:

To estimate whether loading of produced goods at the Port of Bitung

is made to oceangoing vessels or interinsular vessels; to estimate whether the discharging of consumer goods at the Port of Bitung is made from oceangoing vessels or interinsular vessels. These estimates are made on each commodity taking into consideration the past trend and the industrial policy of Indonesia.

The forecast of port tonnage traffic through the Port of Bitung is obtained in principle by combining the above three factors for export and import and for domestic trade. The degree of the depentent rate on the Port of Bitung to be used for the forecast in this section is shown in Table 7-2.

Table 7-2 Forecast of Dependent Rate of Bitung, 1985 and 2000

Origin or Destination	Discharged Cargo	Loaded Cargo			
		Rice	Cement	Mineral Oils	Others
Sub-Area 1	0.4	0.6	0.2	0.4	0.3
Sub-Area 2	1.0	1.0	1.0	1.0	1.0
Sub-Area 3	0.5	0.5	0.5	0.5	0.5
Sub-Area 4	-	0.1	0.1	0.2	0.1
Sub-Area 5	0.2	0.8	0.1	0.4	0.2
Sub-Area 6	0.2	0.8	0.1	0.3	0.2

Most of these values are calculated with the 1974 data (see 5-3) rounded off to the nearest whole number. However, as regards Sub-Area 3, hinterland of the Port of Gorontalo, the value is given as 0.5 because future development of roads is considered to generally enhance the degree of dependency. The dependent rate on the Port of Bitung of cargo other than rice, cement, and mineral oils will approximate the mean value of cement and mineral oils. These two cargoes show contradictory movement and the mean value is considered to well represent general cargo loaded at the Port of Bitung. Rice shares a big quantity and has a higher dependent rate than other goods. For the purpose of calculating the dependent rate of other cargo, it is considered best not to include rice. The dependent rate of loaded cargo at the Port of Bitung is similar to that of discharged cargo. Based on the data of loaded cargo in 1974, 0.4 is given for Sub-Area 1.

Table 7-3 shows a modification rate for the dependent rate on the Port of Bitung to be used to forecast the volume of cargo movement between the Port of Bitung and areas other than its service area.

Using this modification rate, the port tonnage traffic through the Port of Bitung is calculated as follows:

Table 7-3 : Modification Rate for the Forecast of Traffic to and from the Areas Other than Sub-Area 1 to 6.

	Discharged Traffic	Loaded Traffic			
		Rice	Cement	Minerals	Others
Modification Rate	0.1	0.01	0.04	0.4	0.1

Note :

$$\text{Modification Rate} = \frac{\text{Tonnage to/from the Area other than Sub-Areas 1 to 6}}{\text{Tonnage to/from Sub-Areas 1 to 6}}$$

(Cargo related to Sub-Area 1 - 6) x
{1 + (modification rate for the dependent rate on the Port of Bitung) }

The above method is principally used to forecast port tonnage traffic by commodity but for certain commodities it is not always used. For instance, this method is not used for commodities, where there is lack of necessary data or where accuracy of forecast does not increase by such a complicated method because of greater influence of other variables.

Data on the future population, GRP and farm land for each Sub-Area often used in the process of forecast are taken from the forecasts in 6-3, 6-4 and 6-5.

The process of forecast by commodity is mainly given as follows :

The result is summarized toward the end of this section.

(1) Rice

1985

As regards North Sulawesi, the forecast starts with the first estimating supply and demand situation of rice by Sub-Area and calculating the surplus or deficit of rice.

For the whole of North Sulawesi, per capita consumption of rice in 1975 was 194 kg and the maximum 220 kg per capita for Sub-Area 2. In 1985, per capita consumption of rice for the whole of North Sulawesi is estimated at 220 kg and the demand for rice is estimated by multiplying the population for each Sub-Area.

The paddy farm land area in 1985, basis for rice production for each Sub-Area of North Sulawesi, is obtained by extending the past trend as

Table 7-4 Forecast of Rice Field by Sub-Area

Unit : 1,000 tons

Area	1975	1985	2000
Sub-Area 1	-	-	-
	4	7	10
Sub-Area 2	51	91	154
	23	37	58
Sub-Area 3	22	39	66
	7	11	17
Sub-Area 4	40	42	48
Sub-Area 5	39	42	48
Sub-Area 6	6	11	20

Remarks : Upper figures ; wet land paddy
Lower figures ; dry land paddy

in Table 7-4. The rice supply for each Sub-Area is obtained by multiplying this farm land area by the yield rate of rice production (wet land paddy; 3.5 tons/ha : dry land paddy; 1.2 tons/ha). Surplus or deficit of rice is obtained by deducting the supply from demand as in Table 7-5.

Table 7-5 Demand and Supply of Rice in North Sulawesi

Unit : 1,000 tons

Area	1985			2000		
	Demand (A)	Surplus (B)	Surplus (-) or Deficit (+) (A) − (B)	Demand	Supply	Surplus (-) or Deficit (+)
Sub-Area 1	64	8	56	92	62	80
Sub-Area 2	347	363	-16	644	609	35
Sub-Area 3	154	150	4	250	251	-1

The deficit in each Sub-Area of North Sulawesi must be supplied from other areas.

Therefore, for Sub-Areas 1 and 3 where such deficits exist, these deficits are multiplied by the dependent rate on the Port of Bitung (0.6 and 0.5) and then included in loaded cargo at the Port of Bitung (34,000 tons and 2,000 tons). The whole of the loaded cargo must be discharged at the Port of Bitung.

For Sub-Area 2 (hinterland of the Port of Bitung) where surplus exists, such surplus may be deducted from discharged cargo and discharging is described at 16,000 tons (Table 7-6).

Table 7-6 Rice through Port of Bitung, 1985 and 2000

Unit : 1,000 tons

Origin or Destination	1985		2000	
	Discharged	Loaded	Discharged	Loaded
Sub-Area 1	34	34	48	48
Sub-Area 2	-16	-	35	-
Sub-Area 3	2	2	-	-
Sub-Area 4	8	8	12	12
Sub-Area 5				
Sub-Area 6	11	11	18	18
Other Areas	1	1	1	1
Total	40	54	114	79

Remark : Minus sign means surplus of the product.

As for rice loaded at the Port of Bitung for Sub-Areas 4, 5 and 6, not belonging to North Sulawesi, which has a small volume, a simpler method will be used.

Forecast for each Sub-Area is made as follows.

(Tonnage of loaded rice at the Port of Bitung in 1976) x (Population growth) $\times \frac{\text{(per capita consumption in 1985)}}{\text{(per capita consumption in 1976)}}$

e.g. loaded rice at the Port of Bitung for Sub-Area 6 in 1985

$$7.7 \times 1.3 \times \frac{220}{194} \fallingdotseq 11 \text{ thousand tons}$$

As this volume must be supplied from the outside, the discharged

tonnage for Sub-Area 6 in 1985 is 11 thousand tons, the same as the loaded tonnage (Table 7-6).

By adding the forecast amount of each Sub-Area; for Sub-Areas 1 - 6 the discharged and loaded cargo in 1985 are 39 thousand tons and 53 thousand tons respectively.

The movement of rice between the Port of Bitung and areas other than Sub-Areas 1-6 (outside the service area of the Port of Bitung) must be considered. This forecast is made by using the modification rate (0.01 for rice) shown in Table 7-3.

According to the above, the discharged and loaded cargo for rice is 40 thousand and 54 thousand tons respectively.

2000

The method of forecasting discharged and loaded rice cargo at the Port of Bitung in 2000 is same as used for 1985, except values used in each stage of the forecast are different; e.g. per capita consumption of rice is 0.250 tons, and the farm land area is considered to increase further as shown in Table 7-4. Taking the above into consideration, the discharged and loaded rice cargo at the Port of Bitung in 2000 is forecast at 114 thousand and 79 thousand tons respectively. (Table 7-6).

(2) Wheat and wheat flour

1985

Forecast of discharged cargo at the Port of Bitung to fulfill the demand for wheat and wheat flour in Sub-Area N is made as follows.
(discharged cargo at the Port of Bitung for Sub-Area N in 1976) x (population growth 1985/1976) x (per capita consumption growth 1985/1976) x (dependent rate on the Port of Bitung)
e.g. discharged wheat and wheat flour at the Port of Bitung for Sub-Area 2 is forecast as follows.
$13.2 \times 1.3 \times 1.1 \times 1.0 \fallingdotseq 19$ thousand tons.

Per capita consumption growth used here is the same as that used for rice. The forecast of discharged wheat and wheat flour at the Port of Bitung for each Sub-Area is as shown in Table 7-7.

Discharged wheat and wheat flour at the Port of Bitung for other Areas are calculated by using the modification rate as shown in Table 7-3 as follows.

$(1 + 19 + 4 + 2 + 1) \times 0.1 = 27 \times 0.1 \fallingdotseq 3$ thousand tons.

Table 7-7 Wheat and Wheat Flour through Port of Bitung, 1985 and 2000

Unit : 1,000 tons

Origin or Destination	1985		2000	
	Discharged	Loaded	Discharged	Loaded
Sub-Area 1	1	1	1	1
Sub-Area 2	19		38	
Sub-Area 3	4		8	
Sub-Area 4	2	2	3	3
Sub-Area 5				
Sub-Area 6	1	1	2	2
Other Areas	3	3	5	5
Total	30	7	57	11

Thus discharged wheat and wheat flour at the Port of Bitung is
27 + 3 = 30 thousand tons.

Loaded cargo at the Port of Bitung is the same as the discharged cargo at the Port of Bitung for Sub-Areas 1, 4, 5, and 6 and other areas, because discharged wheat and wheat flour at the Port of Bitung is transported by land to consumer areas and therefore is not included in loaded cargo at the Port of Bitung.

Consequently, loaded cargo at the Port of Bitung is forecast
1 + 2 + 1 + 3 = 7 thousand tons (Table 7-7)

2000

The same method used for 1985 applies to the forecast of wheat and wheat flour in 2000, except different values are used in the forecast process.

(3) Sugar

The volume of sugar consumed in Sub-Area 2 (hinterland of the Port of Bitung) is considered to be equal to the difference of discharged cargo and loaded cargo at the Port of Bitung.

Sugar consumption in Sub-Area 2 in 1976 is
16.3 - 0.8 = 15.5 thousand tons.

Wheat and wheat flour consumption is
13.7 - 0.5 = 13.2 thousand tons.

The ratio of both commodities is
15.5 ÷ 13.2 = 1.17

Therefore, sugar consumed in Sub-Area 2 in 1976 was 1.17 times as much as wheat and wheat flour.

If forecast of port tonnage traffic of sugar is made by the same method used for wheat and wheat flour, the results are obtained by simply multiplying values of wheat and wheat flour in 1985 and 2000 with 1.17.
(discharged sugar cargo in 1985) = 30 x 1.17 = 35 thousand tons
(loaded sugar cargo in 1985) = 7 x 1.17 = 8 thousand tons
Likewise, discharged and loaded sugar cargo in 2000 is forecast at 67 thousand and 13 thousand tons respectively.

(4) Salt

Forecast of the port tonnage traffic of salt is made in the same way as sugar.

Salt consumption in Sub-Area 2 in 1976 is
4.5 - 0.1 = 4.4 thousand tons

A ratio of salt consumption versus wheat and wheat flour consumption is
1.4 ÷ 13.2 ≒ 0.1

By multiplying the forecast amount of wheat and wheat flour with 0.1, discharged and loaded salt cargo is forecast at 3 thousand and 1 thousand tons respectively in 1985 and at 6 thousand and 1 thousand tons respectively in 2000.

(5) Copra, coconut oil cake, coconut oil and other coconut products

Coconut is widely cultivated in the service area of the Port of Bitung and are important produce of this area.

1) General

The meat of the coconut in many cases are being processed into copra near farms, the first stage of the movement of coconut is in the form of copra. From coconut shells, fiber called coir and good quality charcoal are made.

From copra, coconut oil and coconut oil cake are manufactured at oil mills. Processing of copra produced in each Sub-Area of

the service area of the Port of Bitung into coconut oil cake and coconut oil in most part is considered to be undertaken near commodity distribution centers around the Port of Bitung.

Coconut oil, a product of coconuts, is also consumed in the service area.

Therefore, to forecast the coconut products cargo passing through the Port of Bitung, a quantitative study must be made for each stage of processing, movement and consumption of coconuts.

2) Farmland area

Coconuts are an important produce of North Sulawesi but for the past few years farmlands have shown little increase. As a matter of fact, coconut farms are cultivated even on steep hills and it is considered there is little room for future development. For Central Sulawesi and North Maluku, a little growth has been seen but the rate of growth is considered small.

The future farmland area in North Sulawesi (Sub-Area 1, 2 and 3) remains the same as the present, and in Central Sulawesi and North Maluku, the farmland area will grow until 1985 following the current trend and thereafter, will remain constant. The result of forecast of the farmland area by Sub-Area is as shown in Table 7-8.

Table 7-8 Forecast of Coconut Field by Sub-Area

Unit : 1,000 ha.

Area	1975	1985	2000
Sub-Area 1	39	39	39
Sub-Area 2	157	157	157
Sub-Area 3	32	32	32
Sub-Area 4	40	51	51
Sub-Area 5	40	51	51
Sub-Area 6	37	47	47

Remarks : Data on 1975 include estimates.

3) Indices related to coconut products

Table 7-9 shows indices related to coconut products. In this table, indices related to copra are expressed in yield rate or ton/ha. For native coconuts, the present yield rate is used. In addition, the yield rate of improved coconuts is also shown. With regard to improved coconuts, the following information was obtained by the Department of Agriculture in August 1977.

"In Indonesia, they are now studying a project to raise the yield rate of coconuts from 0.7 ton/ha to 4 ton/ha. The experiments are being carried out in Medan and Surabaya financed by the World Bank. Actual cultivation will commence in 1982 and the effect on the harvest will be seen 15 years later. In the long run, they expect 30% of the coconut farmland will be replaced by improved species."

This improved species will not affect the forecast of cargo at the Port of Bitung in 1985. However, in 2000, a great change will be brought about in copra production. If 30% of the service area of the Port of Bitung is replaced by improved species in 2000, the average indices related to copra in the total farmland area will be calculated as follows.

0.7 ton/ha x 70% + 0.3 ton/ha x 30% = 1.7 ton/ha

Yield rates of coconut oil cake, coconut oil and other coconut products are expressed in ratio with copra based on past data.

Table 7-9 summarizes the yield rate of coconut products.

Table 7-9 Forecast of Indices Related to Coconut Products

Kidn of Indices	Indices
Copra/field (conventional coconut)	0.7 ton/ha
Copra/field (improved coconut)	4.0 ton/ha
Coconut Oil Cake/Copra	0.35 ton/ton
Coconut Oil/Copra	0.65 ton/ton
Other coconut products/copra	0.22 ton/ton

4) Supply and demand of copra

By using the above farmland area and yield rate, production of

copra by Sub-Area is calculated.

The coconut products consumed in this area are roughly limited to coconut oil. Assuming coconut oil consumption somewhat increases in the future, per capita consumption of coconuts in 1985 and 2000 will be 7 kg and 10 kg, respectively. If these values are converted to copra by using the unit rate of Table 7-9, the copra consumption rate in 1985 and 2000 is 0.01 ton/capita and 0.015 ton/capita respectively. By multiplying the copra consumption rate with the population of each Sub-Area, the consumption in each Sub-Area is obtained.

The difference of production and consumption represents the supply and demand situation. Table 7-10 shows the supply and demand situation of coconut products in terms of copra.

Table 7-10 Forecast of Demand and Supply of Copra

Unit: 1,000 tons

Origin	1985			2000		
	Demand (A)	Supply (B)	Surplus (+) Deficit (-) (B) - (A)	Demand (A)	Supply (B)	Surplus (+) or Deficit (-) (A) - (B)
Sub-Area 1	3	29	26	6	70	64
Sub-Area 2	17	104	87	40	250	210
Sub-Area 3	8	20	12	15	48	33
Sub-Area 4	8	64	56	16	153	137
Sub-Area 5	7	63	56	16	152	136
Sub-Area 6	5	93	88	12	223	211

5) Port tonnage traffic through the Port of Bitung

1985

The results of the forecast by Sub-Area are as shown in Table 7-12. The process of forecasting is given below.

a) Copra

The forecast of discharged cargo of copra at the Port of Bitung uses the following formula for Sub-Area 1, 4, 5 and 6.
(discharged cargo of copra at the Port of Bitung)
= (surplus copra) x { 1 - (local processing rate) } x
(dependent rate on the Port of Bitung)
The preceding tables show surplus copra and the dependent rate

on the Port of Bitung. The local processing rate of copra is forecast as shown in Table 7-11.

Table 7-11 Local Processing Rate of Copra

Area	1985	2000
Sub-Area 1	0.5	1.0
Sub-Area 2	-	
Sub-Area 3	-	
Sub-Area 4	-	
Sub-Area 5	0.2	0.5
Sub-Area 6	0.2	0.5

e.g.
Discharged copra at the Port of Bitung for Sub-Area 1 is
$26 \times (1 - 0.5) \times 0.4 \fallingdotseq 5$ thousand tons

There is no discharged copra at the Port of Bitung from Sub-Area 2 since Sub-Area 2 is the hinter land of the Port of Bitung. Surplus copra of Sub-Area 3 processed around the Port of Bitung is brought to the processing plant by land and therefore is not included in the discharged cargo at the Port of Bitung.

Assuming no copra is brought outside the service area of the Port of Bitung without processing, the loaded cargo at the Port of Bitung is zero.

b) Coconut oil cake

Forecast of discharged cargo of coconut oil cake at the Port of Bitung for Sub-Area 4, 5 and 6 is made by the following formula.
(discharged coconut oil cake at the Port of Bitung)
= (surplus copra) x (local processing rate) x (cake/copra index) x (dependent rate on Port of Bitung)
e.g. Discharged coconut oil cake at the Port of Bitung for Sub-Area 1 is $26 \times 0.5 \times 0.35 \times 0.4 \fallingdotseq 2$ thousand tons

For Sub-Area 2 and 3, since it is transported by land, it is not included in discharged cargo.

For loaded cargo of coconut oil cake at the Port of Bitung, those to be processed around the Port of Bitung and those to be trans-

shipped at the Port of Bitung must be considered. For Sub-Area 2 and 3, loaded coconut oil cake at the Port of Bitung is calculated by multiplying surplus copra with the index. For Sub-Area 1, 4, 5 and 6, there is coconut oil cake to be loaded at the Port of Bitung after having processed discharged copra at the Port of Bitung which is calculated as follows:
(discharged copra at the Port of Bitung) x (cake/copra index)
= 28 x 0.35 = 10 thousand tons.
For Sub-Area 1, 4, 5 and 6, there is transshipped coconut oil cake which is equal to the discharged coconut oil cake at the Port of Bitung.
By adding all these together, the forecast of loaded coconut oil cake at the Port of Bitung is made.

c) Coconut oil

Coconut oil is shipped by vessels equipped with special tanks from each port. There is no advantage in collecting coconut oil produced in other than Sub-Area 2 and 3 in tanks at the Port of Bitung. It is easier to assume, in case of the Port of Bitung, that special vessels call at each port to collect cargo. Therefore, discharged coconut oil at the Port of Bitung is assumed to be nil.

The method of calculating loaded coconut oil at the Port of Bitung is as follows:

For Sub-Area 1, 4, 5 and 6
(discharged copra at the Port of Bitung) x (coconut oil/copra index)
For Sub-Area 2 and 3,
(surplus copra) x (coconut oil/copra index)

d) Other coconut products

Discharged other coconut products at the Port of Bitung is for Sub-Area 1, 4, 5 and 6
(surplus copra) x (other coconut products/copra index) x (dependent rate on the Port of Bitung) x (utilization rate of coconut shells)

It is assumed that the utilization rate of coconut shells will be 0.2 in 1985 and 0.5 in 2000. Although fiber (coir), charcoal and active carbon made from coconut shells are useful materials, it is considered it will take some time before they find a market.

2000
The same method used for 1985 is applied to 2000.

Table 7-12 Forecast of Coconut Products through Port of Bitung

Unit: 1,000 tons

Origin	1985						2000					
	Discharged			Loaded			Discharged			Loaded		
	Copra	Coconut Oil Cake	Other Coconut Products	Coconut Oil Cake	Coconut Oil	Other Coconut Products	Copra	Coconut Oil Cake	Other Coconut Products	Coconut Oil Cake	Coconut Oil	Other Coconut Products
Sub-Area 1	5	2	1					9	4			
Sub-Area 2				30	57	5				74	137	32
Sub-Area 3				2	4	1				6	11	3
Sub-Area 4												
Sub-Area 5	9	2	1				14	10	4			
Sub-Area 6	14	1	1				21	7	6			
Processing*				10	18					12	23	
Transhrjsment**				5		3				26		14
Total	28	5	3	47	79	9	35	26	14	122	171	49

Remarks 1) * Coconut products to be processed near Port of Bitung

2) ** Transhipment

(6) Clove

The cargo amount of clove at the Port of Bitung in 1976 was only 2.3 thousand tons, and all of this was for loading.

Future port tonnage traffic is forecast as follows,

(loaded clove at the Port of Bitung in 1976) x (growth of farmland area in North Sulawesi)

e.g. Loaded clove at the Port of Bitung in 1985 is

$2.3 \times 40/24 = 4$ thousand tons

(7) Nutmeg

Port tonnage traffic of nutmeg at the Port of Bitung in 1976 was 0.2 thousand tons discharged and 2.4 thousand tons loaded.

Future loaded nutmeg is forecast as follows.

(loaded nutmeg at the Port of Bitung in 1976) x (growth of farmland area in North Sulawesi)

Future discharged nutmeg is forecast as follows.

$$\text{(future loaded nutmeg)} \times \frac{\text{(discharged nutmeg in 1976)}}{\text{(loaded nutmeg in 1976)}}$$

e.g. Loaded nutmeg in 1985 is

$2.4 \times 30/18 = 4$

Discharged nutmeg in 1985 is

$4 \times 0.2/2.4 = 0.3 \fallingdotseq 0$

(8) Cassave products

Cassava is not only used as food for the inhabitants but also becomes important export items after having been processed into starch and feed. It has a high land yield and is considered good trading produce. In the future, out of the cassava produced on the farmlands in North Sulawesi, increased production due to increase of farmlands is assumed to be exported after processing.

Future loaded cargo of cassava products at the Port of Bitung is forecast as follows:

(increased farmland area) x (yield rate)

Since the yield rate to be used here is that of processed products such as starch and feed, 60% of the yield rate of cassava is used.

e.g. Loaded cassave products at the Port of Bitung is

(22 - 13) x 8.3 x 0.6 = 43 thousand tons

(9) Cement

1985

Cement used in Sub-Area 2 in 1976 is calculated as follows.

(discharged cement at the Port of Bitung) − (loaded cement at the Port of Bitung)

= 72.3 - 10.6 = 61.7 ≒ 62 thousand tons

Cement to be used in Sub-Area 2 in 1985 is forecast as follows:

(Cement used in 1976) x (growth of GRP)

= 61.7 x 2.3 = 142 thousand tons

Cement to be used in Sub-Area 1, 3, 4, 5 and 6 is forecast as follows:

$$\text{(cement to be used in Sub-Area 2 in 1985)} \times \frac{\text{(GRP of Sub-Area N)}}{\text{(GRP of Sub-Area 2)}}$$

N = 1, 3, 4, 5 and 6.

e.g. Cement used in Sub-Area 1 is

142 x 40/210 ≒ 27 thousand tons

Discharged cement cargo at the Port of Bitung is obtained by multiplying the dependent rate on the Port of Bitung.

27 x 0.3 ≒ 8 thousand tons

Totalling the discharged cement cargo at the Port of Bitung for Sub-Area 1 through 6, it will be 195 thousand tons.

Discharged cement cargo at the Port of Bitung must be adjusted with cement destined to other than Sub-Areas.

195 x (1 + 0.1) = 213 thousand tons

Loaded cement cargo at the Port of Bitung is equal to the discharged cement cargo except for Sub-Area 2 and 3 where goods are supplied from the Port of Bitung by land transportation.

i.e. 213 - (142 + 31) = 42 thousand tons

2000

The forecast of cement consumption is made by the same method used for 1985. Taking into consideration construction of a cement plant at Labuan Uki, the dependent rate on the Port of Bitung as far as cement is concerned is reduced to 50% in 2000.

The result of forecast of discharged and loaded cement at the Port of Bitung by Sub-Area is as shown in Table 7-13.

Table 7-13 Forecast of Cement through Port of Bitung

Unit : 1,000 tons

Destination	1985		2000	
	Discharged	Loaded	Discharged	Loaded
Sub-Area 1	8	8	10	10
Sub-Area 2	142		225	
Sub-Area 3	29		43	
Sub-Area 4	3	3	8	8
Sub-Area 5	5	5	11	11
Sub-Area 6	6	6	11	11
Other Areas	20	20	31	31
Total	213	42	339	71

(10) Asphalt

The use of asphalt in Sub-Area 2 in 1976 was

7.3 - 1.0 = 6.3 thousand tons

Discharged and loaded asphalt is forecast by the same method used for cement for 1985.

(11) Iron and Steel

Forecast is made by the same method used for cement for 1985.

(12) Timber

Forecast is made by the same method used for cement for 1985.

(13) Other construction materials

Forecast is made with the same method used for cement in 1985.

(14) Fertilizer

1985

In 1976 discharged fertilizer was only 0.3 thousand tons and the use of fertilizer in the service area of the Port of Bitung is not very common.

In 1985, it is estimated that fertilizer will be used over one half of the farmland of rice including dry fields. The amount of fertilizer used per unit area is set at 0.25 ton/ha, the same as the planned amount in BIMAS in Pelita II.

Loaded fertilizer cargo at the Port of Bitung is obtained by multiplying the used amount with the dependent rate on the Port of Bitung for each Sub-Area.

Loaded fertilizer cargo at the Port of Bitung is obtained by subtracting the used amount in Sub-Area 2 and 3 from the discharged fertilizer cargo.

2000

In the year 2000, it is predicted that the use of fertilizer will become more common. The service area of the Port of Bitung lacks flat land and it is difficult to enlarge the farmland area. In order to maintain and increase the harvest, it is important to apply fertilizer as well as to introduce new species. The rate of spread of fertilizer and the amount of fertilizer used per unit area are estimated as per Table 7-14.

The forecast of loaded and discharged fertilizer cargo at the Port of Bitung is made by the using the same method as for 1985.

The result of the forecast for each Sub-Area is as shown in Table 7-15.

Table 7-14 Assumption of Fertilizer Application, 2000

Kind of Farm Land	Application Amount	Fertilization Rate
	ton/ha	
Food Crops		
Paddy	0.25	0.5
Food Crops other than Paddy	0.1	0.5
Estate Crops		
Coconut (Conventional)	0.1	1.0
Coconut (Improved)	0.25	1.0
Estate Crops other than Coconut	0.1	1.0

Table 7-15 Forecast of Fertilizer through Port of Bitung

Unit : 1,000 tons

Destination	1985		2000	
	Discharged	Loaded	Discharged	Loaded
Sub-Area 1	-	-	3	3
Sub-Area 2	16		69	
Sub-Area 3	3		10	
Sub-Area 4	1	1	2	2
Sub-Area 5	1	1	4	4
Sub-Area 6			3	3
Other Areas	2	2	9	9
Total	23	4	100	21

(15) Steel and machines

It is difficult to select such producer goods as steel and machines from statistics. However, it is necessary to predict such cargo for ship repairing and building plants most likely to be located near new ports in the future.

1985

Assuming the operation of a yard capable of building 2,000 G/T class ships, the required materials are

1000 ton/ship x 6 ships/year = 6 thousand tons

2000

Assuming the operation of a yard capable of building 5,000 G/T class ships, the required materials are

2000 ton/ship x 4 ships/year x 2 = 16 thousand tons

(16) Vehicles

Vehicles brought into Sub-Area 2 in 1976 was

11.7 - 0.6 = 11.1 thousand tons

Forecasts are made for each Sub-Area for 1985 and 2000, the same as cement for 1985. Some modifications are made for 1985 and 2000, as vehicles brought into Sub-Area 3 are included in the above amount.

The result of the forecasts for each Sub-Area is as shown in Table 7-16.

Table 7-16 Forecast of Vehicles through Port of Bitung

Unit : 1,000 tons

Destination	1985		2000	
	Discharged	Loaded	Discharged	Loaded
Sub-Area 1	1	1	4	4
Sub-Area 2	18		78	
Sub-Area 3	5		16	
Sub-Area 4	1	1	2	2
Sub-Area 5	1	1	5	5
Sub-Area 6	1	1	4	4
Other Areas	3	3	11	11
Total	30	7	120	26

(17) Miscellaneous

Miscellaneous goods brought into Sub-Area 2 from the Port of Bitung

in 1976 were

74.4 - 13.1 = 61.3 thousand tons

Similar forecasts are made as in the case of cement for 1985. In the case of cement, future cargo was forecast for each Sub-Area by using the GRP. In the case of miscellaneous goods, forecasts are made by using the population and the GRP, both of which are averaged to obtain miscellaneous cargo passing through the Port of Bitung.

As miscellaneous goods include both consumer goods and producer goods, their growth is considered between the growth of the population and that of the GRP. The results of the forecasts of miscellaneous goods passing through the Port of Bitung are as shown in Table 7-17. e.g. Discharged miscellaneous cargo at the Port of Bitung for 1985 is forecast by using the values in the table as follows:

$$\frac{(\text{forecast amount by population}) + (\text{forecast amount by GRP})}{2}$$

$$= \frac{129 + 215}{2} = 172 \text{ thousand tons}$$

Table 7-17 Forecast of Miscellaneous through Port of Bitung

Unit: 1,000 tons

Destination	Forecast by Population				Forecast by GRP			
	1985		2000		1985		2000	
	Dis.	Load.	Dis.	Load.	Dis.	Load.	Dis.	Load.
Sub-Area 1	5	5	6	6	8	8	19	19
Sub-Area 2	80		135		141		454	
Sub-Area 3	17		26		31		86	
Sub-Area 4	3	3	5	5	3	3	14	14
Sub-Area 5	7	7	11	11	6	6	28	28
Sub-Area 6	5	5	8	8	6	6	20	20
Other Areas	12	12	19	19	20	20	62	62
Total	129	32	210	49	215	43	683	143

(18) Petroleum

Future petroleum cargo largely varies depending on the management policy of Pertamina. Therefore, in this report, a simple method of forecast is used.

The growth of discharged petroleum at the Port of Bitung is set at 10%, the same as the growth rate of petroleum estimated in Pelita II. Loaded petroleum at the Port of Bitung is forecast as follow.

(future discharged petroleum at the Port of Bitung) x
(ratio of loaded and discharged petroleum at the Port of Bitung)

e.g. Discharged petroleum at the Port of Bitung in 1985 is
$150.2 \times (1 + 0.10)^9 = 150.2 \times 2.4 \fallingdotseq 360$ thousand tons

Loaded petroleum at the Port of Bitung in 1985 is

$$360 \times \frac{66}{150.2} = 360 \times 0.44 \fallingdotseq 160 \text{ thousand tons}$$

The foregoing results are summarized and shown in Tables 7-19 and 7-20 by separating foreign trade and domestic trade. The trend of port tonnage traffic at the Port of Bitung including that for 1976 is as shown in Table 7-18 and the industry location policy of Indonesia to replace imports is as shown in Pelita II.etc, are considered in the above separation.

For 1985, port tonnage traffic through the Port of Bitung will be set at import-226 thousand tons, export-95 thousand tons, discharging for domestic trade-780 thousand tons and loading for domestic trade-425 thousand tons, a total of 1,526 thousand tons. For the year 2000, it will be set at import-496 thousand tons, export – 267 thousand tons, discharging for domestic trade – 2,492 thousand tons and loading for domestic trade – 1,212 thousand tons, a total of 4,467 thousand tons.

Under the macroscopic forecast (7-2-2) of the Port of Bitung, the amount is 1,400 to 1,500 thousand tons for 1985 and 4,300 to 4,500 thousand tons for the year 2000. The total of the forecast amount by commodity is not too far off from the amount of macroscopic forecasts. Therefore, in this report the above forecast traffic by commodity is used as targets for planned port tonnage traffic.

Table 7-18 Port Tonnage Traffic through Port of Bitung, 1976

Unit: 1,000 tons

Commodity	Domestic Trade		Foreign Trade		Grand Total		
	Dis.	Load.	Dis.	Load.	Dis.	Load.	Total
Foodstuffs	56.2	—	43.2	22.9	99.4	22.9	122.3
Rice	53.7		11.2	21.5	64.9	21.5	86.4
Wheat & Wheat Flour			13.7	0.5	13.7	0.5	14.2
Sugar	2.5		13.8	0.8	16.3	0.8	17.1
Salt			4.5	0.1	4.5	0.1	4.6
Agricultural Products	—	71.5	43.1	72.0	43.1	143.5	186.6
Copra		2.1	30.3	4.7	30.3	6.8	37.1
Coconut Oil Cake		67.6	12.1		12.1	67.6	79.7
Coconut Oil				63.7		63.7	63.7
Other Coconut Products				0.3		0.3	0.3
Clove				2.3		2.3	2.3
Nutmeg		1.4	0.2	1.0	0.2	2.4	2.6
Fish		0.4	0.5		0.5	0.4	0.9
Cassava Products							
Construction Materials	76.2	8.0	15.2	6.1	91.4	14.1	105.5
Cement	65.7	8.0	6.6	2.6	72.3	10.6	82.9
Asphalt	3.7		3.6	1.0	7.3	1.0	8.3
Iron & Steel	1.9		1.9		3.8		3.8
Timber			0.4		0.4		0.4
Other Construction Materials	4.9		2.7	2.5	7.6	2.5	10.1
Production Materials	—	—	0.1	0.3	0.1	0.3	0.4
Fertilizer			0.1	0.3	0.1	0.3	0.4
Steel & Machineries							
Vehicles	3.0		8.7	0.6	11.7	0.6	12.3
Miscellaneous	4.1	0.8	70.3	12.3	74.4	13.1	87.5
Total	139.5	80.3	180.6	114.2	320.1	194.5	514.6
Petroleum	0.6		149.6	66.5	150.2	66.5	216.7
Grand Total	140.1	80.3	330.2	180.7	470.3	261.0	731.3

Table 7-19 Forecast of Port Tonnage Traffic through Port of Bitung, 1985

Unit: 1,000 tons

Commodity	Foreign Trade		Domestic Trade		Grand Total		
	Dis.	Load.	Dis.	Load.	Dis.	Load.	Total
Foodstuffs	55	-	53	70	108	70	178
Rice	35		5	54	40	54	94
Wheat & Wheat Flour			30	7	30	7	37
Sugar	20		15	8	35	8	43
Salt			3	1	3	1	4
Agricultural Products	-	95	37	92	37	187	224
Copra			28		28	-	28
Coconut Oil Cake		47	5	-	5	47	52
Coconut Oil				79		79	79
Other Coconut Products		5	3	4	3	9	12
Clove				4	-	4	4
Nutmeg				4	-	4	4
Fish			1	1	1	1	2
Cassava Products		43				43	43
Construction Materials	50	-	220	54	270	54	324
Cement	21		192	42	213	42	255
Asphalt	14		19	5	23	5	28
Iron & Steel	10		3	2	13	2	15
Timber			1	-	1	-	1
Other Construction Materials	15		5	5	20	5	25
Production Materials	6	-	23	4	29	4	33
Fertilizer			23	4	23	4	27
Steel & Machineries	6				6		6
Vehicles	15	-	15	7	30	7	37
Miscellaneous	100	-	72	38	172	38	210
Total	226	195	420	265	646	360	1,006
Petroleum			360	160	360	160	520
Grand Total	226	95	780	425	1,006	520	1,526

Table 7-20 Forecast of Port Tonnage Traffic through Port of Bitung, 2000

Unit: 1,000 tons

Commodity	Foreign Trade		Domestic Trade		Grand Total		
	Dis.	Load.	Dis.	Load.	Dis.	Load.	Total
Foodstuffs	120	-	124	104	244	104	348
Rice	80		34	79	114	79	193
Wheat & Wheat Flour			57	11	57	11	68
Sugar	40		27	13	67	13	80
Salt			6	1	6	1	7
Agricultural Products	-	267	78	209	78	476	554
Copra			35	-	35	-	35
Coconut Oil Cake		122	26	-	26	122	148
Coconut Oil				171		171	171
Other Coconut Products		25	14	24	14	49	63
Clove				6		6	6
Nutmeg			1	6	1	6	7
Fish			2	2	2	2	4
Cassava Products		120		-		120	120
Construction Materials	80	-	433	106	513	106	619
Cement	-		339	71	339	71	410
Asphalt	-		70	13	70	13	83
Iron & Steel	35		8	9	43	9	52
Timber			4	1	4	1	5
Other Construction Materials	45		12	12	57	12	69
Production Materials	16	-	100	21	116	21	137
Fertilizer			100	21	100	21	121
Steel & Machineries	16				16		16
Vehicles	30		90	26	120	26	146
Miscellaneous	250		197	96	447	96	543
Total	496	267	1,022	562	1,518	829	2,347
Petroleum			1,470	650	1,470	650	2,120
Grand Total	496	267	2,492	1,212	2,988	1,479	4,467

7-2-4. Forecast of Port Tonnage Traffic by Type of Ships

Forecast of port tonnage traffic by type of ships is made from the forecast of traffic by commodity.

The amount obtained will be used to forecast calling vessels under 7-3.

Port tonnage traffic by ocean going vessel is that of foreign trade as previously forecast. Traffic of domestic trade by type of ships is forecast based on the past performances of port tonnage traffic by commodity and by type of ships through the Port of Bitung.

Traffic by special vessels is forecast based on the performance in 1976 of special vessels for mainly coconut oil and petroleum.

The balance of the traffic is allocated to discharging and loading by type of ships based on the past trend.

The result of the forecast is shown in Table 7-21.

Table 7-21 Forecast of Port Tonnage Traffic through Port of Bitung by Type of Ships

Unit: 1,000 tons

Type of Ships	1976			1985			2000		
	Dis.	Load.	Total	Dis.	Load.	Total	Dis.	Total	Total
Ocean Going Vessels	140.1	80.3	220.4	226	95	321	496	267	763
RLS V.	153.6	73.9	227.5	382	217	599	940	510	1,450
Special V.	153.8	94.5	248.3	360	183	543	1,470	640	2,110
Local V.	12.1	6.7	18.8	25	19	44	62	53	115
Sailing V.	10.7	5.6	16.3	13	6	19	20	9	29
Total	470.3	261.0	731.3	1,006	520	1,526	2,988	1,479	4,467

7-2-5. Port Tonnage Traffic of Public Wharves

Port tonnage traffic through public wharves is used as a basic figure for planning port facilities.

Most of petroleum and coconut oil carried by special vessels are handled through the exclusive facilities of Pertamina and Bimoli. Other goods are handled through public wharves.

The traffic through public wharves by type of ships is forecast in Table 7-22 based on the actual traffic of petroleum and coconut oil by type of ships. According to the table, the traffic through public wharves for 1985 and 2000 is 1,000

thousand tons and 2,400 thousand tons respectively. Most of them are carried by oceangoing vessels and RLS vessels.

Table 7-22 Forecast of Port Tonnage Traffic through Port of Bitung by Type of Ships

Unit : 1,000 tons

Type of Ships	1976			1985			2000		
	Dis.	Load	Total	Dis.	Load.	Total	Dis.	Load.	Total
Ocean Going Vessels	140.1	80.3	220.4	226	95	321	496	267	763
RLS V.	153.6	73.9	227.5	382	217	599	940	510	1,450
Special V.	6.4	8.3	14.7	-	15	15	-	20	20
Local V.	12.1	6.7	18.8	25	19	44	62	53	115
Sailing V.	10.7	5.6	16.3	13	6	19	20	9	29
Total	322.9	174.8	497.7	646	352	998	1,518	859	2,377

7-3 Ship Calls

7-3-1. General

Forecasting of the ship calls will be made by the type of ships, cargo discharged and loaded per ship call, number of calling ships, size of ships and D.W.T.

7-3-2. Type of Ships

The ships calling at the Port of Bitung comprise sailing vessels, local vessels, special vessels, RLS vessels, oceangoing vessels and warships. The last mentioned, warships, involve highly political problems and defeat the consideration of this report and are thus outside the scope of discussion.

These types of ships are playing an important role in the sea communication of Indonesia respectively, and it is scarcely conceivable that any of the types will disappear in the future. Which type becomes more or less important than the others is a problem of quantity and will be discussed in the following pages.

With respect to the types newly included in the ships calling at the Port of Bitung, discussions are made of a number of possibilities. They are, for example, seatrains, roll-on roll-off ships and pusher barges. From a long range view, there is surely a possibility of these new types of vessels calling at the Port of Bitung. But, North Sulawesi is a region located at one end of the Indonesian territory. Thus, these new types of vessels may appear in Indonesia, but the time of

introduction to the port will never be the first in Indonesia. There will be considerable time available for the Port of Bitung to consider appropriate measures. Thus, in the present forecast, new types of vessels are not included.

In the following, forecasting will be made on the traditional trend and thus only include the sailing vessels, local vessels, special vessels, RLS vessels and ocean going vessels.

7-3-3. Cargo Load Handled per Ship Call

During the past several years, the cargo discharged and loaded per ship call presented no remarkable trend of increase or decrease. Therefore, up to 1985, a quantity approximately equal to that in 1976 will be taken as a forecast value for the respective types of vessels.

For the forecast in the year 2000, it is considered that the productivity of sea communication will increase as a matter of course. Thus, for special vessels performing bulk transportation, a value of two times will be taken, while for local, RLS and ocean going vessels, a value of about 1.7 times will be taken respectively. For the sailing vessels, the construction is such that there is obviously an upper limit in the carrying capacity per vessel so that the cargo discharged and loaded per ships call is regarded to be equal to that of 1976.

Table 7-23 shows forecasts of the cargo discharged and loaded per ship call at the Port of Bitung.

Table 7-23 Forecasts of Cargo Load Handled for Ship Call to Port of Bitung by Type of Ships

Unit : Tons/Call

Type of Ships	1976			1985	2000
	Loading	Discharging	Total		
Ocean Going Vessels	1,015	582	1,597	1,600	2,500
Local V.	18	10	28	30	50
Special V.	879	540	1,419	1,400	3,000
RLS V.	153	73	226	230	400
Sailing V.	18	10	28	30	30
Average	184	102	286	290	570

7-3-4. Number of Calling Ships

The number of calling ships is calculated according to the formula :

Number of calling ships =

$$\sum_{v} \frac{\text{port tonnage traffic by type of ships}}{\text{cargo loaded handled per ship by type of ships}}$$

where v represents the type of ships.

For the port tonnage traffic by type of ships, the amount forecast in paragraph 7-2-4 (Table 7-21) was used, and for the cargo load handled per ship call by type of ships, the value forecast in paragraph 7-3-3 (Table 7-23) was used.

As the result of such calculation carried out for the respective types of ships, the number of calling ships for 1985 is forecast at 5,300, and for 2000 at 7,900, or 2.1 times and 3.1 times that of 1976 respectively. Details by type of ships are shown in Table 7-24. From the table, the type presenting the highest growth was the special vessels (4.0 times), followed by RLS vessels (3.6 times), local vessels (3.5 times) and oceangoing vessels (2.2 times). The sailing vessels are of the lowest growth (at 1.7 times).

The vessels berthing at public wharves are considered to include all types except the special vessels and are forecast at 4,900 in 1985 and 7,200 in 2000.

Table 7-24 Forecasts of Calling Vessels to Port of Bitung by Type of Ships

Type of Ships	1976	1985	2000	Increase	
				1985/1976	2000/1926
Ocean Going Vessels	138	200	300	1.5	2.2
Local V.	658	1,500	2,300	2.3	3.5
Special V.	175	400	700	2.3	4.0
RLS V.	1,005	2,600	3,600	2.6	3.6
Sailing V.	585	600	1,000	1.0	1.7
Total	2,561	5,300	7,900	2.1	3.1

7-3-5. Size of Ships

(1) Average size of ships

The average size of ships is forecast for each type of ships.

The average size of ships is considered to increase or decrease with cargo discharged and loaded per ship call. Then, in 1985, it will be approximately equal to that in 1976, and in 2000, it will be 1,540

D.W.T./ship which is nearly two times that in 1976 (Table 7-25).

Table 7-25 Forecasts of Average Ship Size of Calling Vessels to Port of Bitung by Type of Ships

Unit : D.W.T./Vessel

Type of Ships	1976	1985	2000
Ocean Going Vessels	6,746	7,000	10,000
Local V.	55	60	100
Special V.	2,503	2,500	5,000
RLS V.	672	700	1,500
Sailing V.	8	10	10
Average	814	814	1,540

Considering actual past records of vessels calling at the Port of Bitung and the size of vessels being built, maximum size of vessels is forecast as 10,000 D.W.T. for oceangoing vessels and 2,000 D.W.T. for vessels for domestic use. As far as sailing vessels are concerned, the size being used now is considered for the forecast. For special vessels, the maximum size forecast is 15,000 D.W.T. for facility planning purposes since maximum berthing capacity of 15,000 D.W.T. is already available in existing facilities of Pertamina.

For the size of calling vessels in the year 2000, introduction of size that is 1-rank larger than that of the year of 1985 is assumed, considering 15,000 D.W.T. maximum for oceangoing vessels and 3,000 D.W.T. maximum for local vessels. However, average size of vessels for domestic use will be approximately 2,000 D.W.T.. For sailing vessels, the presently used size is also taken for the future.

7-3-6. D.W.T.

The D.W.T. of the calling ships by type is obtainable by multiplying the average size by the number of calling ships for each type. By summing up such values of D.W.T., the D.W.T. of all ships calling at the Port of Bitung is forecast (Table 7-26).

Table 7-26 Forecasts of Dead Weight Tonnage of Calling Vessels to Port of Bitung by Type of Ships

Type of Ships	1976	1985	2000
Ocean Going Vessels	931	1,400	3,000
Local V.	36	90	230
Special V.	438	1,000	3,500
RLS V.	675	1,820	5,400
Sailing V.	5	6	10
Total	2,085	4,316	12,140

7-4. Passengers

There is no apparent sign of increase or decrease in the number of passengers passing through the Port of Bitung in recent years (Table 1-8). Therefore, the number of passengers forecast for the year 1985 and 2000 is 25,000 persons, which is equal to the maximum actually recorded since 1971.

Chapter-8 Selection of Construction Site

8. Selection of Construction Site

8-1. General

Generally two groups of possible sites can be considered as the construction site for new port facilities for the Expansion Project for the Port of Bitung, as indicated below.

(1) Site in the vicinity of the present Port of Bitung.

(2) Nearby ports in the North Sulawesi Province.

The area in the vicinity of the Port of Bitung is well sheltered by Lembeh Island from wind waves coming from the Maluku Sea and well located for a port with excellent connections with existing the Port of Bitung and the City of Bitung. Therefore, this area is divided into several sections as a possible site and each section is examined in detail.

Nearby ports in the North Sulawesi Province are examined and evaluated as possible sites for the Expansion Project of the Port of Bitung since these ports are located directly behind the Port of Bitung and geographically connected to both Menado and Bitung, which are the center of urban activities in North Sulawesi Province.

8-2. Evaluation of Possible Sites in the Vicinity of Port of Bitung

8-2-1. General

An area appropriate for the new port facilities on the coast in the vicinity of the existing Port of Bitung must be, more or less, sheltered by Lembeh Island from waves. Some of the possible sites may require a new breakwater but even such sites will be considered here for examination and evaluation.

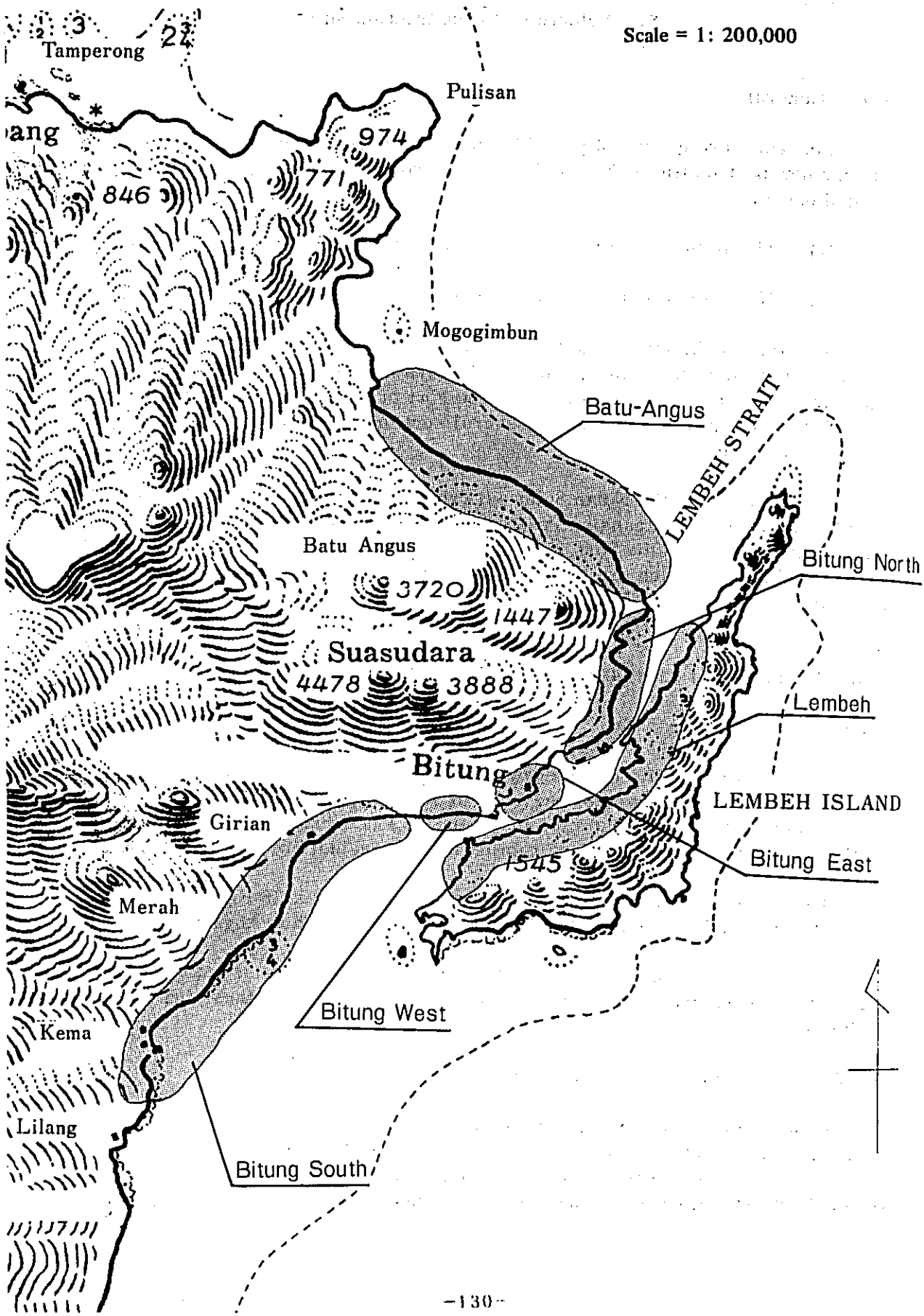
There are six preliminary possible sites as indicated in Fig. 8-1. They are Bitung South, Bitung West, Bitung East, Bitung North, Batu-Angus and Lembeh.

Each site is evaluated analytically from socio-economic aspects and from engineering viewpoints, then conclusions will be formed by synthesizing these analyses.

8-2-2. Evaluation from Socio-Economic Aspects

In selecting a site appropriate for construction of port facilities, a site will be the most desirable if construction of new port facilities does not compete with any other activities. If there is competition with other activities, extra time will be required for adjustments, and costs for compensation will also be required.

Fig. 8-1 Alternative New Port Construction Sites



In such case, this site is disadvantageous for building port facilities.

Adjustments required and costs for compensation will naturally vary depending upon the type of other competitive activities. From this point of view, Bitung West may be the most disadvantageous since Pertamina exists there. However, in other sites farm-land and houses also exist in all cases to a certain extent if it is in a flat area. Thus, some kind of competition will always exist.

In view of port utilization after completion of the port facilities, a site will be desirable if efficient port management is possible and connections with service areas are well maintained. That is, site is favorable if port operation can be unified with nearby existing ports, functions of existing port cities can be utilized and access to service areas is conveniently provided.

In view of such considerations stated above, Bitung West and Bitung East are the most desirable sites, which are located next to existing port facilities. Then, Bitung South where the road from Menado to Bitung runs directly behind it, is considered to be acceptable. However, Lembeh is not desirable since the strait exists between two islands.

In addition, industries related to the port must be able to find required land around the port in order to continuously maintain the development of the port, and thus easy availability of land for the industries is an important prerequisite. Especially, industries are capable of creating new port demands by themselves so that sufficient industrial land should be available around the port site.

Thus, an area where a wide plain is available with less competition or water surface suitable for land reclamation may be considered as an excellent site for construction of new port facilities. In view of this requirement, Bitung South and Lembeh are more advantageous than the others.

8-2-3. Evaluation from Engineering Aspects

1) Bitung East

The Port of Bitung has the Lembeh Island situated in the front sea and is thus protected from waves from the open sea so that it has a natural and calm water area. There may be some littoral drift but not as much as in the coast in the west of the existing concrete pier.

The water depth available is about -9m to -10m at the area of extension face line of the presently existing concrete pier.

The soil bearing layer (N=50 or so) is obtainable at a relatively shallow position of about -15m -17m in the west from the east end of the existing concrete pier to the wooden pier. The area extending from the central part of the bay to the existing dock has a bearing layer at a relatively deep position of about -30m to -42m generally. But, by

choosing the face line appropriately or applying a relatively light structural method such as pile or sheet pile type, it is possible to cope with the soil condition and thus, economically provide a wharf.

The max. tidal current in this area is about 1m/sec and poses no problem for steering.

From the engineering viewpoint, this site is the most suitable place for port construction over the other proposed sites.

2) West Bitung

Engineering problems in this area are waves and littoral drift.

Calculating the monthly rates of working at this point for the wave heights of 0.5m and 1.0m respectively of the waves estimated in paragraph 3-3-3, they are given as shown in Fig. 8-2.

The wave height seldom exceeds 1m except during July and August. However, the wave estimate is based on the records of observation of the wind once a day and weather charts for the coast about 1 km west of the existing concrete pier. Therefore, assuming that no cargo handling is possible if the wave height exceed 1m, the monthly number of days of occurrence and percentages of effective working days are obtainable as

	Jul.	Aug.	Sep.	Total
Occurrence of 1m wave height	8 days	14 days	1 day	23 days
Percentage of effective working days	20%	50%	96%	94%

in which the annual percentage of effective working days is calculated as (365-23)/365 x 100 = 94%.

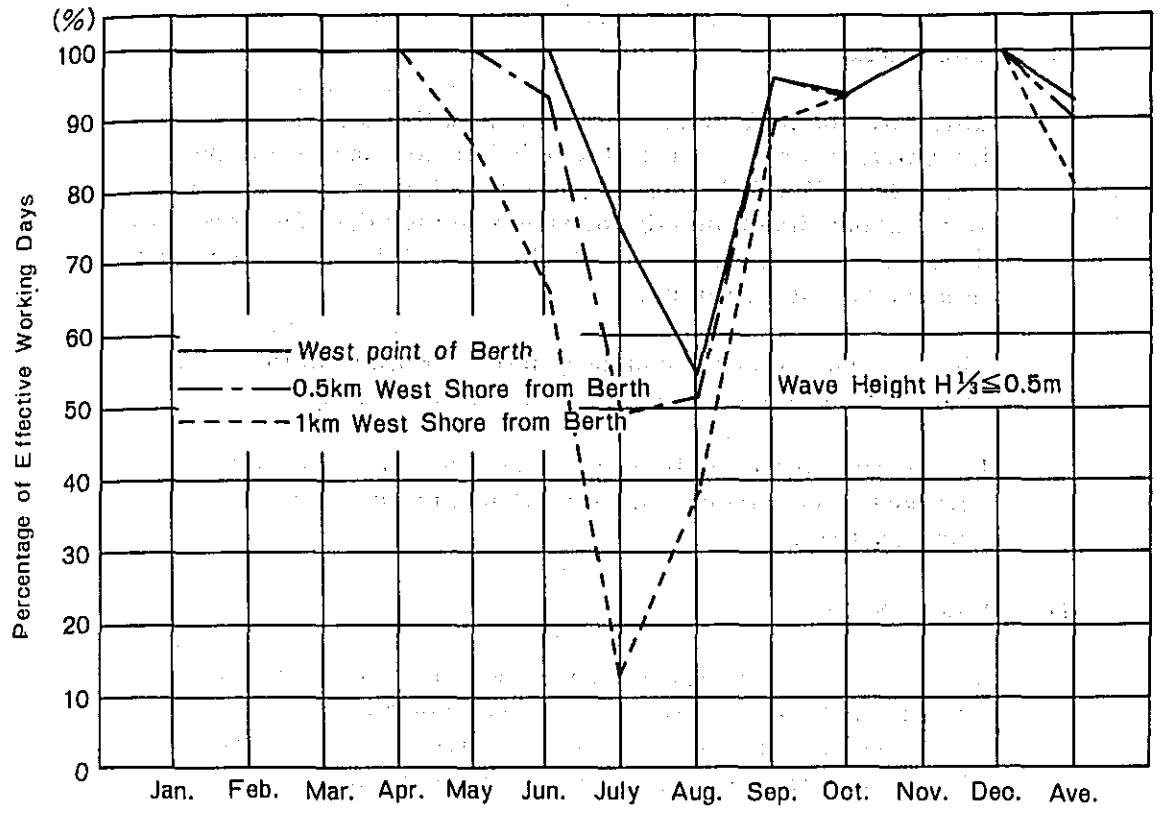
As seen, the percentage of effective working days is 50 - 70% in July - August, but it is given as 94% throughout the year.

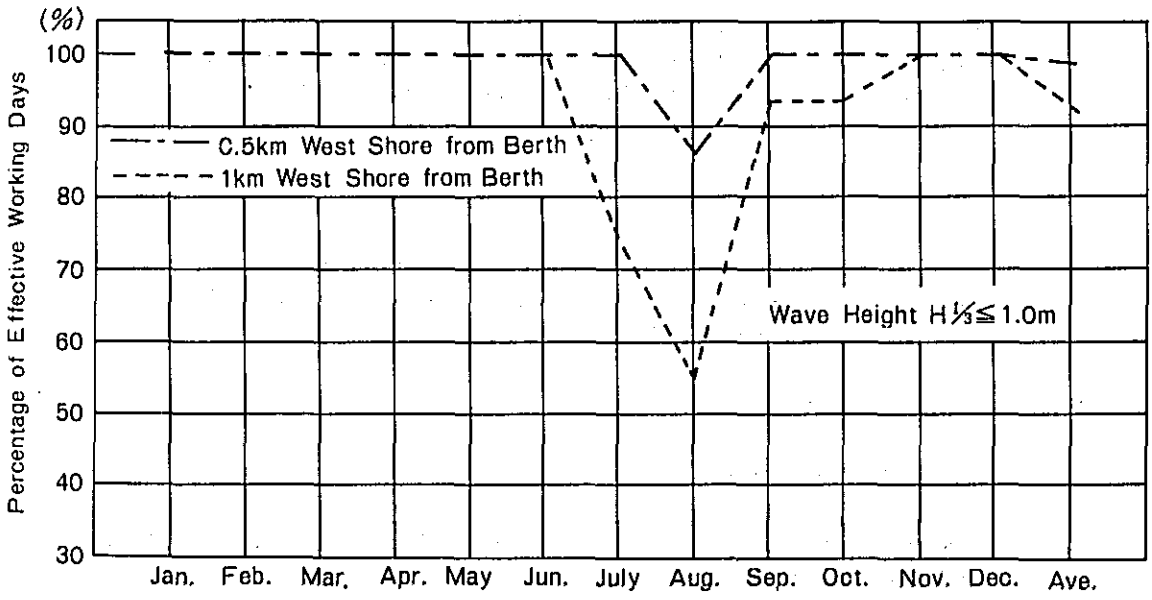
This area has a steep slope in the sea bottom, and the water depth of -10m is obtained at a position relatively close to the coast or about -20m - -50m of the coastline.

The soil bearing layer is positioned at -52m so that if pile foundations are used, long piles will be required.

As far as littoral drift is concerned, much seasonal movement of

Fig. 8-2 Percentage of Effective Working Days





Notes: 1. Based on the Calculated Wave Height
2. Estimated waves were caluclated at the rate of one time/day.

littoral drift is considered so that detailed investigation of the littoral drift will be required prior to execution of the project.

3) Batu-Angus

This site faces directly to the ocean in the north. According to the information obtained from local fishermen, due to the northeast trade winds from December to March waves higher than 1m will occur for 12 to 20 days each month and waves higher than 2m occur for about 7 days and occasionally waves higher than 3.5m will occur especially in January and February.

The material of coast consists mainly boulder in the area and this also proves the roughness of waves on this coast.

Large investments will be necessary for breakwater facilities if a new port is constructed here so that this site is not appropriate for port construction.

4) Bitung North

This site is well shielded by Lembeh and very calm but steep hills exist behind the coastline and the sea bottom is also steep so that obtaining suitable port area and construction of a wharf are costly. Thus, this site is not appropriate for port construction.

5) Lembeh

The water area is sufficiently calm and some portions along the coastline are flat so that the construction of new port facilities is possible in this area. However, this site has more problem due to the access between Sulawesi to Lembeh Island.

6) Bitung South

This site is open to the Maluku Sea and, therefore, large investment will be required for a breakwater to keep the water calm, so that this site is not appropriate for a new port.

8-2-4. Overall Evaluation

(1) Evaluation Method

Requirements for new port facilities will be established here first in order to totally evaluate the possible sites for the new port construction. Then, factors for comparison for relative evaluation of the possible sites will be abstracted. And each possible site will be then evaluated and graded into three ranks A, B and C for each of these

factors.

Ranks A, B and C mean the following:

A : Proper
B : Usual
C : Improper

Finally, tabulations of the three-rank evaluation and importances to the project of the factors for comparison will be totally studied and overall judgment will be made.

(2) Requirements for New Port

The requirements for the new port which are used for site comparison, are the functions of the port to be considered for the year 2000 as follows:

1) The traffic to be handled shall be about 4 times that of the traffic through the existing Port of Bitung.

2) Sufficient calmness shall be secured throughout the year.

As a new port fully meeting such requirements, a new wharf must have berthing facilities and back-up land area and, depending upon the location, a breakwater and access may become necessary. The new facilities required as a new port for each of possible sites are listed in Table 8-1.

Table 8-1 Facilities to Be Needed for New Port

New Facilities	Bitung South	Bitung West	Bitung East	Bitung North	Batu-Augus	Lembeh
Wharvies	o	o	o	o	o	o
Breakwater	o				o	
Access Road				o	o	o*

Note: * Ferries

(3) Comparison Factors and 3-Rank Evaluation

Suitability of each possible site for the construction of a new port should be evaluated first for easiness in construction and secondly for easiness in operation of the constructed port facilities. And in planning the port facilities, full consideration should be given for future

port development, viewing the port as a basis for regional development and as a center of local traffic. Thus as a third comparison factor, the possibility of future development of each possible site must be examined. These three factors are then subdivided into several elements to make significant differences among possible sites and thus the three-rank evaluation will become easier and definitive. Results of the three-rank evaluation by examining each site for its conformity to these comparison factors are indicated in Table 8-2.

Table 8-2 Comparison of New Port Construction Site

Comparative Factors	Bitung South	Bitung West	Bitung East	Bitung North	Ratu-Angus	Lembeh
Construction	C	B	A	C	C	A
Aquisition of Wharf and Berth Space	(C)	(A)	(A)	(C)	(B)	(A)
Competition of Other Activities	(A)	(B)	(A)	(A)	(C)	(A)
Cost of Construction	(C)	(B)	(A)	(C)	(C)	(A)
Operation	A	A	A	B	C	C
Transport	(A)	(A)	(A)	(B)	(B)	(C)
Relation to the Existing Port	(B)	(A)	(A)	(B)	(C)	(B)
Relation to the Cities	(A)	(A)	(A)	(B)	(C)	(C)
Future Development	A	B	B	B	B	A
Room for More Expansion	(A)	(B)	(B)	(B)	(B)	(A)
Space for Water Front Industrial Area	(A)	(A)	(B)	(B)	(B)	(A)
Total Count	2A+C	A+2B	2A+B	2B+C	B+2C	2A+C

(4) Overall Evaluation

By the considerations stated heretofore, the following evaluation can be made for each possible site:

1) Bitung South

A breakwater and probably excavation will be required for this site for securing the calm basin so that high construction costs are expected and this is a critical disadvantage.

2) Bitung West

Pertamina facilities are located in most parts of this construction site. These facilities are fairly new so that building of a new port after removing these facilities is not realistic at the

present time. However, transferring these facilities somewhere else can be naturally considered after the facilities become old or after cities behind them have been developed.

Adjacent to Pertamina, land for factories has been planned behind the coast line so that this site is extremely advantageous for developing industries in the area adjacent to the wharf.

Therefore, this site is excellent as a site for new port construction after Pertamina is removed. But this area is affected by waves and littoral drift and possibly creates some degree of problem as a new port site.

3) Bitung East

Bitung East is the most suitable new port site by the year 2000 from the viewpoint of operation as well as that of construction. However, for building a larger-scale port, the existing ship-repairing facilities should have been removed in advance. New land for relocating these facilities after removal may be easily found in land to be reclaimed in the sea in the direction of Aer Tembaga.

4) Bitung North

This area is steep everywhere on land an adjacent to coast line and the water area is also suddenly deepens so that wharf construction seems very difficult.

5) Batu-Angus

The land behind the site in Batu-Angus is designated as a bird and animal conservation zone so that this land is not suited as a new port, which inevitably invites cities, traffic and industries. Also this area requires a breakwater which means higher cost. In addition, this area may be too far away from present cities and ports which is considered to be a demerit for port management.

6) Lembeh

Lembeh has the advantage of a clam water surface everywhere. And less social or economic friction can be expected in the port construction since both population and industries are relatively thin in this area.

As far as chart examination and on-site investigation is concerned, this area seems to offer no problem in finding proper

land for reclamation. Therefore, this site is considered to have relatively good conditions for port construction up to the year 2000 or even after that.

The greatest disadvantage of this site of Lembeh is the presence of Lembeh Strait between Bitung and Lembeh which is at least 600m wide with some current. Due to the presence of this strait, ferry boats must be used for transportation of passengers and cargo between Salawesi and Lembeh Island. A bridge is too costly and economically unrealistic.

Lembeh Island is better suited as a petroleum distributing center or as a shipbuilding center rather than a port, since danger to life and property by petroleum distributing facilities can be eliminated by the strait located between cities and facilities and petroleum transport to Sulawesi Island can be made through a pipe line. Also less demerit is expected as a shipyard than as a port due to smaller amounts of passenger and material transportation required for a shipyard.

From the analyses and consideration made in Items 1) to 6) above, the most suitable site for port construction by the year 2000 is Bitung East. But Bitung West is also capable, having the same priority as Bitung East if adjustment for Pertamina is properly made. And Lembeh can be effectively utilized in the future as land for relocating of either a petroleum distributing base or a shipyard.

8-3. Evaluation for Other Ports

8-3-1. Port of Menado

This port is located in Menado, provincial capital, and this port historically functioned as a trigger for the development of the City of Menado and North Sulwesi Province. It is advantageously located in relation to cities but it is a small port utilizing a river mouth affected by siltation with a small mooring basin and shallow water depth unsuitable for mooring large vessels. This port also faces Sulawesi Sea and, therefore, a breakwater must be constructed against monsoons if this port is to be selected for the project. Construction of a breakwater is extremely costly and therefore this port is not suited to the project.

8-3-2. Port of Gorontalo

This port is located next to the City of Gorontalo and hills in this city and in its vicinity are being developed as the center of agricultural development in the North Sulawesi Province. This port is located about 275km west of Bitung almost at the center of North Sulawesi Province so that this is an ideal area geographically as a transport center to the west part of the province.

This port is opened to the Maluku Sea so that a tremendous amount of investment will be required if a breakwater is constructed here for building port facilities for large vessels. In addition, the area directly behind this existing port is covered with many hills, and therefore, sufficient land cannot be obtained. Thus, berthing facilities for small vessels must be improved in this port as a supplemental port for the Port of Bitung. But this port itself is not proper as a port for large vessels.

8-3-3. Area around Likupang

Likupang is located at the northeast end of Sulawesi Island. This area on the coast is located about 30km away from the City of Menado and also from the City of Bitung. Across Bangka Strait in the north, Bangka and Talisei Islands are located. Flat land behind the coast in the area is considerably wide and securing of port land and a mooring basin is not difficult. However, this area has no shelter in both the east and west directions so that influence by wind and waves cannot be avoided during the monsoon season. A sandy beach extends widely on the coast and some areas may be adequate as reclamation land. A reef is located offshore and tremendous amounts of dredging costs will be required for maintaining proper depth but possibility of siltation by waves is considered.

Therefore, for the construction of port facilities for large vessels, a breakwater may be built in the east side, the channel and basin can be dredged and a wharf and port facilities can be built because of the large space both on water and land, but tremendous investments are required for these, and therefore inadequate as a site for this project.

8-3-4. Other Ports

Ports other than those described above and worth considering in North Sulawesi, are the Ports of Kuandang, Labuan-Uki and Amurang. All of these ports are located on the north coast in North Sulawesi.

In Kuandang, fishery port facilities are being added presently and local vessels call at this port. This port is located within an extremely calm bay, but the water is shallow and, therefore, it is not suitable as a port site for large vessels.

Labuan-Uki is, according to the chart, a bay with a 0.5km bay mouth width and 1.5km bay length, and its water depth is 30m maximum. Muddy deposits are located at the innermost end of the bay.

At the present time, a construction project of a large-scale cement plant is being studied near this bay and there is a possibility of using this bay as a marine transport base. However, the approach from land is difficult and, in view of available space for port construction in the bay, access and relation with cities, construction of a commercial port taking the place of the Port of Bitung will be difficult.

Amurang has a sufficiently wide bay and a port, navigation aids and houses are already built around the bay. However, this port cannot be a commercial port taking the place of the Port of Bitung due to its geological conditions with relation to service area and to locational relation with the City of Menado which is the center in the area.

8-4. Selection of Construction Site

An excellent construction site for port facilities for expansion of the Port of Bitung is considered to be the area in the vicinity of the Port of Bitung among those two groups stated in Section 8-1. And especially, as described in Section 8-2, the coast and water area in Bitung East are excellent which are located between the -10m wharf of the Port of Bitung and the shipyard. No. 2 site is considered to be Bitung West and No. 3, Lembeh.

Thus Bitung East is proposed in this project as the best site for construction of a new port.

Bitung West which is on the coast in front of Pertamina at the west side of the existing concrete pier is very precious space to allow for port development in the future after the year 2000, even though it is limited by the influence of wind waves and littoral drift for its west side extension and by plan adjustment required for Pertamina.

Of the coast of Bitung East, the front of the shipyard is also an adequate area as an extra allowance for extension of the commercial port if an adjustment is made for the extention plan of the shipyard.

No. 3 site Lembeh is a proper site that can be effectively utilized in the future as a reserve site for extension of a oil tank yard, shipyard and so forth and, thus, this site also should be taken into consideration as an important element when considering future expansion for the commercial port facilities of the Port of Bitung.

Chapter-9 Long Term Plan

9. Long Term Plan

9-1. General

This Chapter describes the long term plan with the year 2000 as the target year.

For a port to develop autonomously, simultaneous and parallel growth and maturity of the functions related to the port activities in the area are indispensable. Thus, it is required, prior to improvement of the port facilities, for the port management body to have a definite insight into the land use in and around the port. Thus, in this Chapter, conception for land use in and around the Port of Bitung will first be discussed. This conception on land use will serve as useful reference for the person desiring better development and management of the port in making adjustment of the opinions with the persons responsible for city planning, industrial promotion and road improvement.

Next, in this Chapter, facility planning of the new port will be described generally. The facility planning handled here is that of the size and layout of the fundamental port facilities required in the year 2000 and is concerned mainly with the layout plan of the berthing facilities. This plan reflects the direction of development of the Port of Bitung in the future. The medium term plan with 1985 as the target year is examined as a stage plan of the long term plan.

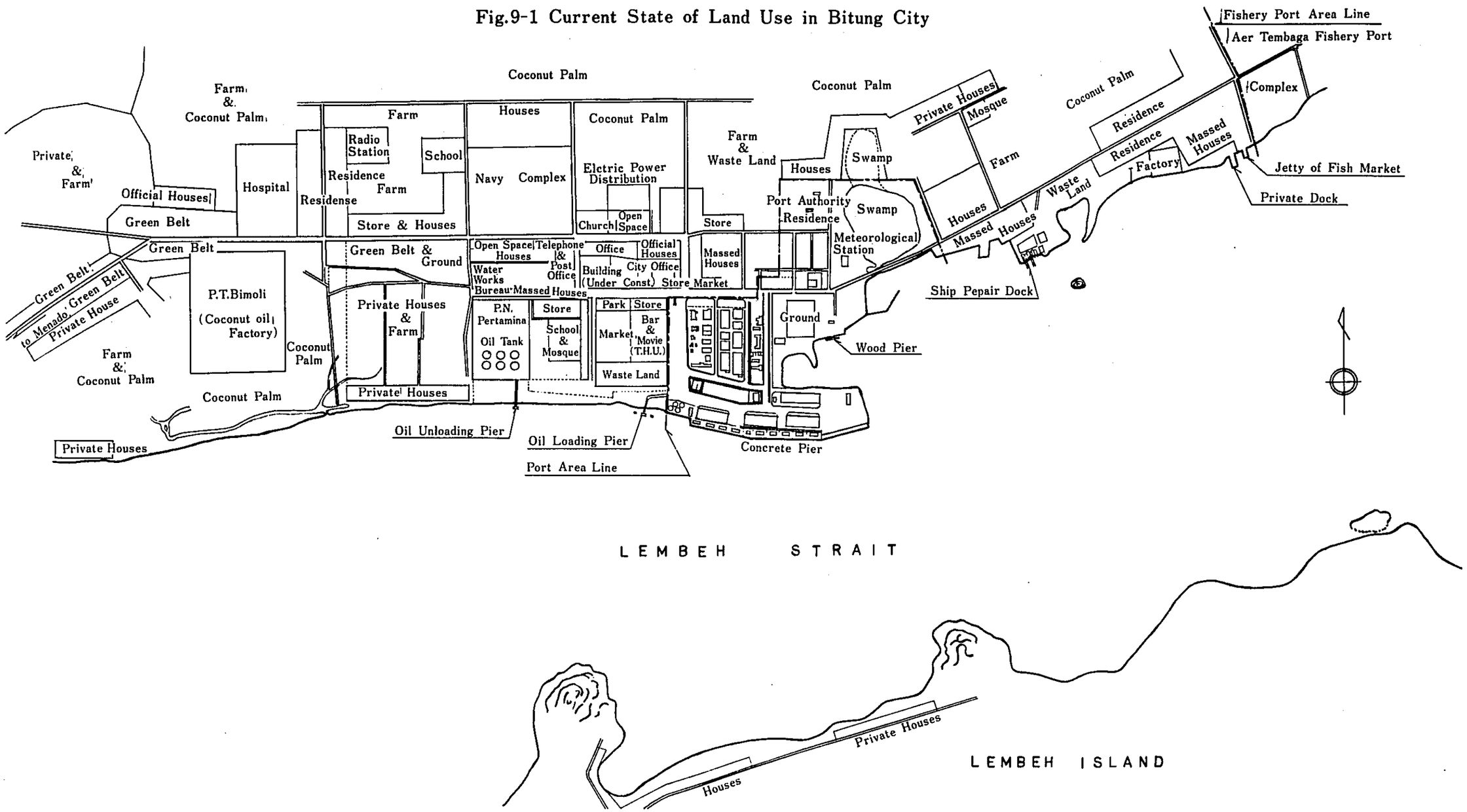
9-2. Conception for Land Use in and around the Port of Bitung

9-2-1. General

Now that the site for a new port is to be Bitung East, the area to be considered in formulating the long term plan of the Port of Bitung is limited, at the largest, to an expansion of 4 km east and west, from Aer Tembaga in the east to Bimoli Company in the west, and 2.5 km north and south, from the foot of the hill in the back of the City of Bitung in the north, to the north shore of Lembeh Island in the south. Greater expansion may be taken as an object of consideration, but such additional area is considered to be practically of no effect upon the port planning.

Actual land use in and around the Port of Bitung is illustrated in Fig. 9-1. In Fig. 9-1, the land area in the north belongs to the Kecamatan Bitung-Tengah. For the sake of convenience of description, this area will be referred to as Area-T in this Chapter. The land area in the south in the figure belongs to the Kecamatan Bitung-Sulatan. This will be referred to as Area-S. Between these two areas runs the Lembeh Strait.

Fig.9-1 Current State of Land Use in Bitung City



9-2-2. Current State of Land Use

(1) Area-T

The land area in the north in Fig. 9-1 (Area-T) comprises topographically a mountainous area, gentle slopes and a plain in sequence from the north. Urban facilities are seen only in the gentle slopes and plain. Including both slope and plain, the width is only about 1 km. Ridges branching from the northern mountainous site are extending into this section here and there as if to divide the portion into several parts.

At the center of Area-T, along the water front, is located the Port of Bitung. Where it faces the Lembeh Strait, a concrete pier has been constructed which is used concurrently for foreign and domestic trade. In the immediate north are the port administration facilities. The area administered by ADPEL extends to the swampy land in the north-eastern part. Dwelling houses are located here and there as if to encircle the swampy land, and they include the official residences of ADPEL. Immediately west of the Port of Bitung are located plainly constructed bars, a movie theater, shops, mosque, school and houses, and some of them are being removed. This site will become the lot to be administered by ADPEL in the future.

West of this site is located the oil distribution base of Pertamina. It was relocated from Menado in 1971 and is relatively new. It occupies an area of about 5 hectares and has 6 tanks. Pertamina has berthing facilities for handling oil, one in the water front adjacent to the Port of Bitung and another in front of the plot of Pertamina.

North of the area extending from the Port of Bitung administration facilities to the plot of Pertamina are business facilities such as the Municipal Office, Post, Telegram and Telephone Bureau, City Waterworks Bureau and other offices; commercial facilities of relatively rigid two storied shops and a shopping center; and bus terminal, to form the central section of the city.

In the central section of the city, a street with a width of about 40 m runs from east to west. It has asphalt pavement at the central part with a width corresponding to four lanes.

This street leads to Menado in the west. Along the street is located a coconut processing plant of the Bimoli Company. This company has a simple products loading jetty in the water front in its front, and the plant and the jetty are connected by a pipeline.

North-east of the Port of Bitung, there is swampy land as stated above. Farther east of the swampy land is located a ship repairing yard with three national slipways (200, 300 and 500 GT class) along the seashore. For this ship repairing yard, there is a plan for installation of a wet dock. About 1 km east from here, a commercial dock (1,000 GT class) is being constructed.

At the east end of Area-T, there is Aer Tembaga fishery port.

Over the whole area of Area-T there are houses of inhabitants. Along the seashore are seen a number of high floored private houses incluster. But, as a whole, the private houses are sparsely distributed here and there in the coconut groves and field. The houses facing the street are generally of relatively high class.

(2) Area-S

The land area belonging to the Lembeh Island in Fig. 9-1 (Area-S) has a steep slope of a hill close to the sea and has little flatland of appreciable extension. Both hill and flatland are farmland for coconuts. However, near the foot of the cape south of the Pertamina facilities, more or less flatland is available. Private houses are spotted along the road, and the inhabitants are engaged in agriculture and fishery. The inhabitants use small boats for communication with the main island, and these boats are placed ashore here and there to indicate that the water-front is used as a slipway.

(3) Lembeh Strait

Lembeh Strait, within the scope of study, has a width of 700 m at the narrowest point. The sea bottom configuration is deep, and the central part of the Strait has a depth of 35 m or more and it has a minimum width of 650 m for the water area and a depth of 10 m or more so that there is no difficulty in securing the access channel, thus insuring no trouble for navigation of 15,000 D.W.T. vessels.

The water area in front of the new port site has a contour line of 10 m depth running about 500 m off the coastline so that it will be relatively easy to do reclamation and structure work. The water area from the shipbuilding yard to the Aer Tembaga fishery port has a site adapted for reclamation work although on a smaller scale. Another reclamation site may also be found on the Lembeh Island side.

Lembeh Strait, within the scope of study, is used for the navigation and anchorage of the vessels calling at the Port of

Bitung, and it is possible for the vessels to pass through Lembeh Strait, Waiting for berthing seems to be made mainly in the calm water area near the Aer Tembaga fishery port.

This water area is also used by the fishery boats for navigation to the Aer Tembaga fishery port, but no fishing operations are apparently carried out.

9-2-3. Land Use Conception

(1) Facilities to be located in and around the Port of Bitung

The facilities to be located in and around the Port of Bitung are shown in Table 9-1. They are port facilities, transport facilities,

Table 9-1 Facilities to be Located in and around Port of Bitung

Facilities/Factor	Distance to Port	Land to be Needed	Traffic to Occur	Other Factors
1) Port Facilities				
(a) Foreign Trade	-	Land with Waterfront	Truck	
(b) Domestic Trade	-	Land with Waterfront	Truck and Passenger	
(c) Port Administration	-	Land	Passenger Car and Passenger Truck	
(d) Storage	-	Land		
2) Traffic Facilities				
(e) Bus Terminal	Near to Domestic Trade	Land	Bus and Passenger	Adjacent to Business and Commerce
(f) Oil Distribution	Near	Land with Waterfront	Tank Lorry and Tanker	Favorably away from. Densed Area
3) Urban Facilities				
(g) Business	Near	Land	Passenger Car and Passenger	
(h) Commerce	Near	Land	Passenger Car, Truck and Passenger	
4) Factories				
(i) Processing of Agricultural Products	Near	Land	Truck	
(j) Ship Building and Repairing	Near	Land with Waterfrong	Truck	
(k) Other Industry	Near	Land	Truck	

urban facilities and industrial plants. The table subdivides these facilities further and lists the factors of location peculiar for the subdivided facilities respectively. The factors for location include the positional relationship to the port, kind of land required, generating traffic, etc. which are considered to be important in discussing the port city facilities.

1) Port facilities

As discussed previously in Chapter 7, the Port of Bitung must have the facilities for foreign trade as well as those for domestic trade. For these facilities, land adjacent to the water front is required. The accruing traffic are mainly trucks for the foreign trade facilities and trucks and passengers for the domestic trade facilities. From these facilities, traffic accompanying cargo handling will generate, but such traffic will not go out of the port area and is, therefore, outside the scope of discussion here.

The port administration facilities must, of course, be included in the port facilities.

For the Port of Bitung, land not only for the foregoing facilities but for storage is required because land space for warehouses and open storages is lacking in the port area.

2) Transport facilities

The transport facilities include the bus terminal as one concerned with traffic of people. This is preferably located close to the domestic trade facilities which are the main source of the generation of passengers.

It is also desirable that they have an access to the business and commerce facilities in the central area of the city.

Among those transport facilities which are concerned with the transport of commodities, the oil distribution base is in need of land having a water front. Traffic of tankers is generated on the sea side, and that of tank lorries on the land side. Presently, Pertamina has a land area of about 5 hectares, and with such land area, an annual distribution capacity of about 1,000,000 tons is considered to be the upper limit. As it is forecast that 1,470,000 tons of oil will have to be distributed in the year 2000, there arises a necessity of acquiring new land during the year 1990's. Further, Pertamina will have to acquire an additional water front for berthing of tankers.*

The port must have bunker oil supplied from the oil distribution base so that it is desirable that both are located close together. On the other hand, tanks storing large amounts of oil should be located as far from the densely populated area as possible. Thus, as a plan, land should be obtained for the oil distribution base which is to be expanded at an appropriate place on Lembeh Island. In such case, however, the central part of the strait has a depth of 35 m or more so that economical and technical considerations will be required for installation of a submarine pipeline.

The present distribution base of Pertamina should continue to exist as a base for tank lorries for the customers in Minahasa Regency. The distribution base to be newly constructed on Lembeh Island is to be used for the distribution of oil by means of tankers to the customers in other areas than Minahasa Regency.

3) Urban facilities

The business facilities are indispensable for the port activities. Their role consists of distribution of information, procedures, financing and transactions required for port activities. They include, for example, branch offices of the

---

* Capacity and facility scale of oil distribution base

The quantity of oil coming in and going out of the oil distribution base is as follows (Chapter 7).

		1985	2000
		(1,000 tons)	(1,000 tons)
Inflow		360	1,470
Outflow	Sea	160	650
	Land	200	820

The required extension of the berthing facility and land area are:

	1985	2000
Berthing facility extension	300 m	1,300 m
Land area	5 ha (Currently possessed)	7 ha

As a premise of the foregoing calculation, it is assumed that the turn over rate of oil in the tank is higher than 12 cycles/year.

central government, local government offices, telegraph, telephone and post offices, banks and offices of private enterprises. These should be located in the central part of the port city and, at the same time, as close to the port as possible.

The commercial facilities are also to be located in the central part of the city. Their positional relationship to the domestic trade facilities is particularly important. The market in the commercial facilities functions as a field of small commercial transactions and has an important role for establishing the commercial territory of the city of Bitung in relation to the domestic liner service vessels. This should also be located close to the port.

4) Plants

There are three kinds of plants which have a possibility of location in the vicinity of the Port of Bitung.

Included in the first category are the processing plants for agricultural products produced in the service area of the Port of Bitung.

In the second category are the ship repair yard and shipbuilding yard. These require land with a water front. The port and ship repair yard have a complementary function for their respective development and are, therefore, to be located close to each other. For development of the port, a larger ship repairing yard than the existing one will be required. The plants related to shipbuilding are also required to be located in the same proximity.

As for the other plants in the third place, those processing commodities consumed in the service area of the Port of Bitung may be considered. Advantageously located close to the port are processing industries of mass or weight goods. They are, for example, steel processing, construction materials manufacturing, food processing and feed manufacturing.

(2) Layout of the facilities

In disposing the foregoing facilities in and around the Port of Bitung, the current state of land use, city planning and requirements for location of the respective facilities are taken into consideration.

First, among the existing or planned roads, those that serve as principal paths of traffic flow are chosen. The road that can be assigned for traffic of passengers or buses and private cars is the street coming from Menado. This road passes through the business and commercial area presently. On the other hand, the road that can be set for cargo traffic by means of trucks and tank lorries is the one immediately south of the said street. If the facilities are laid out so that the cargo vehicles converge onto this road, the path of flow of people can be separated from that of cargo at the central part of the city, and thus creation of an attractive city center can be expected. Fortunately, there are roads conforming to such purpose already developed or being developed except for some parts.

Fig. 9-2 shows a layout of the land sites of the facilities described in (1) with consideration given to adjustment of the paths of flow.

A concept of the layout is as follows.

The facilities generating cargo are gathered, so far as practicable, near the water front on the south side of the urban area. Among these facilities, those requiring land having a water front are arranged in the eastern half where a calm water area is obtainable. Consequently, the new port facilities and ship repairing and shipbuilding yard are arranged on the reclaimed land east of the present Port of Bitung. The land and water front required additionally for the oil distribution base will be sought at an appropriate place along the north shore of Lembeh Island, with pipelines connecting Lembeh Island and the main island. The plants for processing agricultural products and other commodities which do not always require a water front are arranged west of Pertamina.

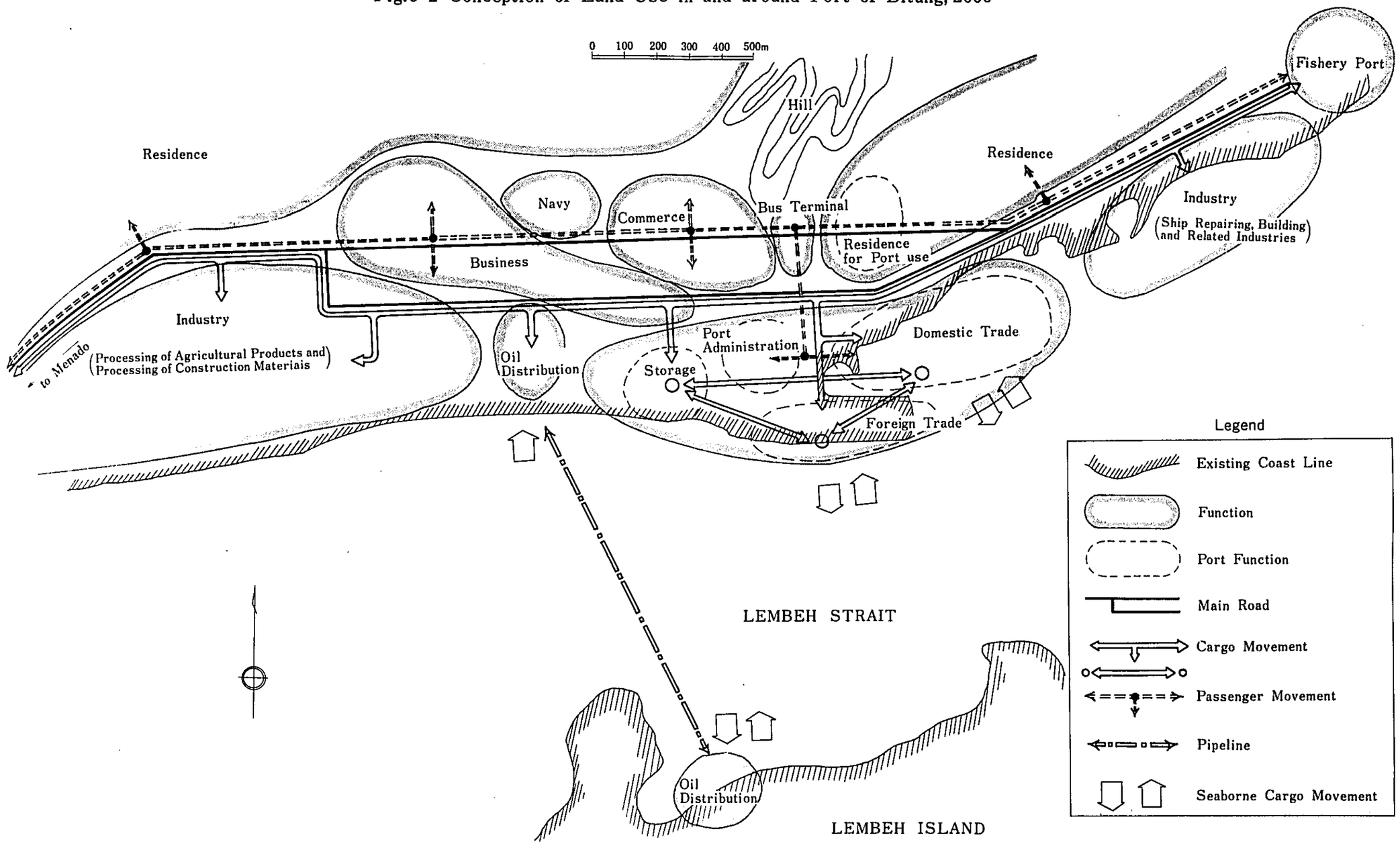
The facilities mainly concerned with people, private cars, and buses such as business and commercial facilities and bus terminals, are arranged on north side.

On the eastern and western side of these facilities, dwelling sites are arranged. The residential quarter of ADPEL located close to the port in the dwelling site is positioned as part of the dwelling houses in general.

The business and commercial facilities and bus terminal are also arranged as close to the port facilities as possible.

The layout of facilities under such a concept is in good agreement with the current trend of land use. It also matches with the city planning map of the City of Bitung. However, use of the land

Fig.9-2 Conception of Land Use in and around Port of Bitung, 2000



reclaimed on the sea (for port and ship repairing and shipbuilding yard) and that of land reclaimed from the swamp in the back of the new port (for dwelling houses) are not shown in the existing city planning map. They are newly proposed in this report. The land allocated for storage in the port includes a portion which is not yet the land of the Port Administration, so that for realizing this concept adjustment with the authorities concerned will be required. Seeking the land for extension of the oil distribution base of Pertamina on Lembeh Island is also a proposal of this report and will require thorough examination from a technical as well as socio-economical point of view.

(Reference) Direction of Land Use after the year 2000.

(1) General

Consideration for the years after 2000 is not within the scope of this report, but the concept for land use requires a longer ranging prospect than the facility plan in general so that it will be noted briefly in the following for reference. However, the following consideration is not always limited to the years after 2000. It should be applied even in the years before 2000 in the event that port development has progressed beyond expectations.

What is likely to occur or should occur in this area with the progress of port development?

Development of the port accompanies, as a matter of course, development of the City of Bitung in its hinterland. For the port, simultaneous development of the functions of business, commerce, physical distribution and industries is particularly important, and for development of these functions, it is required that the residence, entertainment, culture and other similar functions also develop in harmony. Thus, it is a prerequisite to create conditions for development of both port and city.

What is required for development of the City of Bitung are greater area of land and longer extension of the water front. Presently, however, it is difficult to say whether the City of Bitung has both sufficiently. As discussed in paragraph 9-2-2, the city has little flat land in the back of the port facilities and

has a shortcoming in the water front with flat land in the back and a calm water surface in the front.

(2) Layout of activities not requiring a water front

As the space for activities not requiring a water front, the gentle slope extending to the north of the City of Bitung presently may be more or less available. Here, roads are being developed according to the city plan. It is, therefore, desirable to regulate land use so that the land can be used in the future as the site for business and commerce facilities to be located in the central part of the city.

On the other hand, there is a vast land of about 10,000 hectares extending along the coastline from about 5 km west of the Port of Bitung to Kema. It is generally flat, and there is a road connecting Bitung and Menado. It is presently farmland. This area is suitable for the location of industries not requiring a water front and dwelling houses in the future.

(3) Layout of activities requiring a water front

The land requiring a water front is obtainable west of the present port. Here, however, the facilities of Pertamina are located, and further west, a calm water surface is scarcely obtainable. Thus, it is difficult to obtain the required land on a large scale.

Land with a water front may be obtainable north of the Aer Tembaga fishery port. So far as the observation is concerned, flat land is scarcely obtainable along the water front, but a more detailed technical survey is required before a final decision. On the other hand, for location of a port, the land is separated from the present port and new port by the shipbuilding yard and fishery port.

Land with a water front is also obtainable on Lembeh Island. Use of the land on Lembeh Island is advantageous in that there is a calm water and there is little conflict with the present condition of land use. But, it has a shortcoming in that it is separated from the main island by Lembeh Strait so that the traffic is inconvenient. However, separation from

the main island does not present itself entirely as a defect. It is considered advantageous for location of activities that are hazardous if located in the urban area.

(4) Conception for use of Lembeh Island

It has already been discussed that part of Lembeh Island which was located nearer to the Port of Bitung would be allocated as the site for the extension of Pertamina. In addition, activities could be located there that are capable of utilizing the characteristics of the area with a water front having calm water. Such activities are á shipbuilding yard and port, etc.

Locating an oil distribution base on Lembeh Island has many advantages. First, since the island is isolated from the urban area across the sea it is suitable for the storage of oil which is hazardous material. Second, the base can be connected to the main island with pipelines with no problems in the transportation of oil. In this case, however, technical problems concerning the installation of the pipelines must, of course, be examined. Third, the oil distribution base on Lembeh Island can also be used as a transhipment base for other ports. For these reasons, Lembeh Island should first be utilized as the site for an oil distribution base.

In the second place, Lembeh Island should be utilized as the site for a shipbuilding yard. There are many instances of constructing a shipbuilding yard on an isolated island. A greater part of the materials for shipbuilding are brought into the shipbuilding yard via sea transport. Main products of the yard can navigate out on their own. One remaining problem is the commutation of workers, and this can be resolved by providing a ferry wharf in the new port and linking it to the flow of passenger traffic in the city. The concept for land use in and around the Port of Bitung is illustrated in Fig. 9-2 in the chapter on long term planning has this commutation problem incorporated in a plan for a bus terminal and paths of flow.

Third, the port should be considered. When port development has sufficiently progressed and there is no more land with a water front available on the main island, a new site

for the port may be sought on Lembeh Island. As described in the paragraph for general evaluation of the construction sites (8-2-4), Lembeh Island is excellent, except for access to the main island, as a site for port construction. If the port expansion is made on Lembeh Island upon increase of the cargo traffic through the port, the port facilities in units of several berths must be planned so that the higher frequency of ferry services between the main island and Lembeh Island can be justified. Thus, the access problem in putting a port on Lembeh Island will be resolved upon development of the port.

Lastly, whether or not the development of the Port of Bitung will make a progress worthy of the foregoing consideration will be discussed.
Bitung is located at a key point of sea traffic connecting North Sulawesi, Maluku and West Irian. Further, looking at a world map with Bitung placed at the center, everyone will note the importance of its geological position. Bitung is located at a strategic point for communication with Indonesia, Malaysia, Philippines, Japan and Australia. The advantageous geological position of the Port of Bitung must be supported by policies. It will be more important to see if it has any political propriety for Indonesia to develop the Port of Bitung than to see whether or not the development of the Port of Bitung will make progress. It is a problem of choice for Indonesia.

9-3. Long Term Plan of Port Terminal

9-3-1. General

The port tonnage traffic for the target year of the project is shown in Table 7-1. Excluding petroleum to be handled at Pertamina Piers from this table, the port tonnage traffic to be handled at public wharves is indicated in Table 7-2. In accordance to section 7-4 of the types and sizes of ship, a standard wharf 185 m in length with a -10 m water depth is planned for ocean going vessels with a capacity up to 15,000 D.W.T., and a standard wharf 90 m in length with a -5.5 m water depth is planned for RLS vessels for average ships of 2,000 D.W.T.. However, the maximum ship size of 3,000 D.W.T. is assumed for RLS vessels so that 3 berths among necessary numbers of -5.5 m wharves should be provided with effective water depth at least of -6m. For local vessels and sailing vessels, facilities with -5.5 m and -3 m water depth should be constructed respectively.

The number of wharves required in accordance with traffic shown in Table 7-2 is indicated below.

	Year 1985	Year 2000	
-19 m Wharf	2 berths	4 berths	for Ocean going vessels
- 5.5 m Wharf	10 berths	18 berths	for RLS Vessels
- 5.5 m Wharf	150 m	150 m	for Local Vessels
- 3 m Wharf	100 m	100 m	for Sailing Vessels

However, existing facilities are as follows:

-10 m Wharf;	3 berths	582 m length	for Ocean going vessels
- 5.5 m Wharf; approx.	2 berths	350-150=200 m length (under construction)	for RLS Vessels

In addition, a wharf for boats for port service and official use and a wharf for passenger vessels are required with an estimated quay length is 150 m. Thus, the required number of berths to be newly constructed are as follows:

		No. of berths		
1.	-10 m wharf:	0	up to 1985	Note #1
		1	1986 to 2000	Note #1
2.	-5.5 m wharf:	6	up to 1985	Note #1
		10	1986 to 2000	Note #1 & 2
3.	-5.5 m wharf:	150 m	up to 1985	
4.	-3 m wharf:	100 m	up to 1985	

Note #1 : The required number of berths may be subject to slight change. since existing -10 m wharf may be planned for domestic vessels use depending upon plans.

Note #2: 3 berths among 10 berths for -5.5 m wharf shall be a structure with a -6 m water depth.

9-3-2. Layout Plan for Face Line

In planning the layout, a base of facility planning, the required berths which are stated in the previous section are planned to be located in the water area and coast line of Bitung East covering the east side of the existing concrete pier to the existing shipyard. Three alternative layout plans are prepared. These three alternatives are shown in Figs. 9-3, 9-4 and 9-5, and they indicate a long-term plan for the target year 2000 and a medium-term plan for the target year 1985, and master plan of the Port of Bitung in the year 2000 is indicated in Fig. 9-6, 9-7 and 9-8. In preparing these three plans, the following basic ideas are commonly used:

Basic Ideas Used in Planning

1) Required berths should be provided

The facilities to be newly constructed under the expansion project

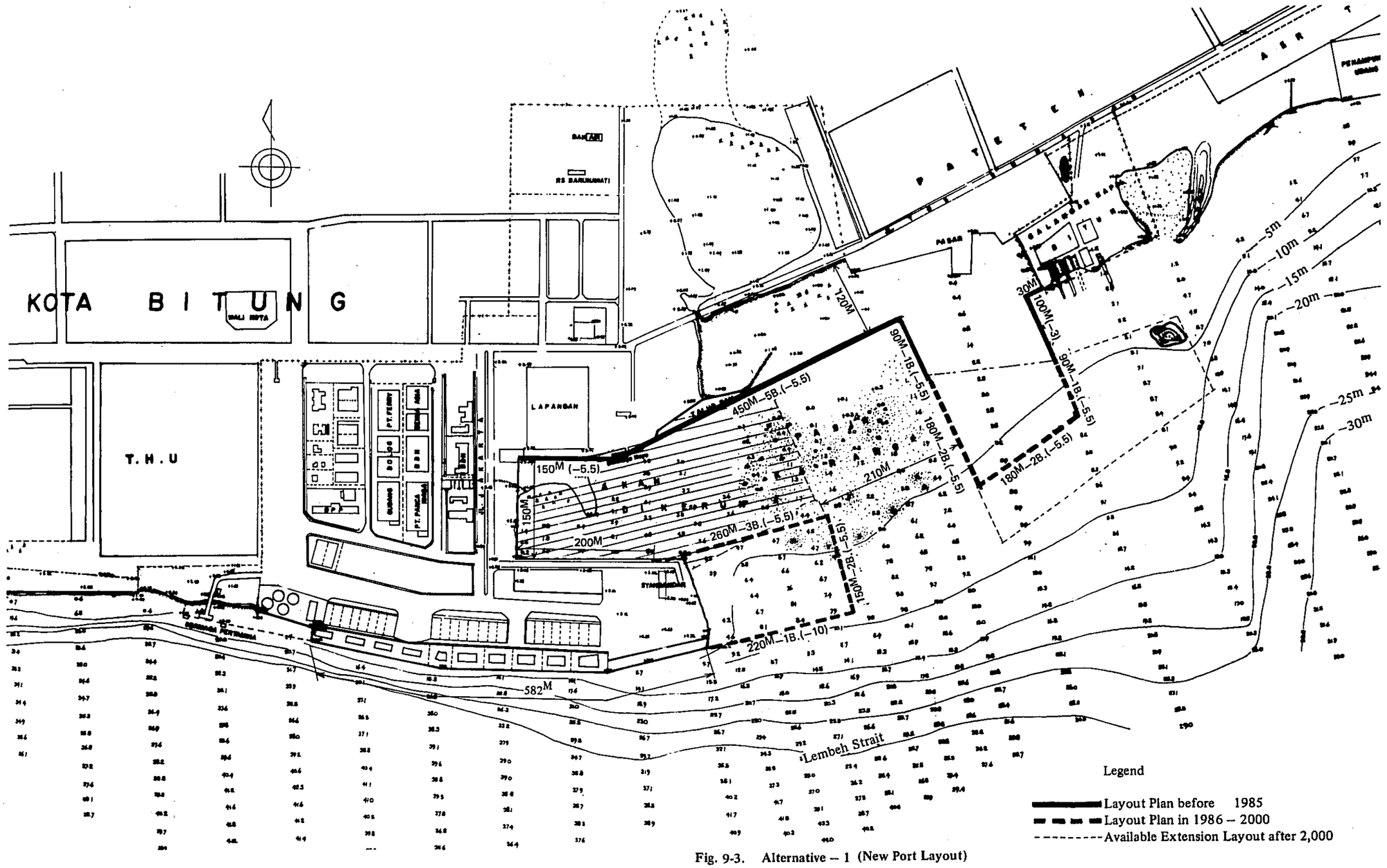


Fig. 9-3. Alternative – 1 (New Port Layout)

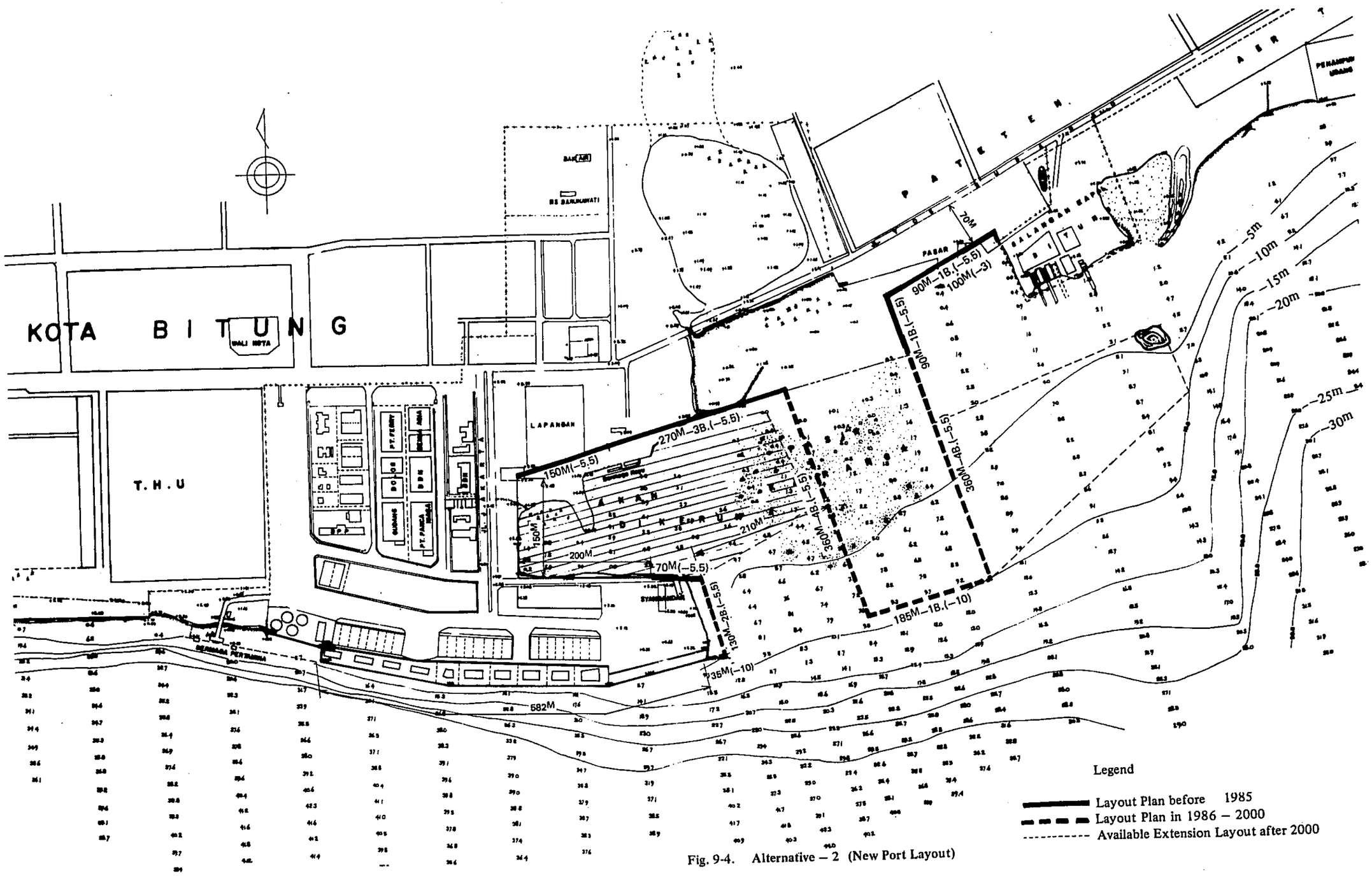


Fig. 9-4. Alternative – 2 (New Port Layout)

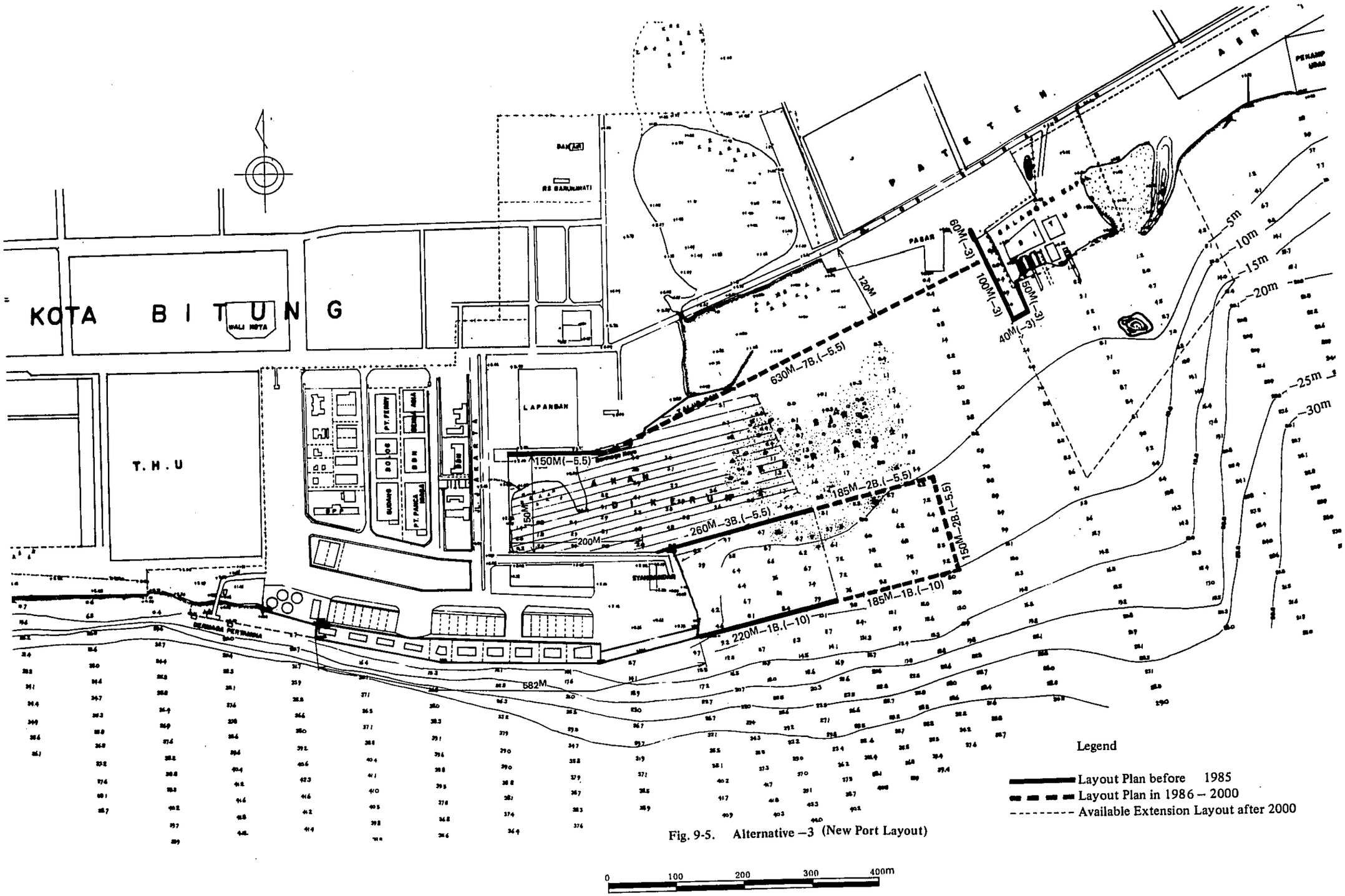


Fig. 9-5. Alternative –3 (New Port Layout)

Fig.9-6 Master Plan of Port of Bitung in 2000 (Alternative-1)

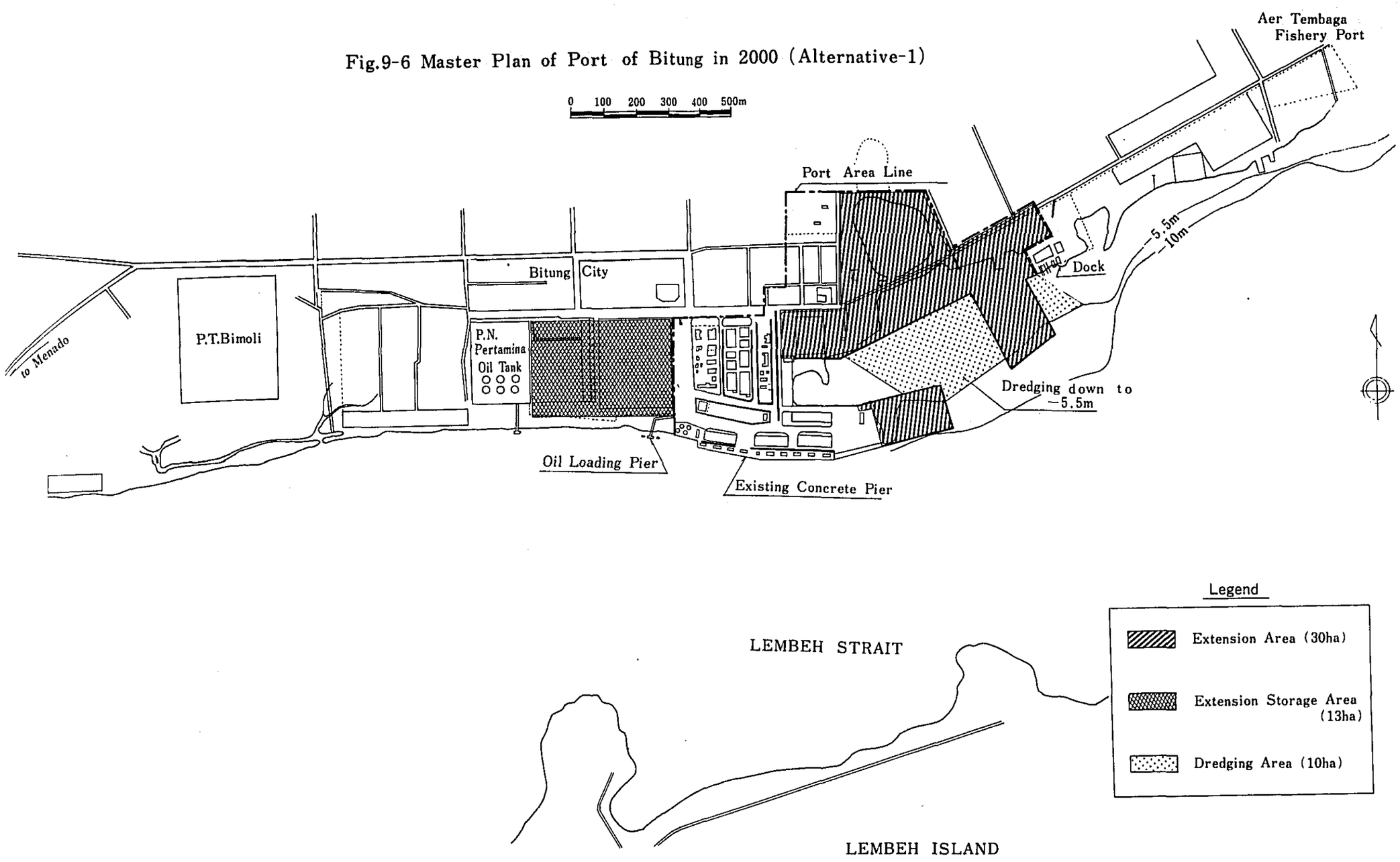


Fig.9-7 Master Plan of Port of Bitung in 2000 (Alternative-2)

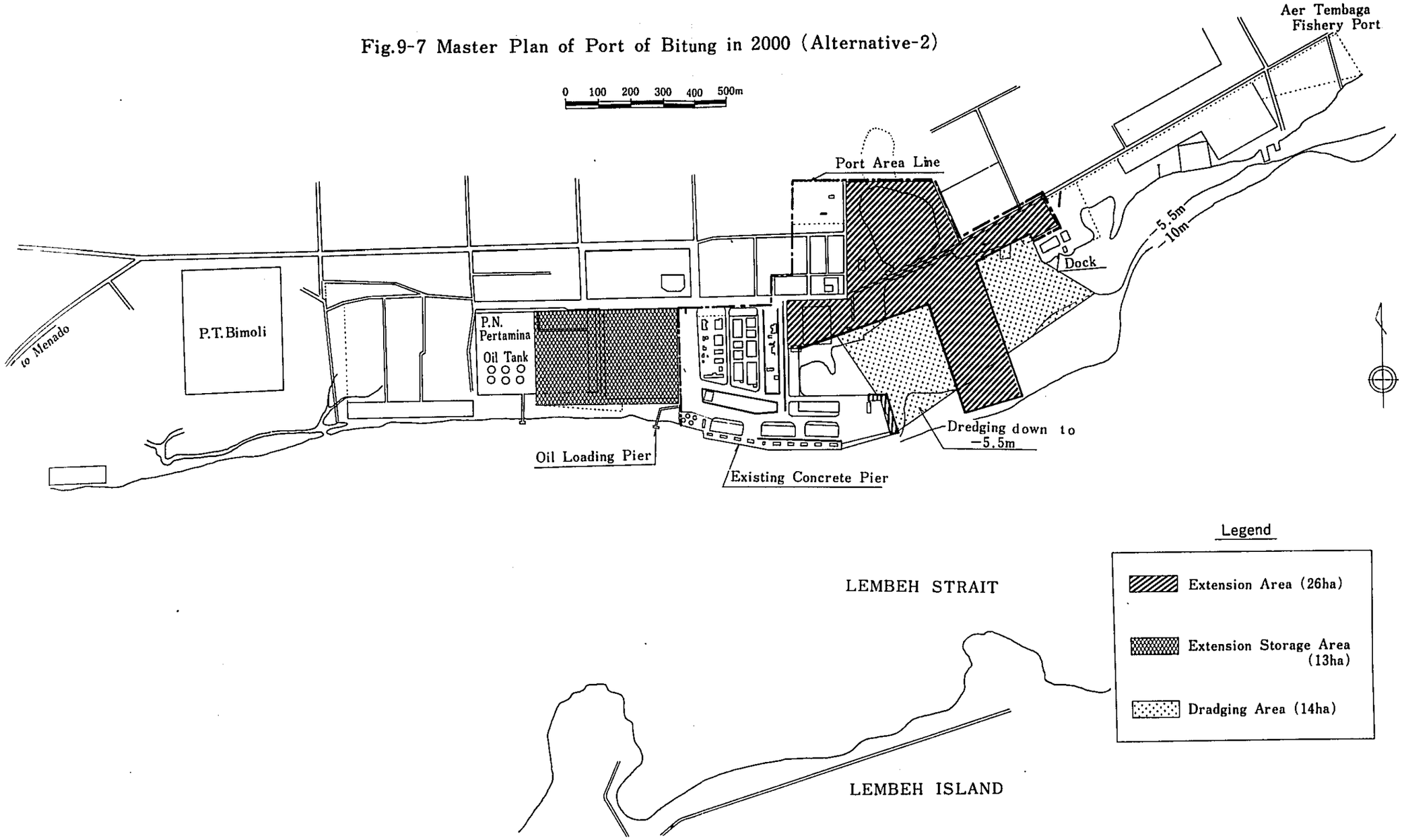
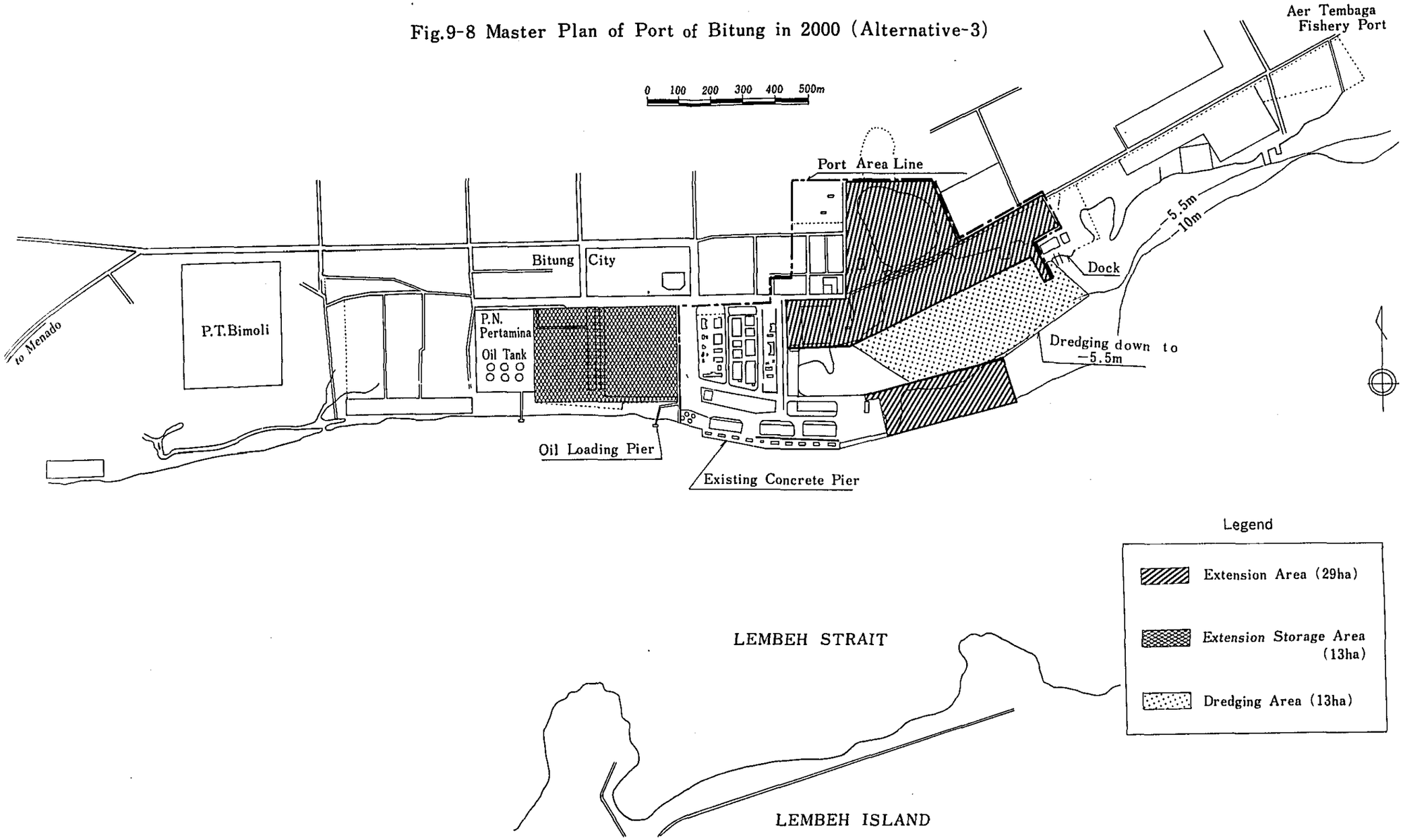


Fig.9-8 Master Plan of Port of Bitung in 2000 (Alternative-3)



are described in the previous section, and the layout of new berths will be made in conformity with the descriptions. However, the number of berths for a -10 m wharf and a -5.5 m wharf may be subject to change, depending upon the contents of the three plans since the existing concrete piers can be utilized also for domestic trade.

Berths for local vessels, port service boats, official-use boats and passenger's vessels, berths with total length of 300 m consisting of 150 m of part of a -5.5 m wharf being constructed now behind the existing concrete piers and of 150 m of a -4m wharf planned for new construction, will be considered in each of the three plans.

2) Type and size of vessels are determined as shown below.

Ocean going vessels:	15,000 D.W.T.
RLS vessels:	2,000 D.W.T. average
	3,000 D.W.T. maximum
Local vessels:	700 to 1,000 D.W.T.

3) Each berth should be used by specific types of vessels.

Especially, local vessels, boats for port service, boats for official use and passenger's vessels and sailing vessels should be separated as much as possible from berths for large vessels and RLS vessels.

For a certain period of time during construction, large vessels and RLS vessels may use common berths but, after completion, these berths should be used by specific vessels only if so desired.

4) Easy ship navigating is fully taken into consideration.

The current of Lembeh Strait will not have too much affect on the entrance and departure of vessels. However, the face line for large vessel berths is planned in such a manner that the face line will become parallel with or become close to parallel with the current of the strait as much as possible. In addition, the width of the harbor entrance and turning basin in the port are properly secured for each specific type of vessel.

5) Background area should be secured.

In Bitung East, the area behind the port is not wide enough so that the securing of land may be limited to a certain degree, but securing the largest amount of land required is taken into consideration. Land with a minimum width of 120 m can be secured for this purpose behind the face line of the wharf in the south side of the road between Bitung and Aer Tembaga. Also for a jetty type wharf,

securing of a 180 m wide jetty area is considered but this is inevitably reduced to 130 m to 150 m in some cases due to interference with existing facilities.

6) Soil conditions and water depth should be considered.

In discussing the soil in the Bitung East area, the foundation layer is deeply located at the center of the bay east or northeast of the concrete pier and shallowly located gradually as it goes west and east from there so that this is advantageous for the construction of structures.
In regard to water depth, a -10 m contour line runs along the face line in front of the concrete pier approximately in parallel with the current of the strait so that it is considered to be advantageous to maintain construction on the further north side than the contour line.

7) Future space for port expansion after the year 2000 should be taken into consideration.

This may not be directly related to the purpose of this report but, in view of the potentiality of the Port of Bitung, space allowed for future expansion is projected in advance within a certain degree of possible limit, and special cautions should be taken so as not to obstruct future expansion and for providing flexibility responding to transport innovations in the future.

9-3-3. Selection of a Long Term Plan as an Alternative

Preliminary plans and rough estimates for construction costs as Alternative 1, 2 and 3 are shown in the following Tables 9-2, 9-3 and 9-4.

Table 9-2 Construction Plan of Main Facilities of Port of Bitung for Alternative – 1

Facilities \ Year	~ 1985	1986 ~ 2 000	Total	2 000 ~ (Future Expansion)
– 10 m Wharf (Ocean going Vessels)	0	1 Berth 220m [*1]	1 Berth 220m	3 Berths
– 5.5 m Wharf (RLS Vessels)	6 Berths 540m (450m + 90m)	10 Berths 860m [*2] (150m+260m+180m+180m+90m)	16 Berths 1,400m	3 Berths
– 5.5 m Wharf (Local Vessels)	150m	–	150m	
– 3.0 m Lighter Wharf (Sailing Vessels)	130m [*3] (100m + 30m)	–	130m	
Temporary Revetment	180m	–	180m	
Cost Estimate of Construction	21.422 million US$	28.7 million US$	50.122 million US$ (Approx.)	

*1 Including 35m extention to existing berth.

*2 Water depth of these 3 berths is 6m

*3 Including side wall length 30m

Table 9-3 Construction Plan of Main Facilities of Port of Bitung for Alternative – 2

Facilities \ Year	~ 1985	1986 ~ 2 000	Total	2 000 ~ (Future Expansion)
– 10 m Wharf (Ocean going Vessels)	0	1 Berth 220m [*1]	1 Berth 220m	3 Berths
– 5.5 m Wharf (RLS Vessels)	6 Berths 520m (70m+270m+90m+90m)	10 Berths 850m [*2] (360m+360m+130m)	16 Berth 1,370m	4 Berths
– 5.5 m Wharf (Local Vessels)	150m	–	150m	
– 3.0 m Lighter Wharf (Sailing Vessels)	90m	–	90m	
Temporary Revetment	185m	–	185m	
Cost Estimate of Construction	22.6 million US$	29.4 million US$	52.0 million US$ (Approx.)	

*1 Including 35m extention to existing berth.

*2 Water depth of these 3 berths among 10 berths is 6 m.

Table 9-4 Construction Plan of Main Facilities of Port of Bitung for Alternative – 3

Facilities \ Year	~ 1985	1986 ~ 2 000	Total	2 000 ~ (Future Expansion)
– 10 m Wharf (Ocean going Vessels)	1 Berth 220m [*1]	1 Berth 185m	2 Berths 405m	1 Berth
– 5.5 m Wharf (RLS Vessels)	3 Berths 260m	11 [*2] Berths 965m (150+185+630)	14 Berths 1,225m	
– 5.5 m Wharf (Local Vessels)	150m	–	150m	
– 3.0 m Lighter Wharf (Sailing Vessels)	100m+140m [*3] (100+30+50+60)	–	240m	
Temporary Revetment	150m	–	150m	
Cost Estimate of Construction	23.4 million US$	31.0 million US$	54.4 million US$ (Approx.)	

*1 Including 35m extension to existing berth

*2 Water depth of these 3 berths among 10 berths is 6 m

*3 Including the length of side wall 40m+50m+60m.

Merits and demerits of these Alternatives are compared here and an outline evaluation is shown in the table below (Table 9-5).

Table 9-5 Comparison of the Alternative Layout Plans

Comparative Factors		Alternative 1	Alternative 2	Alternative 3
Construction Cost	1985 Plan	Medium	Low	High
	1986/2 000 Plan	Medium	High	Low
	Total	Low	Medium	High
Concentration of Foreign Trade Area		Possible	Impossible	Possible
Separation of Sailing Vessels		Possible	Possible	Not Perfect
Ship Maneuvering		Excellent	Good	Possible
Room for Further Expansion		Large	Large	Only around the Surface Attached to Ship Yards
Overall Priority		1	2	3

As a basis of the evaluation, the items such as economic problems, construction costs, problems in utilization, possibility of unified layout for foreign trade berths, ease of ship navigation, and the possibility of separating sailing and other vessels have been considered. In addition, the possibility of future port development is also considered from a long-term viewpoint.

These three plans were made for laying out facilities with similar quality and quantity within a limited area so that they will not greatly differ from the other. However, Alternative-3 is highest in cost and has some elements for navigation and port utilization which are inferior to the other two plans.

There is no outstanding difference between Alternative-1 and 2 and a decision on superiority or inferiority seems to be very difficult to make. However, as far as easiness for unified utilization and management of the foreign trade wharf area are concerned, Alternative-1 is more likely to be advantageous. And also for the ease of ship navigation within the inner harbor during entrance and departure, Alternative-1 seems to be slightly better due to the shape of face line of the berth.

Therefore, this report uses Alternative-1 as the proposed plan for the expansion project.

Chapter-10 Medium Term Plan

10. Medium Term Plan

10-1. General

As a result of investigation for a long-term plan, in Section 9-3, the alternative-1 is selected as the proposed plan, then, medium-term plan is formulated within the frame work of the alternative-1, and will be described in the following (Reference Figs. 10-1 ~ 10-4).

10-2. Plan of Berthing Facilities

The volume of cargo handled at the berths on the public wharf in the medium term plan is shown in Table 7-2. The length of wharves required for such volume of cargo is estimated as given below.

	Required berth	Existing berth	Extension berth
Foreign trade -10 m wharf (15,000 D.W.T.)	$\frac{321{,}000 \text{ ton}}{185 \text{ m/B} \times 900 \text{ ton/m}} \fallingdotseq 2$ Berth	3 Berth (582 m)	–
RLS vessels -5.5 m wharf (2,000 - 3,000 D.W.T.)	$\frac{614{,}000 \text{ ton}}{90 \text{ m/B} \times 700 \text{ ton/m}} = 10$ Berth	2 Berth (200 m)	*1 8 Berth *2 (150m + 90m x 6 B)
Local vessels -5.5 m wharf (700 - 1,000 D.W.T.)	$\frac{44{,}000 \text{ ton}}{90 \text{ m/B} \times 500 \text{ ton/m}} \fallingdotseq 1$ Berth	-	
Port service vessels & Passenger vessels -5.5 m wharf	150 m	*3 150 m	–
Sailing vessels -3.0 m wharf	100 m		130 m *4 (100m + 30m)
Temporary revetment	–	–	*5 180 m

Note: *1. Ecisting 1 berth of the -10 m wharf is used as berth for RLS vessels.
Of 10 berths of the -5.5 m wharf, 3 berths will be constructed for -6 m water depth.

*2. Berth extension of 150 m is considered as 2 berths.

*3. Berthing facilities for plying boats and official vessels and also for passenger vessels are required, and the berth extension of 150 m now under construction is allocated for such purpose.

Fig.10-1 Medium Term Plan of Port Terminal Facilities (Alternative-1)

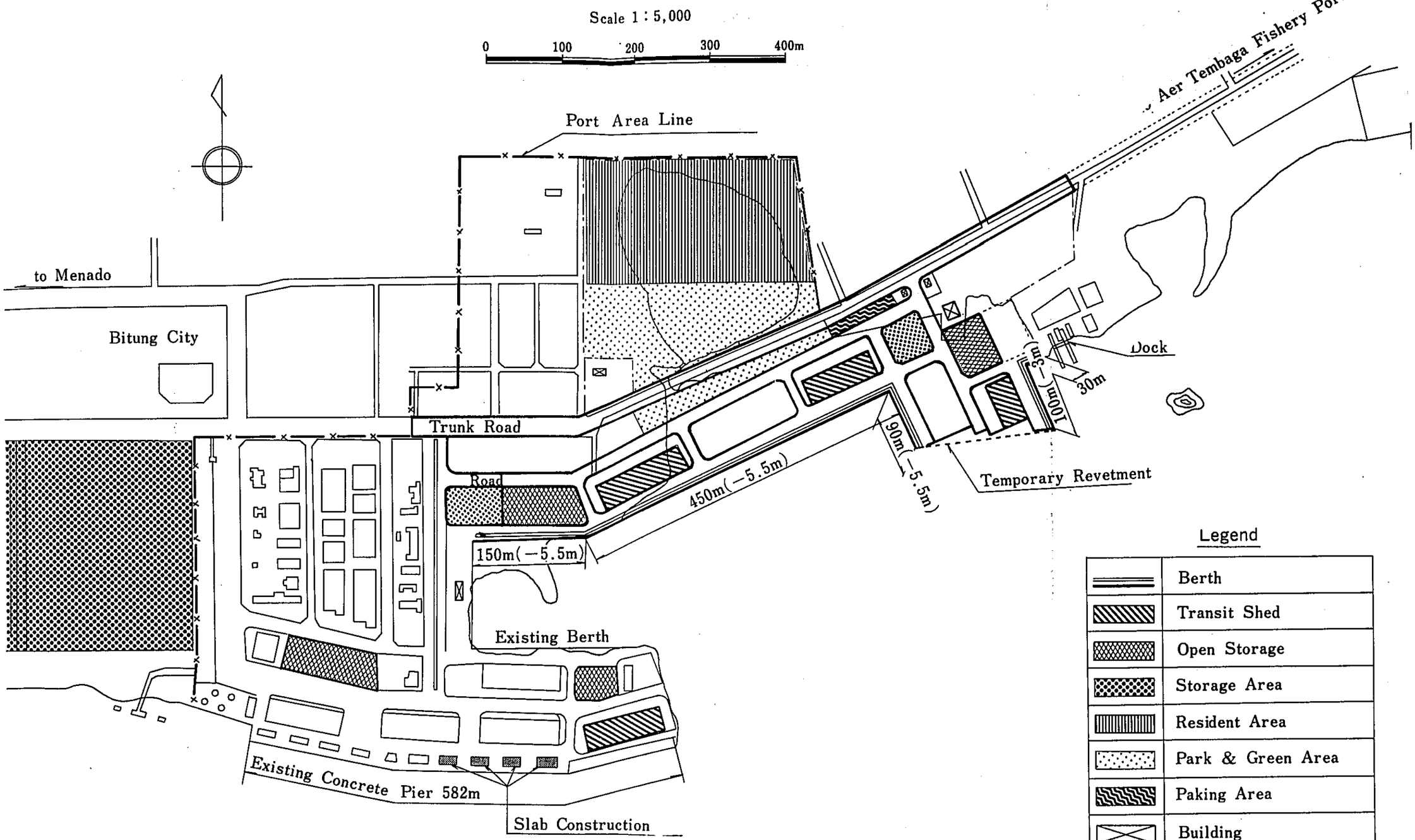
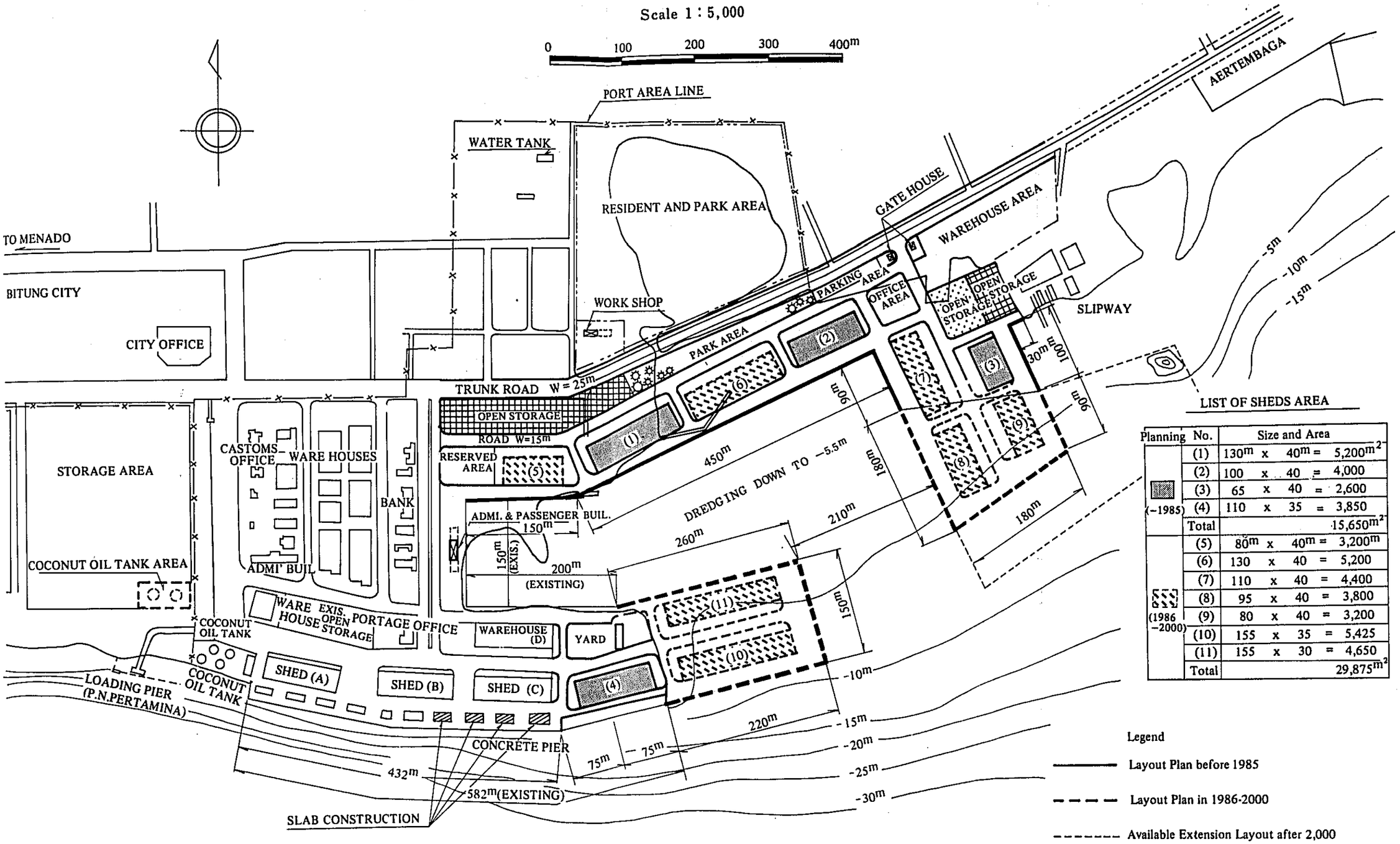


Fig.10-2 Alternative-1. Layout of Port Terminal Facilities

Scale 1 : 5,000



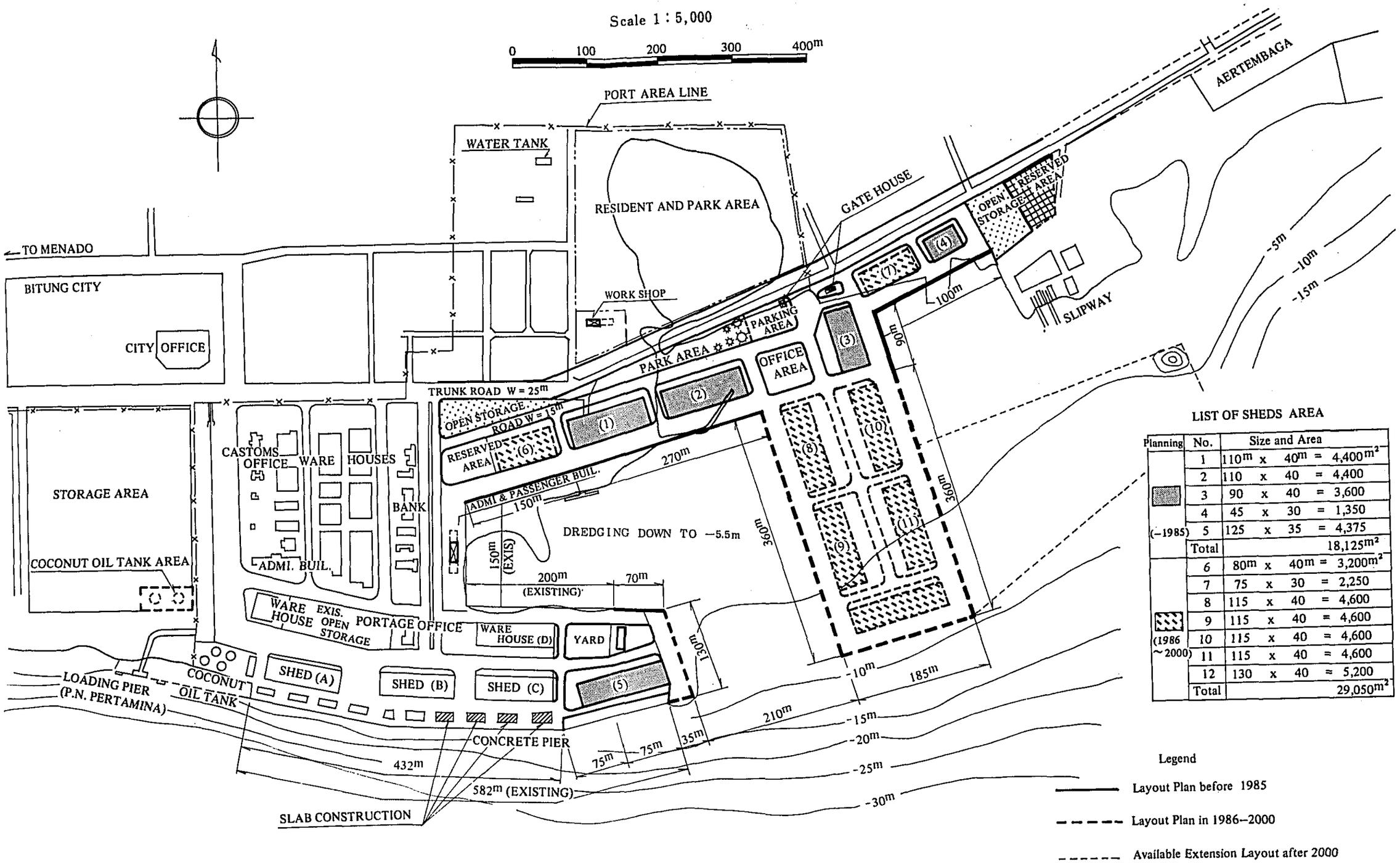
LIST OF SHEDS AREA

Planning	No.	Size and Area
(-1985)	(1)	130m x 40m = 5,200m²
	(2)	100 x 40 = 4,000
	(3)	65 x 40 = 2,600
	(4)	110 x 35 = 3,850
	Total	15,650m²
(1986 -2000)	(5)	80m x 40m = 3,200m
	(6)	130 x 40 = 5,200
	(7)	110 x 40 = 4,400
	(8)	95 x 40 = 3,800
	(9)	80 x 40 = 3,200
	(10)	155 x 35 = 5,425
	(11)	155 x 30 = 4,650
	Total	29,875m²

Legend

- Layout Plan before 1985
- Layout Plan in 1986-2000
- Available Extension Layout after 2,000

Fig.10-3 Alternative－2. Layout of Port Terminal Facilities



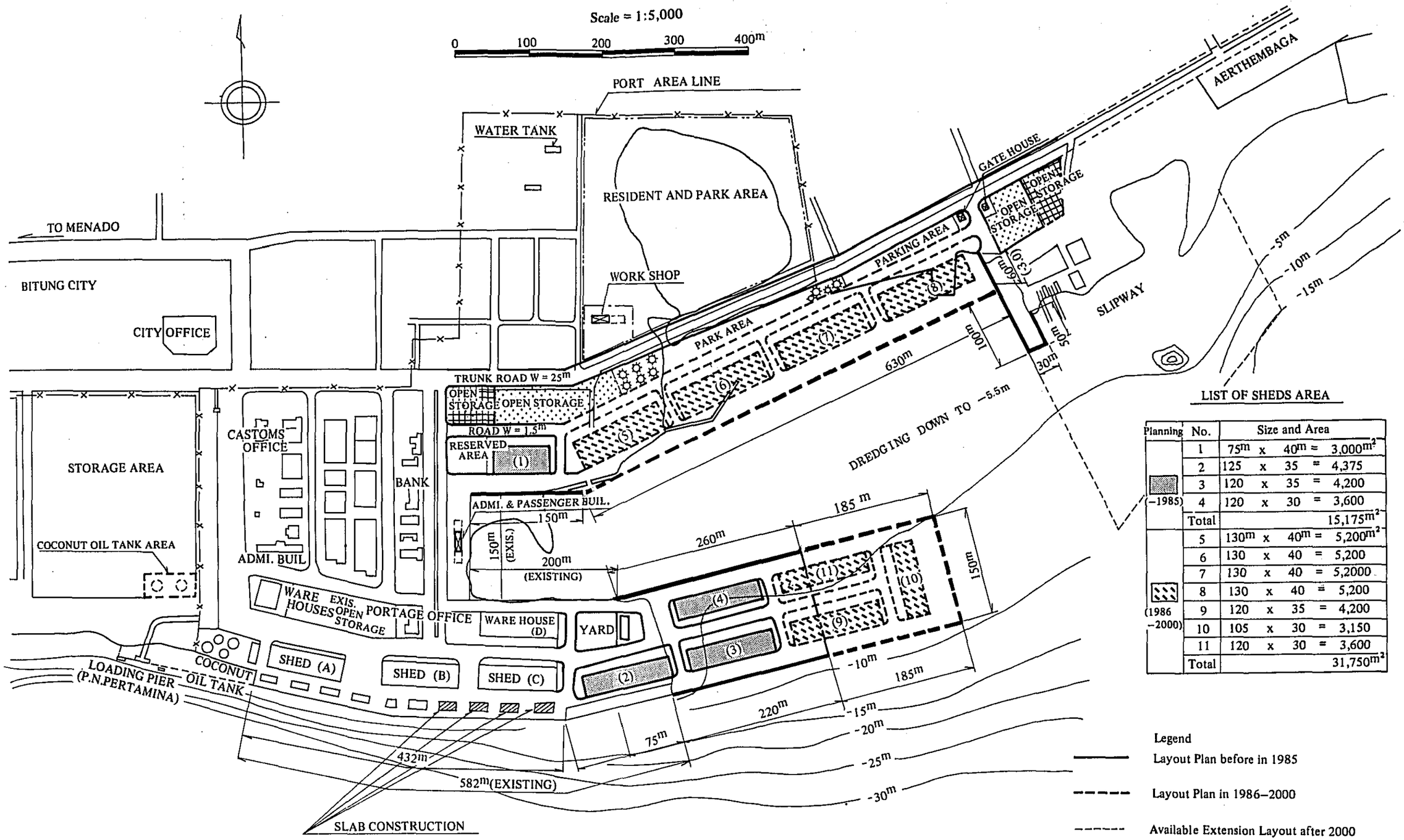
LIST OF SHEDS AREA

Planning	No.	Size and Area
(－1985)	1	110m x 40m = 4,400m²
	2	110 x 40 = 4,400
	3	90 x 40 = 3,600
	4	45 x 30 = 1,350
	5	125 x 35 = 4,375
	Total	18,125m²
(1986 ～2000)	6	80m x 40m = 3,200m²
	7	75 x 30 = 2,250
	8	115 x 40 = 4,600
	9	115 x 40 = 4,600
	10	115 x 40 = 4,600
	11	115 x 40 = 4,600
	12	130 x 40 = 5,200
	Total	29,050m²

Legend

- Layout Plan before 1985
- Layout Plan in 1986--2000
- Available Extension Layout after 2000

Fig.10-4 Alternative—3. Layout of Port Terminal Facilities



LIST OF SHEDS AREA

Planning	No.	Size and Area
(–1985)	1	75m x 40m = 3,000m²
	2	125 x 35 = 4,375
	3	120 x 35 = 4,200
	4	120 x 30 = 3,600
	Total	15,175m²
(1986 –2000)	5	130m x 40m = 5,200m²
	6	130 x 40 = 5,200
	7	130 x 40 = 5,2000
	8	130 x 40 = 5,200
	9	120 x 35 = 4,200
	10	105 x 30 = 3,150
	11	120 x 30 = 3,600
	Total	31,750m²

Legend
- Layout Plan before in 1985
- Layout Plan in 1986–2000
- Available Extension Layout after 2000

*4. Includes an access berth of 30 m to the present ground.

*5. The extension in the long term plan is considered as a temporary revetment.

In this estimation, for the annual port tonnage traffic per meter of the wharf, the following figures will be considered: 900 tons/m for the foreign trade wharf; 700 tons/m for the RLS vessels wharf; and 500 tons/m for the local vessel wharf.

As a plan for use of the berthing facilities, the existing -10 m wharf is classified for exclusive use for foreign trade (partly used as wharf for RLS vessels), and the newly constructed -5.5 m wharf as wharf for RLS vessels.

The wharf for the plying boats and official vessels and the berth for passenger vessels were arranged at the inner part in the planned mooring basin, with the local vessel wharf arranged alongside, so that they would be separated from the large vessel wharf as far as practicable. Further, it was planned that the sailing vessel wharf would be arranged as close to the existing shipyard as possible so that the sailing vessels could come into the port directly from the access channel (Lembeh Strait) and that the wharf could be separated from the other wharves.

10-3. Mooring basin

The mooring basin is arranged as shown in Fig. 10-2 - 10-4. This arrangement is advantageous in that a longer face line is obtainable in a narrower range, that dredged soil can be used for reclamation and that calmness of the mooring basin is secured.

The port entrance to the mooring basin will have a width of 210 m to allow easy entry and exit of 3,000 D.W.T. class vessels, while securing space for permitting turning of vessels within the mooring basin will be considered.

Further, a wharf of -5.5 m water depth is planned to allow berthing of 2,000 D.W.T. class vessels under full-load draft, with the mooring basin dredged to an equivalent depth of -5.5 m. Provided, with the current status of contour lines taken into account, the wharf closer to the port entrance is constructed to a depth of -6 m to be used by 3,000 D.W.T. vessels.

10-4. Storage Facilities Plan

As cargo storage facilities for the Port of Bitung, transit sheds and open storage are planned. For the warehouses, it is planned to leave their construction and operation in the hands of private companies with only the required land secured in the port area.

The sheds are arranged in the back of the wharf apron (with a width of 25 m standard). The required area of the shed for port traffic in the year 1985 is as shown below. Here, it is assumed that 50% of the cargo will transit the sheds.

	Cargo volume	Required area of shed	Shed use plan (Alternative-I)	
For foreign trade	321,000 x 0.5 = 160,500 ton	8,900 m^2	Existing shed Newly planned shed Total	6,700 m^2 3,850 m^2 10,550 m^2
For domestic trade	677,000 x 0.5 = 338,500 ton	18,800 m^2	Existing shed Newly planned shed Total	11,000 m^2 11,800 m^2 22,800 m^2

Note: The required shed area was calculated with the cargo storage quantity per unit area taken at 2.0 t/m^2, shed rotation at 15 cycles/year and cargo storage ratio at 0.6.

Layout of the sheds is planned as shown in Fig. 10-2. The sheds have a width of 40 m which is convenient for use and a length taken appropriately for the face line of the wharf respectively. The construction is of iron frame with corrugated asbestos cement roofing.

In planning the open storage, it is assumed that 10% of the total cargo will transit from the open storage. With the cargo storage quantity per unit area taken at 2.0 t/m^2, rotation at 6 cycles/year and the cargo storage ratio at 0.7, the area required for open storage is A = 12,000 m^2. Existing open storage is available for about 9,000 m^2, the area to be newly provided is 3,000 m^2. However, with the existing open storage being located at a remote place from the newly installed wharf, the site allocated for a shed under the long term plan (Shed No.5 in Fig. 10-1) is used as open storage, while an additional space is provided near the sailing vessel wharf, so that the open storage has enough space as a whole. Further, to cope with generation of new forms of cargo such as containers in the future, an exclusive open storage of about 3,000 m^2 for heavy cargo is planned and provided near the foreign trade wharf (existing concrete pier).

The open storage area, both existing and newly installed, has asphalt pavement to permit introduction of handling equipment in rainy weather.

10-5. Port Administration Facilities Plan

It is planned to newly install a small building of about 500 m^2 as the

wharf administration office for convenience of administration and operation since the wharves extend over a wide range. However, the existing administration office continues to be primarily responsible for administration and operation, and the new building has a sub role.

The passenger terminal is located presently at about the center of the existing concrete pier so that the passenger traffic crosses with the cargo handling on the apron, thus causing inconvenience and involving safety problems. In the medium term plan, the terminal is relocated.

The passengers in the year 1985 are estimated to be 25,000 persons/year maximum or 70 persons/day on the average. To cope with such figures, a new terminal building of 300 m^2 is planned.

For effective use of the handling equipment, proper maintenance and repair are indispensable factors. Thus, a 200 m^2 workshop is constructed.

As a rest area for workers, a space of about 500 m^2 is proposed. Small and simply constructed buildings, each having a lavatory and a shower room, are distributed in several places.

As for other facilities, there is a power receiving and transformation station, water station, guardhouse, and fence and gate.

10-6. Road Plan

The trunk road also serves as the city road of Bitung so that adjustment with the city planning of Bitung is required. This route serves as a trunk line connecting the urban area of Bitung with the Aer Tembaga fishery port so that a road capacity is required commensurate with the total volume of traffic generated, such as cargo generated in the fishery port, cargo generated in the commercial port and intra-city traffic. Thus, a road of a width of 25 m with a median strip, sidewalk on each side and four lanes for both inbound and outbound traffics is planned. With four lanes provided for inbound and outbound traffic inclusive, it can cope with the traffic volume of a total of 5,000 vehicles/hour at the peak.

With respect to the plan of the main road in the new Port of Bitung, the road planned is extended and used as the road in the long term plan so that a road width capable of complying with the traffic volume forecast in the long term plan is considered.

Now assuming a road in the largest area of the pier region in the lay-out plan and considered with respect to Plan-2:.

With;

Wharf cargo handling volume at about 1,000,000 tons/year;
Average loading capacity of trucks at 1 ton/truck; and
proportion of the passenger and other vehicles to trucks at 2.5,

Then;

Traffic volume per hour:

$$\frac{1{,}000{,}000 \text{ ton/yr.}}{1 \text{ ton/truck} \times 365 \text{ day} \times 7 \text{ hr.}} \times 2.5 \fallingdotseq 1{,}000 \text{ Trucks/hr.}$$

Corresponding to such traffic volume and also in consideration of the access of vehicles from the road to the sheds, turns, runs, etc., a 15 m wide road with four lanes for inbound and outbound traffic is planned. For the access road to the wharves, a width of 10 m is considered.

10-7. Water Supply, Oil Supply and Electric Power Supply Facilities Plan

The water station in the Port of Bitung will have the water supplied from the Waterwork Bureau of the City of Bitung. To make up for shortage in the quantity of water supplied per hour from the City of Bitung, a reservoir is provided. Further, to increase the water pressure, it is planned to install a elevated water tank, and pipelines to the newly constructed wharves are planned also. The existing piers have presently water supply pipelines, so that under the plan, only changing the routes of water supply is taken as an objective.

As fire extinguishing facilities on land, hydrants on wharves are provided in several places. For fire fighting at sea, fire extinguishing equipment on board the newly procured tugboats will be used.

As regards the fuel supply, fuel oil handling and management are made by P.N. Pertamina, supply to the vessels being made by bunker vessels, etc.

The electric power facilities have the power supplied from the National Electric Power Corporation (P.L.N.) located in the City of Bitung. With a power receiving and transformation station provided in the Port of Bitung, the power will be distributed to the newly installed and existing lighting facilities.

Further, to insure minimum lighting for security in an emergency, an independent power plant is planned.

10-8. Cargo Handling Equipment and Port Service Vessels

The estimated quantity of port tonnage traffic through the Port of Bitung up to the year 1985 totals 998,000 tons, with foodstuff estimated to constitute 18%, agricultural products 22% and construction materials 32%, and thus the cargo is considered in the form of bulk cargo and general cargo. Therefore, in the stage of the medium term plan, there will be no generation of a large amount of

special cargo. Further, rice, coconut-oil cakes and fertilizer are transported presently in bags, and it is considered that there will be no change in the type of packing for the time being. Accordingly, the handling method is such that there will be no installation of special facilities such as an exclusive wharf, silo, special crane, etc. for the time being but that handling as general cargo will be considered.

Cargo handling from the vessel to the shed is made mainly by forklift. As a rule, the foreign trade wharf has standard four units of forklifts provided per berth, and the domestic trade wharf has standard two units of forklifts per berth. Concurrently, additional installation of cargo handling equipment to be used on the existing wharves will be considered.

Additionally, provision for truck cranes and trailers is planned to permit handling of cargo of weight and length.

Port service vessels will also be additionally acquired to cover the shortage in existing vessels and answer to expansion of the facilities.

In the medium term plan, the handling equipment and port service vessels are planned as follows.

Forklift	6	ton	6 units
Forklift	2.5	ton	22 units
Truck crane	35	ton	1 unit
Trailer	20	ton	4 units
Tugboat (with fire extinguishing equipment)	600	ps	1 unit
Pilot boat	50	G.T.	1 unit
Motor boat	40	ps	1 unit

10-9. Land Use Plan

The port land is subject to certain restrictions due to relationships with the service area so that vast land is not always procurable. But, as effective a land use as possible is planned so that the required land will remain within the range of the existing port land area. Land use under the medium term plan is contemplated so that it would have a relationship with the long term plan in the future and also with the layout plan of the facilities in the wharf area. The land use is illustrated in Figs. 10-2 through 10-4, and its outlines are as follows.

1) The present swampy land north of the road running between Bitung and Aer Tembaga is reclaimed. Being adjacent to the urban area of Bitung, this area is used mainly as a green area and park site to harmonize with the city. But, partly, it is used as quarters for official residences and land for workshops of handling equipment.

2) The strip area between the road south of the road between Bitung and Aer Tembaga and the sheds is used mainly as open storage and as a parking lot with part saved for the warehousing site, but in the central part a park is provided to present a nice appearance to the wharf area.

3) Near the sailing vessel wharf in the east, a land area for gate and office is secured.

4) Land area for a parking lot and green land is secured near the administration office and passenger terminal building.

5) The area immediately in back of the existing oil unloading pier owned by P.N. Pertamina (now used for a recreation center and market (T.H.U.)) is extended as a port area, a part of which is allocated as a coconut oil storage tank yard and a greater part of which is allocated as a warehousing site.

10-10. Navigation Aids

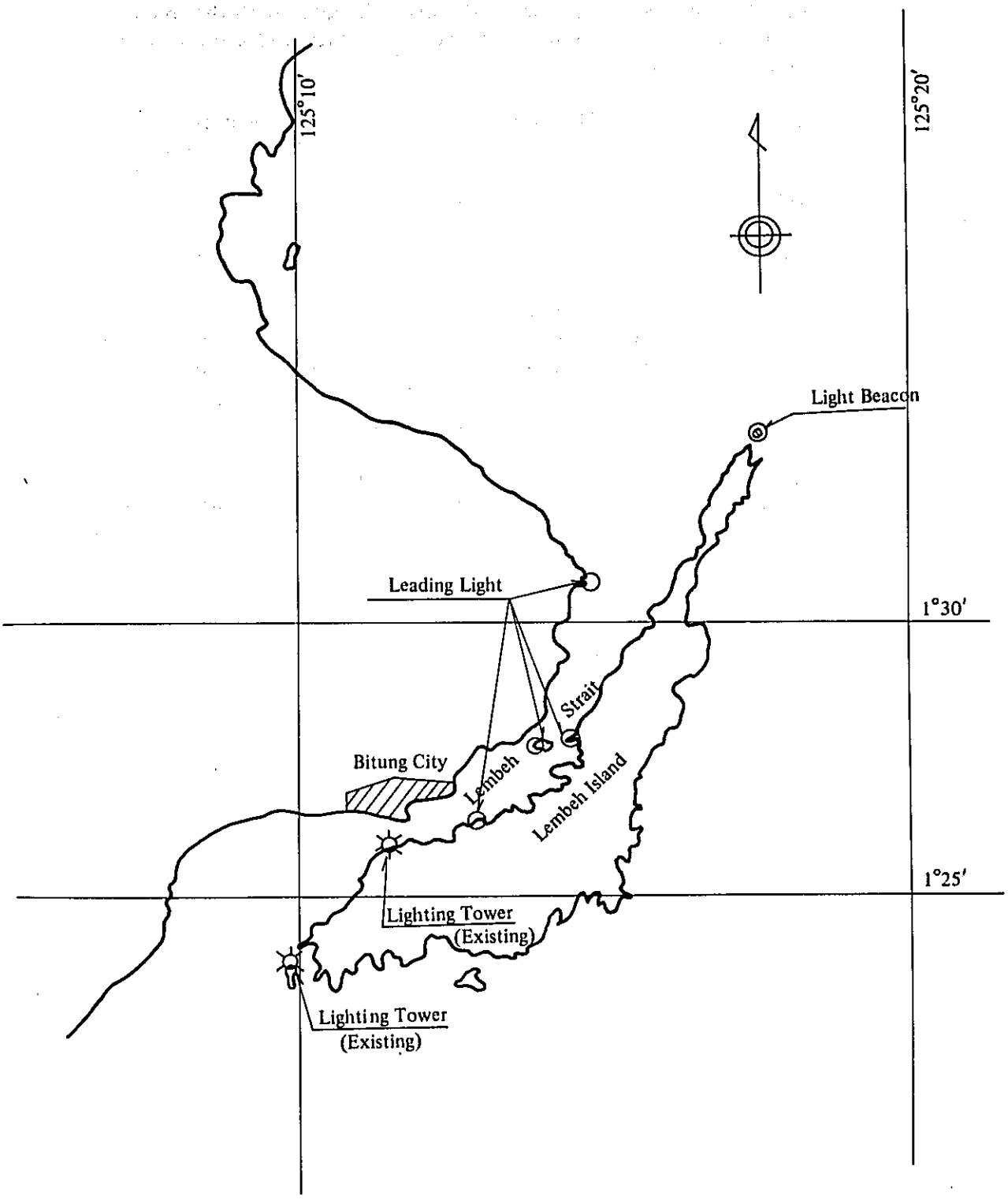
South of Lembeh Island exist aids-to-navigation. With these facilities utilized, there is no problem for navigation of vessels in the southern water area to the Port of Bitung. However, in the channel in the northern part of Lembeh Strait, there is no aids-to-navigation provided, while there are islands situated in the central part of the strait so that there is danger for vessels passing through the strait. Thus, five sets of aids-to-navigation are provided as shown in Fig. 10-5.

10-11. Other Facilities

1) Additional installation of slabs that are lacking on the aprons of the existing pier.

   Slabs are lacking on the aprons in some places. This impedes handling efficiency and is not desirable for insuring safety. To enhance the handling efficiency further with increasing cargo handling equipment to be installed hereafter, slab work must be done where they are lacking. In the medium term plan, slab installation is made at four places to permit use of one berth of the foreign trade wharf.

Fig. 10-5. Location of Navigation Aids



2) Coconut oil storage facilities

The estimated volume of coconut oil to be handled at the public wharf in the future and, when the oil is handled with the existing tanks (capacity 3,800 tons in total), the rotation of the tanks are as given below.

Year	Handling quantity (tons)	Rotation (Cycles/year)
1976	27,500	7
1985	39,000	10
2000	71,000	19

If the rotation of the coconut oil tanks is taken as 10 cycles/year, the existing tanks can accommodate the storage up to 1985. However, in the long term plan, installation of additional coconut oil tanks with a total capacity of about 3,300 tons is required. For construction, the port area to be extended in the back of the Pertamina Oil Pier will be allocated, as described in Section 10-9.

With such a plan, the berth at the west end of the existing concrete pier can be used as an exclusive berth for special cargos such as coconut oil and cement in the future.

Chapter- 11 Construction Plan

11. Construction Plan

11-1. General

While the construction of the port facilities is planned under the medium term plan described in Chapter 10 and upon the layout plan (Fig. 10-1), the following may be cited as principal factors pertaining to construction at the Port of Bitung.

1) Natural conditions - Works at sea is of greater weight, but the sea conditions (waves and wind) are generally good so that it is possible to do work throughout the year. However, care should be exercised against decreasing work efficiency during the rainy season.

2) Executing capacity - Since there are no large contractors available at the site or in its peripheral area, they will have to be introduced from the outside. The same applies to the major construction machinery and skilled labor.

3) Materials - Timber, stone and aggregate for concrete are produced in this area and are, therefore, available in required quantity. But, the materials such as standardized products for construction, cement and steel which are used in great quantity must be introduced from the Java Island or other area.

4) Construction base - Space which is by no means spacious enough, but is usable as a work yard, is available within the port area, and for transporting the materials and equipment by sea, the existing pier is usable.

The following shows the facilities schedule taking into full consideration the foregoing work conditions, as well as the soil condition, resistance to earthquakes, durability and economy of this port.

11-2. Basic Design

11-2-1. Wharf Facilities

Here, the basic design is shown with respect to the foreign trade vessel berthing -10 m wharf and domestic trade vessel berthing -5.5 m wharf. Principal design conditions are as follows:

Tide level: H.W.L. +1.9 m

Wharf crown height: D.L. +3.0 m

Surcharge:	Normally 2.0 t/m^2, At earthquake, 1.0 t/m^2	
Design seismic coefficient:	Horizontal seismic coefficient k_h = 0.15	
Objective vessels:	15,000 D.W.T. (Length 165 m, draft 9.5 m) ------ -10 m Wharf	
	3,000 D.W.T. (Length 90 m, draft 5.7 m) ------ -6 m Wharf	
	2,000 D.W.T. (Length 77 m, draft 5.1 m) ----- -5.5 m Wharf	
Berthing speed:	15 cm/sec	15,000 D.W.T.
	15 - 20 cm/sec	3,000 - 2,000 D.W.T.

As the optimum wharf structure, the open type structure was chosen for the -10 m wharf, and the sheet pile type structure for the -5.5 m wharf. Structural diagrams of the wharves are shown in Fig. 11-1. Provided that the -10 m wharf is to be constructed under the long term plan.

The soil for the new wharves is such that the foundation layer is shallow in the west and deep east of the mooring basin. Thus, as a measure of preventing uneven settlement, the wharves were designed with the pile length changed for the east and west sides respectively.

As an alternative plan, structures of the sheet pile type for the -10 m wharf and of the open type for the -5.5 m wharf were considered, as illustrated in Fig. 11-2. But, they are of higher cost than the former respectively and are not used. As another alternative, the gravity type (caisson type), concrete block type, cellular block type or L-form retaining wall type is conceivable. But, such types were not advantageous in the scaffolding, construction method, resistance to earthquakes and construction cost, thus, it was not used.

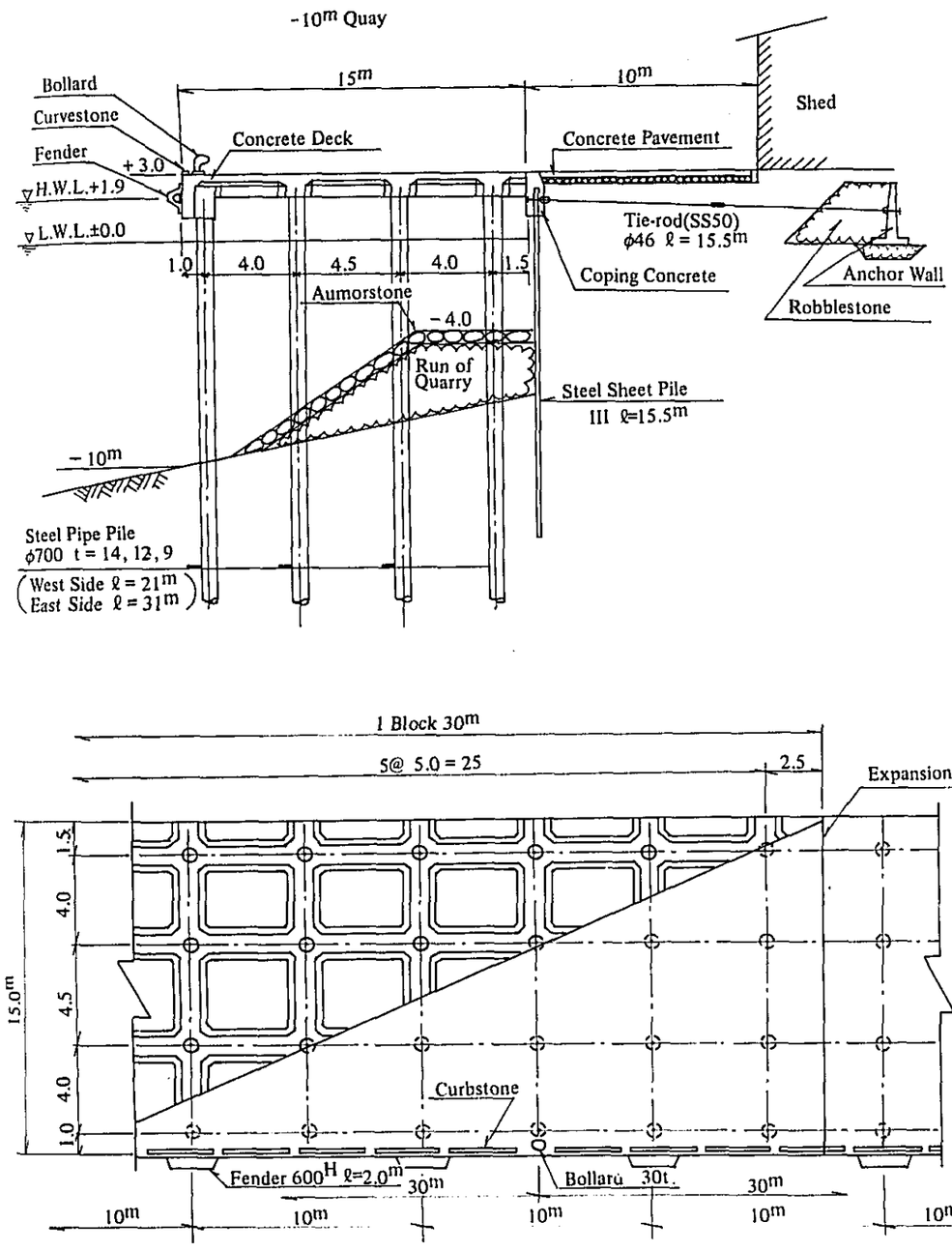
To connect with the facilities under the long term plan, temporary revetments have been considered.

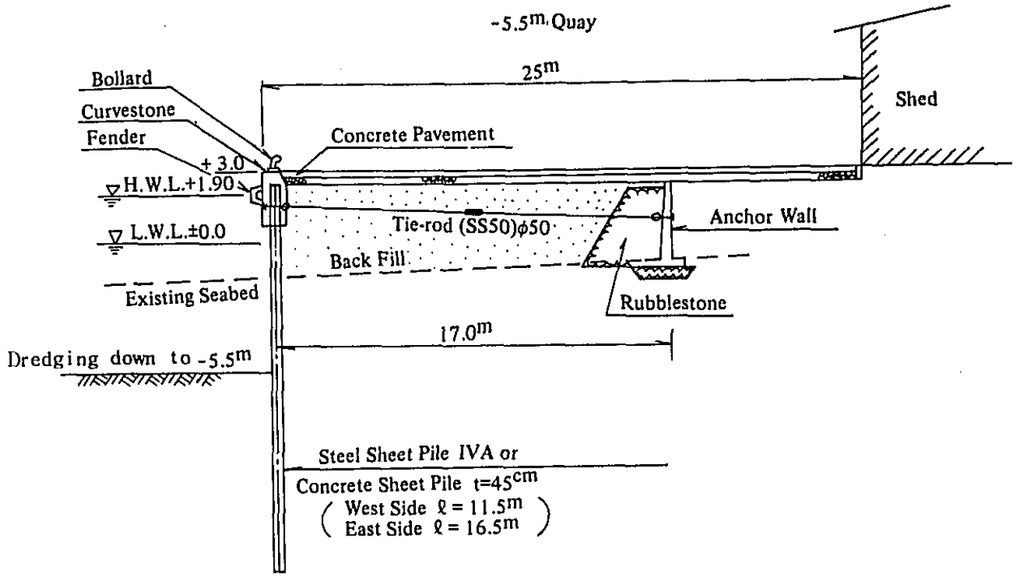
11-2-2. Transit Sheds

With a surcharge of 20 t/m^2 considered, the transit sheds have concrete base floors. The structures are steel frame with a standard span of 40 m and corrugated asbestos cement sheet roofing. Some of them are constructed on the reclaimed land, but the present sea bottom soil has a sand layer so that if compaction is carried out thoroughly after reclamation, the mat foundation is applicable.

Fig.11-1 Structural Plan of Quay

Scale 1 : 250





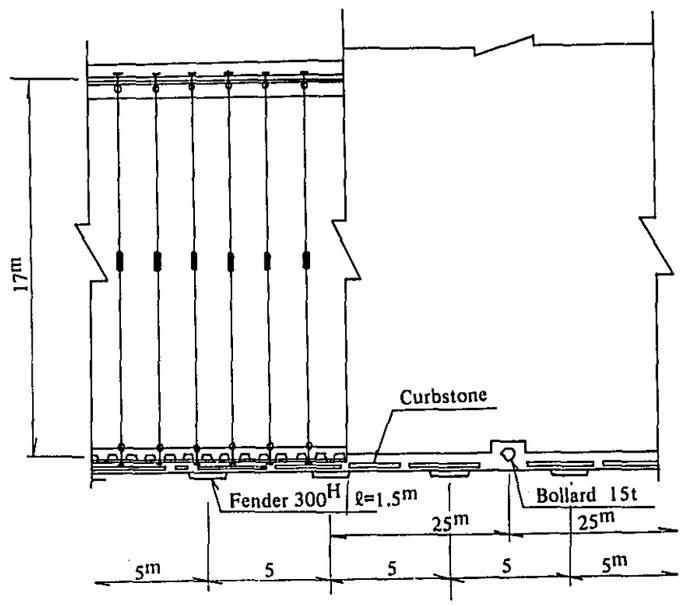
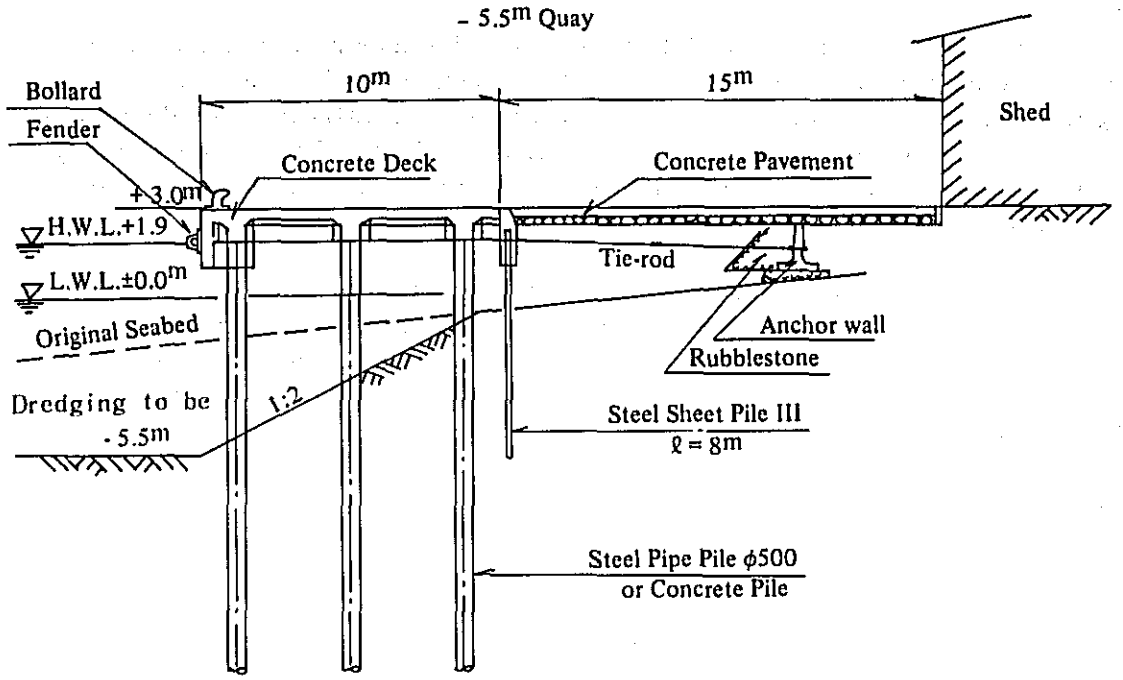
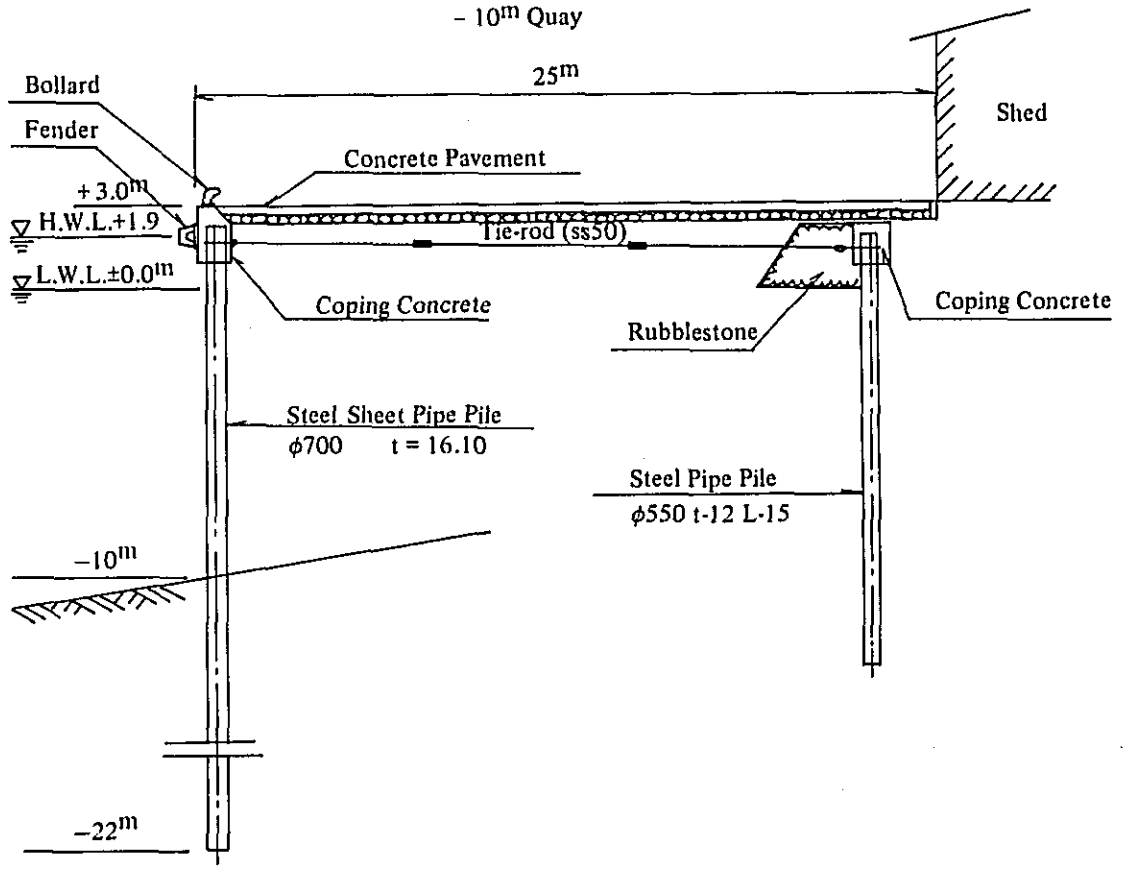


Fig. 11-2 Alternative Plan of Quay Structure
Scale 1:250





11-3. Implementation Schedule

The implementation schedule of the facilities under the medium term plan will do on a step-by-step basis in order to cope with the yearly increasing cargo. Such a schedule is adequate in that it no longer calls for introduction of investment all at once and enables the distribution of annual investment evenly throughout the term. The relationship of the cargo versus the facilities and their capacity are shown in Fig. 11-3.

The construction schedule is shown in Fig. 11-4. As seen, the preparatory procedural work is to start in 1978, followed by surveying and engineering works to be carried out in the year 1978 and 1979. The construction work is to start in 1980 and completed in 1984, thus implementing the schedule to correspond to the cargo in the year 1985.

11-4. Construction Cost

The construction cost of the medium term plan (Plan-1) is shown in Table 11-1. The conditions for estimation are given below.

(1) The exchange rate is US$1 = Rp. 415.

(2) The estimate is based on the unit price of construction as of 1977, and no consideration is given to inflation and escalation of commodity price, personnel expenses, etc.

(3) Custom duties and taxes on the imported construction materials and machines (shown as foreign currency in the statement of estimation) are not included. For domestic commodities, a sales tax of 5% is included.

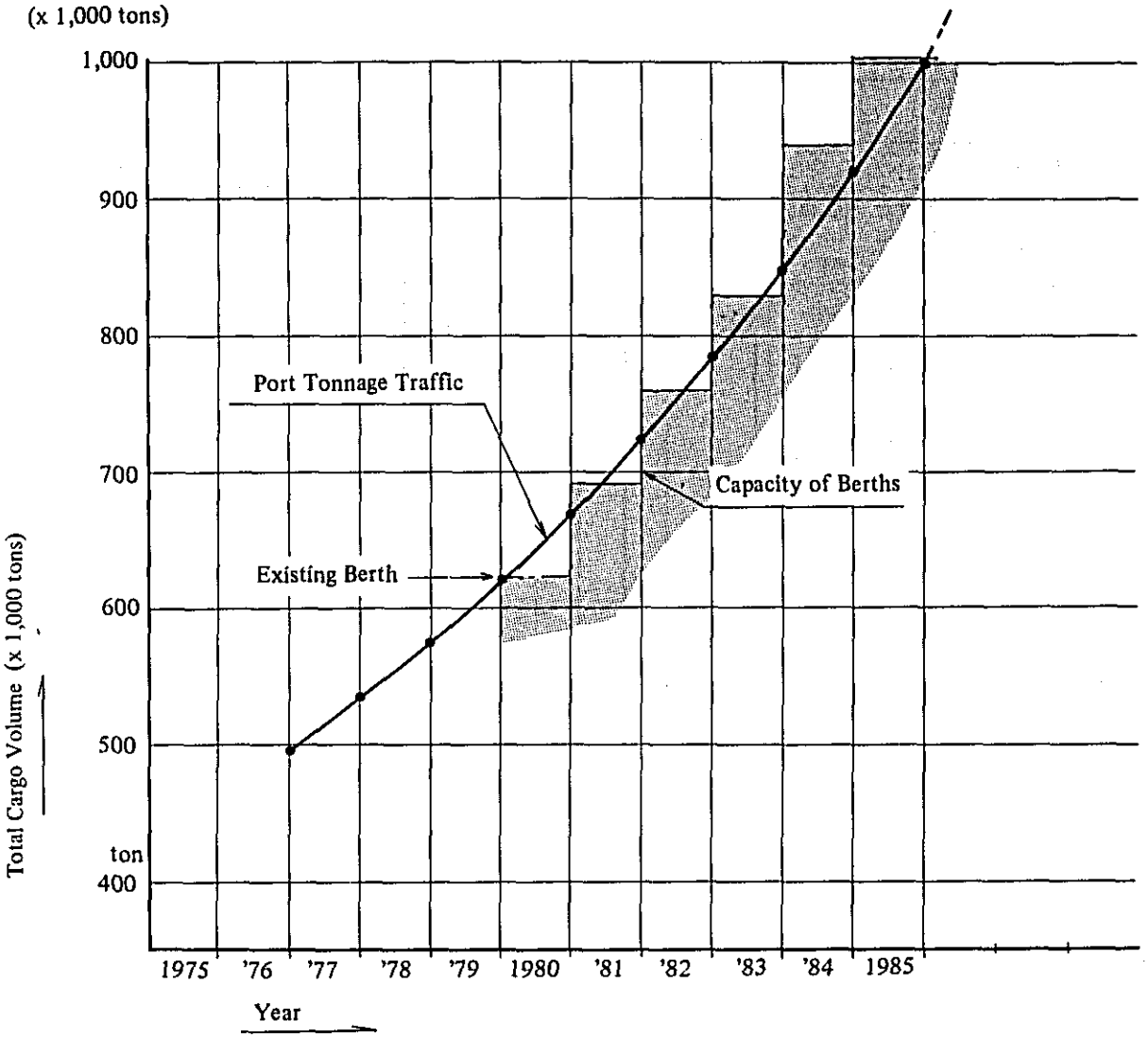
(4) As contingencies, 15% of the total cost of construction is estimated. These contingencies include allowances for main items, alteration of the wharves, buildings, etc. as the result of detailed soil surveys, modification of the scale of the facility incident to the change of conditions, price change due to lagging schedule, etc.

For reference, approximate construction costs of the medium term plan and long term plan estimated for Alternative-1, -2 and -3 under si similar conditions of estimation to the foregoing, are shown below (Reference Figs. 10-2 - 10-4).

Unit: US$ x 1,000

	Medium term plan	Long term plan
Alternative-1	21,422	28,700
Alternative-2	22,600	29,400
Alternative-3	23,400	31,000

Fig. 11-3 Port Tonnage Traffic and Capacity of Berths



Construction Schedule of Expansion Berth

1980	———	1 Berth (−5.5m.L = 90m) Berth (−5.5m.L = 150m)
1981	———	1 Berth (−5.5m.L = 90m)
1982	———	1 Berth (−5.5m.L = 90m)
1983	———	2 Berth (−5.5m.L = 180m)
1984	———	1 Berth (−5.5m.L = 90m) Lighter (−3m.L = 130m)
1986 ~ 2000	- - - →	Foreign Trade 1 Berth Domestic Trade 10 Berth

Fig. 11-4. Program for Construction of Annual Expenditure

Alternative – 1 (Medium Term Plan)

Item \ Year	1978	1979	1980	1981	1982	1983	1984	Total (1,000 US$)
a Progress Appraisal and Tender Award	—	—						
1 –5.5 m Quay			1 Berth+150m	1 Berth	1 Berth	2 Berth	1 Berth	3,946 (1,943)
2 Lighter Berth						—	—	547 (216)
3 Temporary Revetment						—	—	366 (171)
4 Dredging						—	—	738 (547)
5 Reclamation						—	—	141 (–)
6 Transit Sheds				—	—	—	—	4,681 (2,206)
7 Road			—	—	—	—	—	810 (–)
8 Open Storage and behind Shed Area			—	—	—	—	—	353 (–)
9 Buildings			—	—	—	—	—	611 (–)
10 Utilities			—	—	—	—	—	1,129 (695)
11 Slab Construction at Concrete Gap of Existing Pier				—	—			739 (–)
12 Cargo Handling Equipment and Port Service Vessels			—	—	—	—	—	2,371 (2,371)
13 Mobilise/Demobilise			—	—	—	—	—	800 (517)
b Construction Cost			2,684 (1,223)	4,117 (1,954)	3,508 (1,992)	4,684 (2,517)	2,239 (980)	17,232 (8,666)
c Soil Investigation and Topographic, Hydragraphic Survey	190 (110)							190 (110)
d Engineering Service and Supervision	90 (65)	270 (200)	205 (125)	180 (115)	130 (70)	205 (140)	126 (65)	1,206 (780)
e Contingency			445 (200)	657 (330)	575 (330)	756 (416)	361 (157)	2,794 (1,433)
f Total Cost	280 (175)	270 (200)	3,334 (1,548)	4,954 (2,399)	4,213 (2,392)	5,645 (3,073)	2,726 (1,202)	21,422 (10,989)

Notes: 1. All costs are based on 1977 construction price.

2. Foreign currency components are shown in brackets below.

Table 11-1 Construction Cost for Medium-term Plan (Alternative – 1)

Item No.	Description	Unit	Quantity	Rate			Amount		
				Local Currency US$	Foreign Currency US$	Total Rate US$	Local Currency US$x10^3	Foreign Currency US$x10^3	Total Amount US$x10^3
1	−5.5 m Quay Wall (West Side)	m	300	2,400	2,200	4,600	720	660	1,380
2	" (East Side)	"	390	2,400	2,500	4,900	936	975	1,911
3	Lighter Berth	"	130	2,100	1,400	3,500	273	182	455
4	Temporary Revetment	"	180	900	800	1,700	162	144	306
5	Dredging	m^3	330,000	0.5	1.5	2	165	495	660
6	Reclamation	"	230,000	0.5	–	0.5	115	–	115
7	Transit Shed	m^2	15,650	130	120	250	2,035	1,878	3,913
8	Road	"	44,100	15	–	15	662	–	662
9	Open Storage and behind Shed Area	Sum	1				282	–	282
10	Land Scape	"	1				6	–	6
11	Building	"	1				499	–	499
12	Water Supply (including Hydrant)	"	1				94	198	292
13	Electric Power Supply	"	1				131	346	477
14	Drainage	"	1				105	–	105
15	Cargo Handling Equipments	"	1				–	915	915
16	Port Service Vessels	"	11				–	1,230	1,230
17	Slab Construction at Concrete Gap of Existing Pier	Place	4	151,000	–	151,000	604	–	604
18	Navigation Aids	Sum	1				27	49	76
19	Miscellaneous	"	1				356	338	694
20	Mobilise/Demobilise	"	1				244	468	712
	Sub Total						7,416	7,878	15,294
21	Profit (10%)	"	1				742	788	1,530
	Sub Total						8,158	8,666	16,824
22	Sales Tax (5%)	"	1				408	–	408
	Sub Total						8,566	8,666	17,232
23	Soil Investigation & Topo. Hydrographic Survey	"	1				80	110	190
24	Engineering Service and Supervision	"	1				426	780	1,206
	Total						9,072	9,556	18,628
25	Contiengency (15%)	"	1				1,361	1,433	2,794
	Grand Total						10,433	10,989	21,422
	(Percentage of Financial)						(48.7%)	(51.3%)	(100%)

Note: All Cost are based on 1977 Construction Price.

Chapter-12 Port Administration and Operation

12. Port Administration and Operation

12-1. General

The operation of the Port of Bitung is carried out mainly on the existing concrete piers. These piers are of a scale corresponding to 3 berths for large vessels and have transit sheds in the back so that they have a satisfactory function as a fundamental facility. But their aprons lack slabs in some places, and their cargo handling equipment is inadequate, so that they are still shortcomings for modern cargo handling.

In the port of Bitung, approximately 500,000 tons of cargo was handled at these piers in 1976. Therefore, the port activity is considered to be conducted with a relatively high level of efficiency.

This is accounted for by the relatively small cargo volume of the port, small-scale and compact port facilities to permit easy administration, and a cheap and abundant labor force. On the contrary, there arise problems undesirable for port operation such as the mixed use of berths by various types of vessels, a large amount of queuing which is partly due to the inadequate capacity of the facilities, occasional complications of cargo transportation on the wharf and the mixing of passengers and cargo.

These may not present themselves as serious problems as long as the scale of the port remains as it stands but are likely to cause various problems in the event of expansion of the Port of Bitung in the future.

12-2. Precautions on Administration and Operation

By the end of 1985 when the medium term plan will be completed, the condition of the Port of Bitung is expected to change from the current state as follows.

- Both the cargo volume and number of ships will double the current volume and number.
- The wharf length will be doubled and the wharf area will be widely expanded.
- Cargo volume for foreign trade will increase so that the Port of Bitung will be required as a foreign trade port.

Therefore, the port administration will be required to be more rationalized than at present.

In order to meet such requirements, the following points should be noted for port administration.

(1) The foreign trade yard should be designated specifically for integral operation.

It is desirable to integrate the customs clearance, tariff and other relevant procedures, with respect to the foreign trade cargo, for more effective operation.

In the medium term plan, foreign trade berths are planned on the east side of the existing concrete pier, and in the long term plan, it is planned to provide 4 foreign trade berths centering around this concrete pier, as a unified foreign trade district.

Effective use of this facility is fully expected.

(2) Wharf utilization shall be classified by type of ship

Currently, the concrete piers are used at random, with every type and size of vessel using them in a disorderly manner although such may be inevitable from the scale of the facilities. This is causing trouble for efficient port operation.

To resolve such problems, a system should be established in which wharves are classified groups designated not only for foreign trade vessels but for RLS vessels, local vessels and sailing vessels for effective use.

In the medium term plan, the pier for sailing vessels is planned to be newly built at the east end of port together with transit sheds and open storage. Therefore, it can be operated independently from the groups of larger size vessels.

Local vessels shall use the -5.5 m pier newly constructed on the north side of the existing concrete pier.

Passenger ships are preferably excluded from the general wharves but should use the -5.5 m pier in front of the passenger terminal.

(3) Handling of special cargo and cargo of large quantity

Generally, these kinds of cargo are effectively and preferably handled exclusively at a specific pier.

Such kinds of cargo are coconut oil, cement and rice in the Port of Bitung. However, their volumes are not as large at present,

and they are mainly handled as transit cargo. Therefore, simultaneous transition to the above-mentioned system is not preferable at least at the present time.

However, coconut oil and cement are easily classified so that it is desirable to proceed toward specialization of the wharf step by step, increasing the cargo volume in the future.

The wharf to be specialized in this case, is the berth at the west end of the concrete pier.

(4) Maintaining the cargo handling equipment in good condition

In the Port of Bitung, there are many transit cargo, while the wharf area and storage area are separated from each other. Thus, there is a large amount of transversal transportation of cargo in the wharf as well as between the wharf and storage areas.

The direction of cargo movement are thus complicated and the distances of cargo transportation handling are considerably long. To cope with such a situation, in the medium term plan, provisions for more mobile and general purpose cargo handling equipment are planned, such as a mobile crane, forklift, truck, trailer and others. However, to realize the rational transportation and handling of cargo, the cargo handling machines must be properly maintained and must be utilized to the fullest extent.

(5) Compliance with the future innovation of sea transportation

No substantial plan is involved in this plan with regard to the so-called innovative sea transportation system, e.g. containers, barge-line system, etc., because of the forecast that there will be no influence on the Port of Bitung throughout the period of plan.

However, partial containerization may become a reality soon after that period. Further, there is a possibility of semi-container ships coming into the port. Therefore, in the foreign trade area, it is planned to provide an open yard which is usable as a small-scale container yard.

A flexible counterplan is preferred while observing the future trend of the sea transportation system.

This open yard is also applicable for handling heavy cargo, e.g. discharge of plant machinery for regional development, etc.

Chapter-13 Economic Analysis

13. Economic Analysis

13-1. General

The Port of Bitung which is a major port in East Indonesia, has a particularly important role as a base for distribution of commodities for the area comprising not only North Sulawesi but part of North Maluku and Central Sulawesi.

In the intermediate prospect up to the year 1985, this area is expected to have increasing production of coconut, rice and other agricultural products and also related investments for improvement of the infrastructures concerned. Therefore, the functional role of the Port of Bitung as a base for distribution of commodities is indispensable to the development of the area.

With increasing port cargo along with economic development of the area of East Indonesia during PELITA-I and PELITA-II, it is essential to maintain the scale of the port appropriately upon the long term prospect up to the year 2000, as well as the intermediate prospect up to the year 1985.

Such an optimum investment to the Port of Bitung will bring a considerable amount of benefits to the national economy of the Republic of Indonesia as well as to regional development.

13-2. Preconditions for Economic Analysis

In making an economic analysis, the following preconditions were taken into account.

(1) As an objective project, the intermediate project up to the year 1985 (Medium-term plan) would be taken, and the subsequent period would be dealt with as a separate project (Long-term plan). Therefore, the period subsequent to 1986 would not be included in the objective period of the cost-benefit analysis.

(2) The 350 m wharf being constructed presently was treated as an existing facility and would not be included in the objective facilities of the cost-benefit analysis.

(3) As regards to the request of the Indonesian Government that the cost-benefit analysis of both Alternative-I and Alternative-III should be executed before deciding the facility plan, only Alternative I was employed on this analysis.

Because Alternative-I would be more advantageous on the whole than Alternative-III in the following two points:

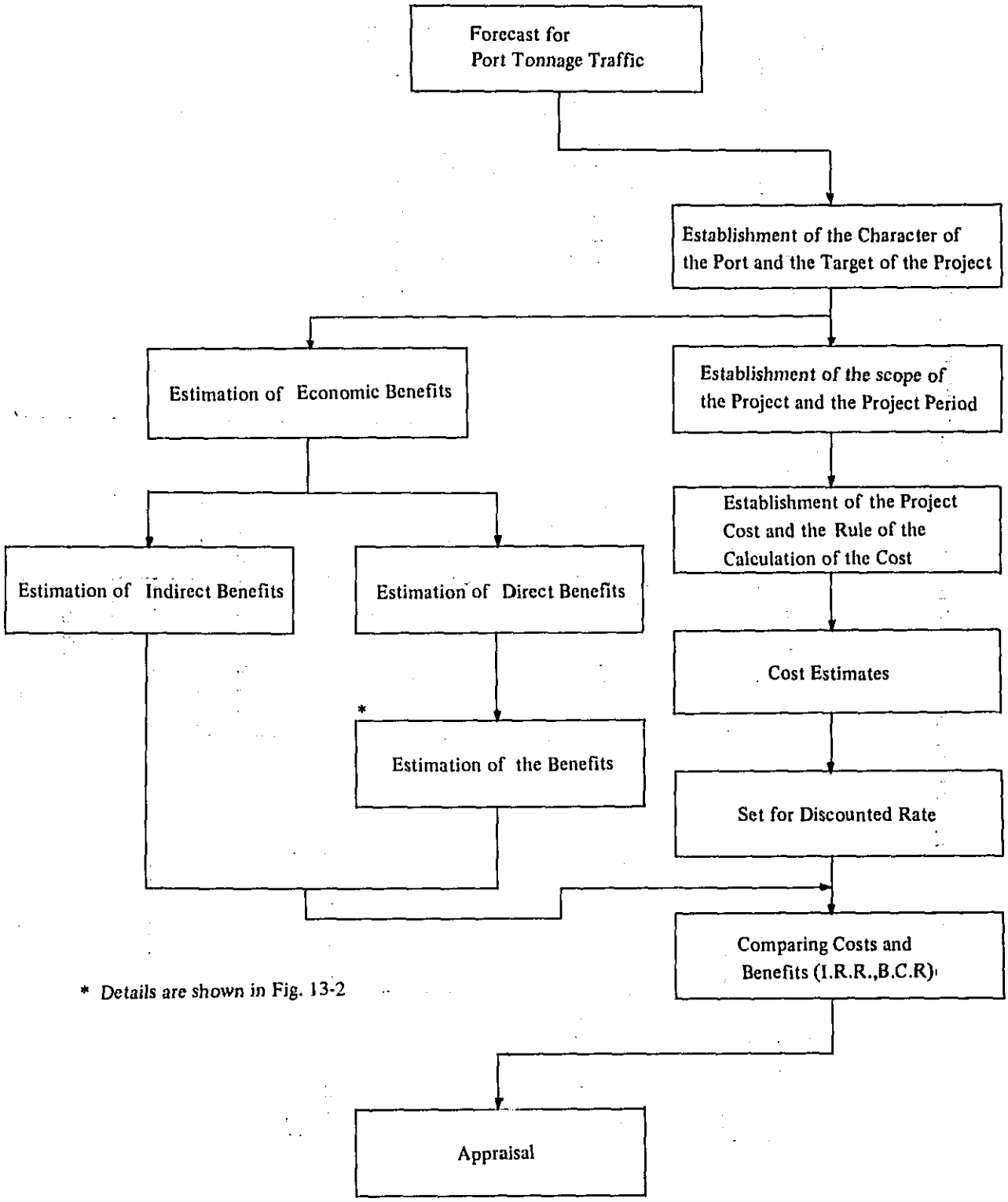
1) Alternative-III would gain slightly greater benefit than Alternative-I.

2) On the other hand, Alternative-III is more expensive than Alternative-I. (About 2,000,000 US$)

13-3. Procedure of Economic Analysis

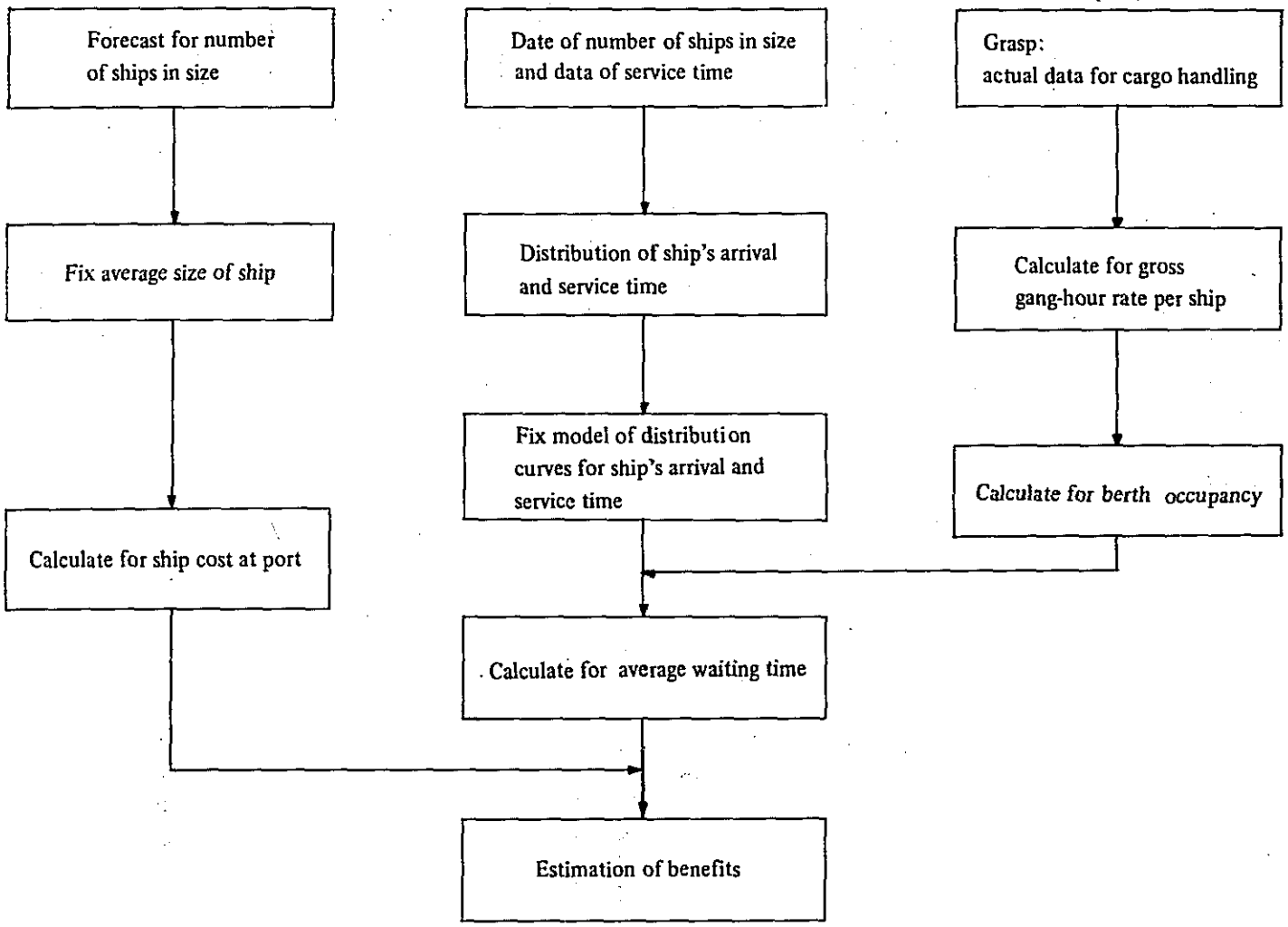
The procedure for the economic analysis of the project of the Port of Bitung is illustrated in the following. (Refer to Figs. 13-1 and 13-2)

Fig. 13-1 Procedure of Economic Analysis



* Details are shown in Fig. 13-2

Fig. 13-2 Procedure of Estimation of Benefits (Decrease of demurrage cost)



13-4. Cost Estimates

(1) Project Cost

The project costs of the economic analysis cover the construction cost of additional facilities of the Port of Bitung (7 years from 1978 to 1984) and the increment of the maintenance and administration cost required for maintenance and administration of the additional facilities.

The construction cost is 21,422 x 1000US$ as described in Section 4, Chapter 11. In the economic analysis, it is required to deduct the transfer of custom duties, etc. for the imported equipment and materials. Now, obtaining the amount to be deducted, is given as 2.8 x 1000US$. The project cost for the economic analysis is thus 18,581 x 1000US$.

The maintenance and administration cost include the cost of maintenance of wharves and roads, maintenance dredging, electric power supply, and water supply cost and fuel oil cost and personnel and miscellaneous expenses.

(2) Maintenance and administration cost

The increment of the maintenance and administration cost in the respective years from the year 1978, when the project investment will be started, to the year 1985 would be included in this project cost.

In the following will be shown the basis of assessment of the respective items of the maintenance and administration cost as of 1985.

1) Maintenance Cost

Maintenance Cost (1985)

Unit : Million Rp.

Facilities	Maintenance Cost	Const. Cost	Percentage of Const. Cost (%)	Remarks
Quay & Berth	19	1,865	1	Fender Curbstone
Dredging	37	306	12	
Roads & Yard	5	483	1	Asphalt Pavement & Marking
Cargo Handling Equipment	5	1,133	5	Repairing & Spare Parts
Other Facilities	57	2,665	2.1	Building & Other Facilities
Total	175			

2) Electric Power, Fuel Oil and Water Supply Cost

Electric Power, Fuel Oil and Water Supply Cost

Unit : Million Rp.

Items	Cost	Remarks
Electric Power Supply Cost	441,000 KWH x 34 RP. ≒ 15	Lighting
Fuel Oil Cost	Lump Sum = 21	Cargo Handling Equipment Port Services Vessels
Water Supply Cost	96,000 m^3 x 125 RP. ≒ 12	Office & Others
Total	48	

Note: 1. For the power cost and water charge, the unit costs of 1976 were employed.

2. The fuel cost is intended for the fuels and the lubricating oil of the existing and additionally installed cargo handling machines and service offering ships.

3) Official Cost

Estimates of Official Cost

	1985	1976
Official Cost	85 Million Rp.	* 37 Million Rp.
Officers	220 Persons	150 Persons
Official Cost /man-year	386,000 Rp.	250,000 Rp.
Annual Elevation	5 %	

* Sauce : ADPEL Bitung.

4) Miscellaneous Expense

The miscellaneous expense includes stationary expense, book expense, communication expense, etc. It was estimated at about 10% of the total maintenance and administration cost.

(3) Shadow prices

The shadow prices would be applied where 1) there is a shadow rate against the foreign exchange rate and 2) there are laid-off personnel but the wages of laborers are controlled by the minimum

wages law. But, according to the result of investigation of the survey team, neither of the foregoing situations was observed so that application of shadow prices was not made in the cost-benefit calculations.

13-5. Estimation of Benefits

The port investment to the Port of Bitung is intended for reinforcement of the capacity of port facilities to cope with the increasing traffic demand with development of the regional economy and will, therefore, be one of the important means for development of the regional economy.

Such development will effectively break through the bottlenecks causing obstacles to the economic development.

Additionally, socio-economic benefits such as the development of local industries and cities, would be expected.

Through such benefits, it will contribute greatly to the economic development in Indonesia as well as the economic development in region.

The benefits to be brought about by the port investment to the Port of Bitung are indicated as follows.

1) Decrease of demurrage cost

As described in the foregoing, the Port of Bitung, from its character as a base for distribution of commodities, will have increased ship congestion in the future if the port facilities remain unchanged against the increasing marine transport with development of the East Indonesia in the future. In this case, the evaluation of the other adjacent ports will not be taken into account, as they are sorted from both physical and economical aspects in the stage of selection of the site location (Refer to Chapter 7).

Further, estimation of benefits is made under the with-and-without principle assuming cases where additional installation of facilities at the Port of Bitung would be realized as a project or where the port facilities would remain unchanged.

If there would be no expansion of the port facilities (for domestic trade), the domestic trade cargo would have to be handled by the existing facilities so that improvement of the handling capacity or increase of the loading proportion of the domestic trade vessels would no longer be expected.

Now, taking the cargo volume, it is considered that the domestic trade cargo will increase with progress of agricultural development.

Consequently, congestion of the domestic trade vessels would be forecast with the domestic trade wharves handling the domestic export and import cargo expanded by 1.5 times of the present condition in 1980, 1.8 times in 1982 and 2.5 times in 1985 as shown in Table 13-3. Saving of the increasing ship waiting time due to this congestion would be added as one of the economic benefits.

Table 13-1 Preconditions for Calculating Benefits (1985)

	Domestic Trade	Foreign Trade
Average Ship Size *1	500 D.W.T.	7,000 D.W.T.
Working Days/Year	300	300
Working Hours/Day	20 hr	20 hr
Cargo Handling Capacity	15t/gang/hour	20t/gang/hour
Ship Cost *2	480 US$/Day	2,500 US$/Day
Numbers of Gangs	2	4
Numbers of Berths		
Alternative-1		
1985	12	2
1976	6	2

*1 Source : from forcast for ship size (reffer to Table 13-2).

The result of calculation upon the preconditions given in Table 13-1 is shown in Table 13-3, and the benefit calculated according to the following formula based on the data shown in Table 13-3, is given in Table 13-4 and Table 13-5.

$$\left(\begin{array}{c}\text{Cost of Stay at} \\ \text{Anchorage per Day}\end{array}\right) \times \left(\begin{array}{c}\text{Increase of Days} \\ \text{of Stay at Anchorage}\end{array}\right) \times \left(\begin{array}{c}\text{Number of} \\ \text{Arrival Ships}\end{array}\right)$$

Table 13-2 Forecast for Ship Size in 1985

Type of Ship	Ship Size	Number of Ships
Sailing Vessel	$10^{D.W.T.}$	600
Local Vessel	60	1,500
Special Vessel	2,500	* 11
RLS	700	2,600
Ocean Going Vessel	7,000	200
Average Ship Size	** 500 D.W.T.	

Note * : This shows only vessels which use public wharf.

** : This is calculated by weighted average on the basis of the above figures.

Table 13-3 Comparison of Congestion at Domestic Trade Wharf

	1980		1982		1985	
	With	Without	With	Without	With	Without
Annual Cargo Volume	407 1,000t		498 1,000t		677 1,000t	
Average Ship Size	500	D.W.T.	500	D.W.T.	500	D.W.T.
Number of Berths	(7)	(6)	(9)	(7)	(12)	(9)
Number of Calling Ships	2,510	2,510	3,050	3,050	4,100	4,100
Ship Moring Time (day/number)	0.8	0.8	0.8	0.8	0.8	0.8
Ship Moring Time (day/year)	2,000	2,000	2,440	2,440	3,280	3,280
Ship Waiting Time (day/number)	0.42	1.03	0.09	2.07	0.06	2.2
Ship Waiting Time (day/year)	1,055	2,585	274	6,314	246	9,020
Balance	-	-		-		
Ship Waiting Time (day/year)		+ 1,030	-	+ 6,040		+ 8,750
Cost of Stay at Anchorage		480 US$		480 US$		480 US$

2) Decrease of damage of port cargo

With the improvement of the port, expansion or installation of the cargo handling yard, warehouses, stacking area, cargo handling equipment, etc. the damage of port cargo would be decreased.

3) Benefits developing from the functions as a transit port

The Port of Bitung maintains and develops the transit functions by itself and serves to bring about economic benefits indirectly for the Republic of Indonesia.

4) Increasing agricultural production and other favorable effects upon the regional development.

In the North Sulawesi area, agricultural development and road development are now in progress. In conjunction with such developments, the development of the Port of Bitung will further accelerate the development of the North Sulawesi area

13-6. Cost-Benefit Analysis

On the costs and benefits provided in the foregoing Chapter 13-4 and Chapter 13-5, the cost benefits will be analyzed as shown in Table 13-4 and Table 13-5.

It shows the results of calculation of the costs and benefits on the 1977 prices with the life span of the project taken as 30 years.

According to the calculation, I.R.R. is 19.7%, and B.C.R. is 1.37 at a discount rate of 15%, presenting a very high level respectively.

While the minimum value of I.R.R. to be evaluated is a matter of controversial opinion, the following two methods are available for assessment of the value, viz. (1) method employed by the Asia Development Bank and (2) method of determining the value based on projects of Indonesia in the past. In the latter however, the assessment is subject to change with the investment opportunity, etc. of the Republic of Indonesia and is, therefore, a very difficult problem.

If we take the* concept employed by the Asia Development Bank, the expansion project of the Port of Bitung may be concluded to be feasible.

* the concept is as follows;

1) If I.R.R. accounts for more than 12% in case there are a number of investment opportunities in the country, or more than 8% in other cases, each case prove the project to be feasible.

Table 13-4 Cost Benefit Table

Unit : 1,000 US$

Year	Cost			Benefit	Discounted Value (I.R.R.: 19%)	
	Const. Cost.	Operation Cost	Total		Cost	Benefit
1978	280	42	322		322	
1979	270	59	329		276	
1980	2,894	81	2,975	730	2,100	515
1981	4,274	108	4,382	730	2,598	433
1982	3,633	233	3,866	2,900	1,927	1,446
1983	4,875	351	5,226	2,900	2,189	1,215
1984	2,355	515	2,870	2,900	1,010	1,020
1985		607	607	4,200	179	1,243
1986		607	607	4,200	151	1,044
1987		607	607	4,200	127	877
1988		607	607	4,200	107	737
1989		607	607	4,200	90	620
1990		607	607	4,200	75	520
1991		607	607	4,200	63	438
1992		607	607	4,200	53	367
1993		607	607	4,200	44	308
1994		607	607	4,200	37	259
1995		607	407	4,200	31	218
1996		607	607	4,200	26	195
1997		607	607	4,200	22	150
1998		607	607	4,200	18	126
1999		607	607	4,200	16	109
2000		607	607	4,200	13	91
2001		607	607	4,200	11	76
2002		607	607	4,200	9	64
2003		607	607	4,200	8	54
2004		607	607	4,200	6	45
2005		607	607	4,200	5	38
2006		607	607	4,200	4	29
2007		607	607	4,200	3	25
	18,581	14,743	32,718	106,760	11,513	12,262

I.R.R. = 19.7

Table 13-5 Cost Benefit Ratio

Year	Discounted Ratio (15%)	
	Cost	Benefit
1978	320	
1979	285	
1980	2,250	550
1981	2,880	480
1982	1,505	1,650
1983	1,445	1,440
1984	1,090	1,250
1985	470	1,465
1986	355	1,275
1987	270	1,100
1988	205	960
1989	155	840
1990	115	730
1991	90	635
1992	65	550
1993	50	480
1994	40	415
1995	30	360
1996	20	315
1997	15	270
1998	10	235
1999	9	205
2000	7	180
2001	5	155
2002	4	135
2003	3	115
2004	2	100
2005	1	90
2006	-	84
2007	-	71
	11,696	16,135

Cost Benefit Ratio = 1.37

13-7. Evaluation

As the result of a cost benefit analysis, the internal rate of return (I.R.R.) was given as 19.7%, and the cost benefit ratio (B.C.R.) as 1.37 at 15% of the discounted rate.

The project was thus evaluated to be feasible in the quantitative scope of analysis.

Further, the effects of the project are not limited to the scope of the quantitative effect above mentioned. Through such effects, it will be expected to bring a great number of benefits on the national economy of the Republic of Indonesia as well as the regional development such as the promotion of agricultural production. Taking the foregoing together, this expansion project can be evaluated as being fully feasible.

Chapter- 14 Financial Analysis

14. Financial Analysis

14-1. General

The purpose of a financial analysis for the project of port construction is to investigate the health of financial situation of the organization to take charge of the project execution, while the economic analysis aims at evaluation of the effect of the project on the national economy.

What is the most important in this analysis is that the organization executing the economic activity has adequate accounting procedures established, that is, (1) whether the assets were evaluated properly, (2) whether the depreciation was made satisfactorily, (3) whether a long term investment plan was established and (4) whether there was a system established, permitting flexible disbursement of expenses with a change in the situation.

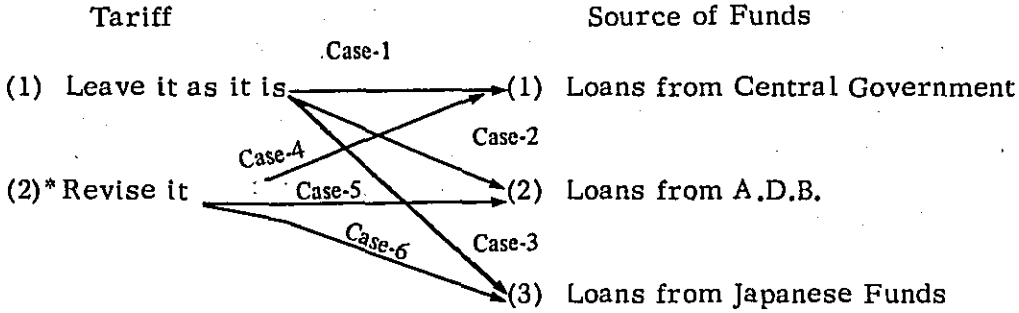
With recommendations for improvement on accounting procedures made already by I.B.R.D. and A.D.B. in the cases of the Port of Tg. Priok, etc., it was thought that such procedures in the Port of Bitung was improving at the stage of considerable progress.

On the other hand, in estimating the operating expenses, payment of debt services, etc. in the future, financial calculations had to be made upon several assumptions in (1) that there was a strong possibility of the financial cost principle being weakened coping with inflation and (2) that there were not yet any specified countries from which overseas loans could be borrowed for investment funds.

Thus, the financial analysis of the Port of Bitung was carried out upon the foregoing preconditions (These are mentioned below) in the case where the development was executed by the Central Government budget with no change of dues and in the another cases as a sensibility test, to evaluate the financial soundness.

For raising funds, the portion corresponding to foreign currencies (51.3% of the total fund) would be sought from overseas, the remaining being from the Central Government fund.

Cases for sensibility test



*It is raised at annual rate of 17% from the year 1979 to the year 1985, and will turn out to be 2.5 times as much as in the year 1985.

Premise of Condition

(1) Took enterprise accounting formula based on the principle of prime costs.

(2) Present Port of Bitung makes balance sheets of total assets and liabilities of neighboring ports, however, the Port of Bitung is to make its own balance sheets by conducting its own capital management in the future.

(3) The object of the financial analysis applies to medium-term plan with 1985 at the target year.

As this is an analysis for future planning, financial statements to be subjected to analysis here are income statements, balance sheets and source and application of funds.

Under the above situation, the financial position as an administrative target transits as follows;

Unit: Million Rp.

	1976	1985
Port revenue	200	420
Total assets	873	9,798
Fixed assets	650	9,540
Central Government fund	573	8,900

14-2. Calculating Revenue and Expenditure

14-2-1. Calculating Method of Total Revenue

The revenue was calculated in detail upon available materials.

Essentially, the unit charges relative to vessels should be correlated by quantity. But in the absence of sufficient data concerning the vessels, it was assumed that the ship size would be proportional to the cargo volume. The cargo quantity, and thus correlation of the ship between the total revenue and the cargo quantity was obtained. From the past records at the Port of Bitung, it was noted that the port dues and quay dues were highly related with the total cargo and that warehouse and water supply were highly related with the total general cargo.

14-2-2. Revenue Calculating Method for Each Classification

(1) Port dues and quay dues: Obtained by apportioning the total annual revenue of both dues according to the proportion of port due per unit cargo and quay due (as of 1985).

(2) Warehouse: Calculated by multiplying the areas of warehouse and open storage by the working ratios of each storage and the charge.

* Warehouse area; 33,350 square meters
Open storage: 15,000 square meters
Working ratios:
Warehouse: 65%
Open storage: 50%

** Above datas are estimated in 1985.

(3) Water Supply: Calculated by multiplying the water supply per D.W.T. of vessel by the gross tonnage (D.W.T.) and the charge in 1985.

(4) Others: Calculated by decreasing each of the above income from total income. (But charges remain at present.)

14-2-3. Calculating Expenditures

Expenditures in Income statements are classified into official cost, maintenance cost, administration cost, depreciation cost and others. The method of calculation of the respective costs is omitted in this chapter to be stated in the preceding chapter. However, regarding calculation of the depreciation cost of fixed assets, the straight line method was employed. Summing up the depreciation rates of the following items, the amount of depreciation cost of the assets to be depreciated was obtained for the respective years. The durable years are based on the following standards.

(1) Quay: 0.02 (Durable years - 50 years)
(2) Cargo handling equipment: 0.05 (Durable years - 20 years)
(3) Transit shed: 0.10 (Durable years - 10 years)
(4) Open storage: 0.02 (Durable years - 50 years)
(5) Warehouse: 0.03 (Durable years - 30 years)
(6) Road: 0.01 (Durable years - 100 years)
(7) Water and oil supply equipment: 0.04 (Durable years - 25 years)
(8) Office building: 0.03 (Durable years - 30 years)

The interest on long term loans was based on the following consideration;

(1) The loan conditions of A.D.B. include those for general loans and those under special fund. Assuming that this project would be an object of special fund, repayment in 20 years with 10 years of the unredeemed term and an interest rate of 2% were employed.

2) The loan conditions for yen credit are different from country to country.

In the case of the Republic of Indonesia, an interest rate of 3% and repayment in 30 years with 10 years of the unredeemed term were employed as it was considered to be appropriate from past examples.

Income Tax is imposed at 50% of net profits.

14-3. Revenue-Expenditure Forecast by Enterprise Accounting Formula

14-3-1. General

For Case-1, that is, the project is carried out upon financing of the Central Government without change of the dues, the expected revenue and expenditure is shown in Table 14-1. From 1976 to 1980, high profits can be maintained supported by a favorable increase of about 10% of cargo quantity.

However the net operating revenue will be in deficit because of increased depreciation for new facilities after 1981.

In this case, the Central Government will be required to subsidize about 420 million Rp. to the port in the year 1985.

But, in view of the necessity of this project, large contributions to the economy of Indonesia and the fact that the amount of deficit is relatively small, there is a possibility to subsidize the port to a reasonable degree. Therefore, this project as a whole is financially feasible.

14-3-2. Financial Tables (for case-1)

The financial tables for case-1 are shown as follows:

Table 14-1 INCOME STATEMENT (Case-1)

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cargo Volume (1000t)	731	781	874	967	1,060	1,153	1,240	1,340	1,433	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526
Revenue																									
Port Due	39	42	47	52	57	62	66	71	76	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81
Quay Dues	81	87	97	107	117	128	137	148	159	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172
Water Supply	36	40	45	48	51	55	57	63	67	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
Warehouses	22	24	26	28	31	34	37	40	43	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Miscellaneous	28	30	32	34	36	38	40	42	45	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
(Total)	206	223	247	269	292	317	337	364	390	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420
Expenses																									
Official Cost	37	39	42	46	50	57	63	69	77	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Maintenance	9	10	10	11	12	19	59	97	152	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175
Fuel and Electric Power Supply	18	22	27	29	32	36	39	42	45	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Depreciation	125	130	145	155	175	232	332	448	509	509	469	469	469	469	469	392	333	255	210	210	210	210	210	210	210
Miscellaneous	8	8	9	9	10	13	16	18	20	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
(Total)	197	209	233	250	279	357	509	674	803	841	801	801	801	801	801	724	665	587	542	542	542	542	542	542	542
Net Operating Income	9	14	14	19	13	-40	-172	-310	-413	-421	-381	-381	-381	-381	-381	-304	-245	-167	-122	-122	-122	-122	-122	-122	-122
Other Income and Expenses (Total)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Interest Earned on Investment	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Interest on Long Term Loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income before Tax	10	15	15	20	14	-39	-171	-309	-412	-420	-380	-380	-380	-380	-380	-303	-244	-166	-121	-121	-121	-121	-121	-121	-121
Subsidy from Central Government	-	-	-	-	-	40	170	310	410	420	380	380	380	380	380	300	240	170	120	120	120	120	120	120	120
Tax	5	7	7	10	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income after Tax	5	8	8	10	7	1	-1	1	-2	0	0	0	0	0	0	-3	-4	+4	-1	-1	-1	-1	-1	-1	-1

Table 14-2 BALANCE SHEET (Case-1)

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Assets																									
Net Current Assets	288	371	456	545	666	899	1,230	1,679	2,187	2,696	3,165	3,634	4,103	4,572	5,041	5,430	5,759	6,018	6,227	6,436	6,645	6,854	7,063	7,272	7,481
Net Fixed Assets	575	500	539	572	1,842	3,666	5,082	6,977	7,599	7,090	6,621	6,152	5,683	5,214	4,745	4,353	4,020	3,765	3,555	3,345	3,135	2,925	2,715	2,505	2,295
Fixed Assets	(650	(650	(766	(878	(3,262	(4,318	(6,066	(8,409	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540
Accumulated Depreciation	75	150	227	306	420	652	984	1,432	1,941	2,450	2,919	3,388	3,857	4,326	4,795	5,187	5,520	5,775	5,985	6,195	6,405	6,615	6,825	7,035	7,245
Investment	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Total Assets	873	881	1,005	1,127	2,518	4,575	6,322	8,666	9,796	9,796	9,796	9,796	9,796	9,796	9,796	9,793	9,789	9,793	9,792	9,791	9,790	9,789	9,788	9,787	9,786
Liability and Equity																									
Liability																									
Total Liability	573	573	689	801	2,185	4,241	5,989	8,332	9,463	9,463	9,463	9,463	9,463	9,463	9,463	9,463	9,463	9,463	9,463	9,463	9,463	9,463	9,463	9,463	9,463
Equity																									
Capital	275	300	308	316	326	333	334	333	335	333	333	333	333	333	333	333	330	326	330	329	328	327	326	325	324
Retained Earnings																									
Net Income after Tax	5	8	8	10	7	1	-1	1	-2	0	0	0	0	0	0	-3	-4	4	-1	-1	-1	-1	-1	-1	-1
Total Equity	295	308	316	326	333	334	333	334	333	333	333	333	333	333	333	330	326	330	329	328	327	326	325	324	323
Total Liability and Equity	873	881	1,005	1,127	2,518	4,575	6,322	8,666	9,796	9,796	9,796	9,796	9,796	9,796	9,796	9,793	9,789	9,793	9,792	9,791	9,790	9,789	9,788	9,787	9,786

Table 14-3 SOURCE & APPLICATION OF FUNDS (Case-1)

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Source (Total)	130	138	269	277	1,566	2,328	2,251	3,101	2,052	929	849	849	849	849	849	692	573	425	330	330	330	330	330	330	330
Subsidy from Central Government	0	0	0	0	0	40	170	310	410	420	380	380	380	380	380	300	240	170	120	120	120	120	120	120	120
Net Income after Tax	5	8	8	10	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation	125	130	145	155	175	232	232	448	509	509	469	469	469	469	469	392	333	255	210	210	210	210	210	210	210
Loans from Central Government	0	0	116	112	1,384	2,056	1,748	2,343	1,131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Application (Total)	50	55	184	188	1,445	2,095	1,919	2,652	1,543	420	380	380	380	380	380	303	244	166	121	121	121	121	121	121	121
Addition to Fixed Assets	0	0	116	112	1,384	2,056	1,748	2,343	1,131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income before Tax	0	0	0	0	0	39	171	309	412	420	380	380	380	380	380	303	244	166	121	121	121	121	121	121	121
Other Assets Increment	55	55	68	76	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Increase	75	83	85	89	121	233	331	449	507	509	469	469	469	469	469	389	329	259	209	209	209	209	209	209	209
Accumulated Total	75	158	243	332	453	686	1,018	1,467	1,976	2,485	2,954	3,423	3,892	4,361	4,830	5,222	5,555	5,814	6,024	6,234	6,444	6,654	6,864	7,074	7,284

14-4. Financial forecast from Sensibility Test

14-4-1. Conclusion from sensibility test

We have carried out a sensibility test upon conditions in Table 14-4.

As a result of the test, we have come to the following conclusion;

1) Under the existing tariffs, the income statement will be caused to show an increase in the red by interest on Long Term Loans as well as depreciation cost.

2) When the tariffs are raised at an annual rate of 17% from 1979 to 1985, the statement will show an increase in net Income.

   Furthermore, Interest and Tax could be paid by the income and repayment for loans would be quite practicable by capital savings since the revenue will increase. (Refer to Case-4, Case-5 and Case-6).

3) If the tariff would be raised by about 2.5 times, it may cause such disadvantages as cost-push inflation and lowering of export competitive power to the Republic of Indonesia.

   Therefore, if the Republic of Indonesia would decide to revise the tariff, the scope of revision of the tariff should be determined taking into consideration financial policy as well as tariff policy.

14-4-2. Financial Tables

Financial tables according to the result of the sensibility test are shown below. (Refer to Table 14-5 and 14-6)

Table 14-4 Conditions of Sensibility Test

	Conditions for Loans			Standard for Tarift
	Sources of funds	Borrowings million Rp.		
Case - 1	Central Government	8,980	(100.0) %	*
Case - 2	Central Government	4,368	(49.7)	
	A. D. B Loans	4,612	(51.3)	
Case - 3	Central Government	4,368	(49.7)	
	Loans from Japanese Funds	4,612	(51.3)	
Case - 4	Central Government	8,980	(100.0)	**
Case - 5	Central Government	4,368	(49.7)	
	A. D. B Loans	4,612	(51.3)	
Case - 6	Central Government	4,368	(49.7)	
	Loans from Japanese Funds	4,612	(51.3)	

Note * As it is now (Tariff of 1976)

** Raise Tariff at annual rate of 17% from 1979 to 1985.

$$\frac{\text{the tariff of 1985}}{\text{the tariff of 1976}} = 2.5 \text{ times}$$

*** Cargo volumes are supposed to remain unchanged up to the year 2000.

Table - 14-5 INCOME STATEMENT AND FINANCIAL RATIO ON EACH CASE

Unit : Million Rp.

	Case-1		Case-2		Case-3		Case-4		Case-5		Case-6	
	1985	2000	1985	2000	1985	2000	1985	2000	1985	2000	1985	2000
Revenue Total (A)	420	420	420	420	420	420	1,059	1,059	1,059	1,059	1,059	1,059
Direct Cost (B)	332	332	332	332	332	332	332	332	332	332	332	332
Depreciation (C)	509	210	509	210	509	210	509	210	509	210	509	210
Net Operating Revenue (A-B-C)	-421	-122	-421	-122	-421	-122	218	517	218	517	218	517
Interest on Long Term Loans	0	0	91	33	137	79	0	0	91	33	137	79
Tax	0	0	0	0	0	0	109	258	63	242	40	219
Net Income after Tax	-421	-122	-511	-154	-557	-200	109	259	64	242	41	219
Subsidy from Central Government	420	120	510	150	560	200	0	0	0	0	0	0
Working Ratio (B/A)	Total operating expenses before depreication / Total operating revenue						31.3%	(31.3%)	31.3%	(31.3%)	31.3%	(31.3%)
Operating Ratio $(\frac{B+C}{A})$	Total operating expenses after depreciation / Total operating revenue						79.4%	(51.2%)	79.4%	(51.2%)	79.4%	(51.2%)
Return on Net Fixed Assets	Net income after depreciation / Fixed assets balance						3.1%	(22.5%)	3.1%	(22.5%)	3.1%	(22.5%)
Interest Earned Ratio	Net income after depreciation / Interest on long term loans						—	—	790%	(2200%)	530%	(920%)
Debt Service Coverage	Net operating income before depreciation / Debt service						—	—	7.9%	(2.8%)	5.3%	(3.1%)
Return on Capital Employed	Net operating income before depreciation / Liabilities, balance						7.6%	7.6%	7.6%	(11.2%)	7.6%	(9.7%)

Table 14-6 BALANCE SHEET ON EACH CASE

	Case-1		Case-2		Case-3		Case-4		Case-5		Case-6	
	1985	2000	1985	2000	1985	2000	1985	2000	1985	2000	1985	2000
Assets												
Net Current Assets	2,696	7,481	2,684	4,516	2,676	5,496	3,165	11,026	2,972	7,351	2,886	7,949
Net Fixed Assets	7,090	2,295	7,090	2,295	7,090	2,295	7,090	2,295	7,090	2,295	7,090	2,295
(Fixed Assets	9,540	9,590	9,540	9,540	9,540	9,540	9,540	9,540	9,540	9,540	9,540	9,540
(Accumulated Depreciation	2,450	7,245	2,450	7,295	2,450	7,245	2,450	7,245	2,450	7,992	2,450	7,992
Investment	10	10	10	10	10	10	10	10	10	10	10	10
Total Assets	9,796	9,786	9,784	6,821	9,776	7,801	10,265	13,331	10,072	9,656	9,986	10,252
Liability and Equity												
Liability	9,463	9,463	9,463	6,499	9,463	7,487	9,463	9,463	9,463	6,499	9,463	7,487
Capital	333	324	322	323	310	314	692	3,609	545	2,914	481	2,545
Net Income	0	-1	-1	-1	3	0	110	259	64	243	42	220
Total Equity	9,796	9,786	9,784	6,821	9,776	7,801	10,265	13,331	10,072	9,656	9,986	10,252

Appendix 14-1 INCOME STATEMENT (Case-3)

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cargo Volume (1000t)	731	781	874	967	1,060	1,153	1,240	1,340	1,433	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526
Revenue																									
Port Due	39	42	47	52	57	62	66	71	76	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81
Quay Due	81	87	97	107	117	128	137	148	159	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172	172
Water Supply	36	40	45	48	51	55	57	63	67	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
Warehouses	22	24	26	28	31	34	37	40	43	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Miscellaneous	28	30	32	34	36	38	40	42	45	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Total	206	223	247	269	292	317	337	364	390	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420
Expenses																									
Official Cost	37	39	42	46	50	57	63	69	77	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Maintenance	9	10	10	11	12	19	59	97	152	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175
Fuel and Power Electric Supply	18	22	27	29	32	36	39	42	45	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Depreciation	125	130	145	155	175	232	332	448	509	509	469	469	469	469	469	392	333	255	210	210	210	210	210	210	210
Miscellaneous	8	8	9	9	10	13	16	18	20	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Total	197	209	233	250	279	357	509	674	803	841	801	801	801	801	801	724	665	587	542	542	542	542	542	542	542
Net Operating Income	9	14	14	19	13	-40	-172	-310	-413	-421	-381	-381	-381	-381	-381	-304	-245	-167	-122	-122	-122	-122	-122	-122	-122
Other Income and Other Expenses	1	1	-1	-4	-18	-53	-83	-121	-136	-136	-136	-136	-132	-127	-123	-118	-114	-109	-105	-100	-96	-91	-87	-82	-78
Interest Earned on Investment	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Interest on Long Term Loans	0	0	2	5	19	54	84	122	137	137	137	137	133	128	124	119	115	110	106	101	97	92	88	83	79
Net Income before Tax	10	15	13	15	-5	-93	-255	-431	-549	-557	-517	-517	-513	-508	-504	-422	-359	-276	-227	-222	-218	-213	-209	-204	-200
Subsidy from Central Government	0	0	0	0	0	90	250	430	550	560	520	520	510	510	500	420	360	280	230	220	220	210	210	200	200
Tax	5	7	6	7	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0
Net Income after Tax	5	8	7	8	-5	-3	-5	-1	1	3	3	3	-3	2	-4	-2	1	4	3	-2	2	-3	1	-4	0

Appendix 14-2 BALANCE SHEET (Case-3)

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Assets																									
Net Current Assets	288	371	455	542	651	880	1,207	1,654	2,164	2,676	3,148	3,620	3,934	4,253	4,566	4,804	4,986	5,093	5,154	5,210	5,270	5,325	5,384	5,438	5,496
Net Fixed Assets	575	500	539	572	1,842	3,666	5,082	6,977	7,599	7,090	6,621	6,152	5,683	5,214	4,745	4,353	4,020	3,765	3,555	3,345	3,135	2,925	2,715	2,505	2,295
Fixed Assets	(650	(650	(766	(878	(2,262	(4,318	(6,066	(8,409	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540
Accumulated Depreciation	75	75	227	306	420	652	984	1,432	1,941	2,450	2,919	3,388	3,857	4,326	4,795	5,187	5,520	5,775	5,985	6,195	6,405	6,615	6,825	7,035	7,245
Investment	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Total Assets	873	881	1,004	1,124	2,503	4,556	6,299	8,641	9,778	9,776	9,779	9,782	9,627	9,477	9,321	9,167	9,016	8,868	8,719	8,565	8,415	8,260	8,109	7,953	7,801
Liability and Equity																									
Long Term Loans	0	0	73	156	799	1,795	2,787	4,063	4,562	4,562	4,562	4,562	4,410	4,258	4,106	3,954	3,802	3,650	3,498	3,346	3,194	3,042	2,890	2,738	2,586
Other Liability	0	0	616	645	1,386	2,446	3,202	4,269	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901
Total Liability	573	573	689	801	2,185	4,241	5,989	8,332	9,463	9,463	9,463	9,463	9,311	9,159	9,007	8,855	8,703	8,551	8,399	8,247	8,095	7,943	7,791	7,839	7,487
Equity																									
Capital / Retained Earnings	295	300	308	315	323	318	315	310	309	310	313	316	319	316	318	314	312	313	317	320	318	320	317	318	314
Net Income after Tax	5	8	7	8	-5	-3	-5	-1	1	3	3	3	-3	2	-4	-2	1	4	+3	-2	2	-3	1	-4	0
Total Equity	295	308	315	323	318	315	310	309	310	313	316	319	316	318	314	312	313	317	320	318	320	317	318	314	314
Total Liability and Equity	873	881	1,004	1,124	2,503	4,556	6,299	8,641	9,773	9,776	9,779	9,782	9,627	9,477	9,321	9,167	9,016	8,868	8,719	8,565	8,415	8,260	8,109	7,953	7,801

Appendix 14-3 SOURCE & APPLICATION OF FUNDS (Case-3)

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Source Total	130	138	268	275	1,559	2,378	2,330	3,221	2,191	1,072	992	992	979	981	969	812	694	539	443	430	432	420	421	410	410
Subsidy from Central Government	0	0	0	0	0	90	250	430	550	560	520	520	510	510	500	420	360	280	230	220	220	210	210	200	200
Net Income after Tax	5	8	7	8	0	0	0	0	1	3	3	3	0	2	0	0	1	4	3	0	2	0	0	0	0
Depreciation	125	130	145	155	175	232	332	448	509	509	469	469	469	469	469	392	333	255	210	210	210	210	210	210	210
Loans from Central Government	0	0	116	112	1,384	2,056	1,748	2,343	1,131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loans from A.D.B.	0	0	73	83	642	996	993	1,275	499	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Application Total	55	55	184	188	1,450	2,149	2,003	2,774	1,681	560	520	520	665	662	656	574	512	432	382	374	372	365	362	356	352
Addition to Fixed Assets	0	0	116	112	1,384	2,056	1,748	2,343	1,131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Repayment of Long Term Loans	0	0	0	0	0	0	0	0	0	0	0	0	152	152	152	152	152	152	152	152	152	152	152	152	152
Net Income before Tax	0	0	0	0	5	93	255	431	550	560	520	520	513	510	504	422	360	280	230	222	220	213	210	204	200
Other Assets Increment	55	55	68	76	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Increase	75	83	84	87	109	229	327	447	510	512	472	472	314	319	313	238	182	107	61	56	60	55	59	54	58
Accumulated Total	75	158	242	329	438	667	994	1,441	1,951	2,463	2,935	3,407	3,721	4,040	4,353	4,591	4,773	4,880	4,941	4,997	5,057	5,112	5,171	5,225	5,283

Appendix 14-4 INCOME STATEMENT (Case-6)

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cargo Volume (1000t)	731	781	874	967	1,060	1,153	1,240	1,340	1,433	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526	1,526
Revenue																									
Port Due	39	42	47	55	72	96	121	153	186	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Quay Due	81	87	97	115	149	199	250	319	387	416	416	416	416	416	416	416	416	416	416	416	416	416	416	416	416
Water Supply	36	40	45	51	66	89	111	142	172	185	185	185	185	185	185	185	185	185	185	185	185	185	185	185	185
Warehouses	22	24	26	31	41	54	68	87	106	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113
Miscellaneous	28	30	32	40	51	69	87	110	134	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145
(Total)	206	223	247	292	379	507	637	811	985	1,059	1,059	1,059	1,059	1,059	1,059	1,059	1,059	1,059	1,059	1,059	1,059	1,059	1,059	1,059	1,059
Expenses																									
Official Cost	37	39	42	46	50	57	63	69	77	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Maintenance	9	10	10	11	12	19	59	97	152	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175
Fuel and Power Electric Supply	18	22	27	29	32	36	39	42	45	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Depreciation	125	130	145	155	175	232	332	448	509	509	469	469	469	469	469	392	333	255	210	210	210	210	210	210	210
Miscellaneous	8	8	9	9	10	13	16	18	20	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
(Total)	197	209	233	250	279	357	509	674	803	841	801	801	801	801	801	724	665	587	542	542	542	542	542	542	542
Net Operating Income	9	14	14	42	100	150	128	137	185	218	258	258	258	258	258	335	394	472	517	517	517	517	517	517	517
Other Income and Other Expenses (Total)	1	1	-1	-4	-18	-53	-83	-121	-136	-136	-136	-136	-132	-127	-123	-118	-115	-109	-105	-100	-96	-91	-87	-82	-78
Interest Earned on Investment	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Interest on Long Term Loans	0	0	2	5	19	54	84	122	137	137	137	137	133	128	124	119	115	110	106	101	97	92	88	83	79
Net Income before Tax	10	15	13	38	82	97	45	16	49	82	122	122	126	131	135	217	279	363	412	417	421	426	430	435	439
Tax	5	7	6	19	41	48	22	8	24	41	61	61	63	65	67	108	139	181	206	208	210	213	215	217	219
Net Income after Tax	5	8	7	19	41	49	23	8	25	42	61	61	63	66	68	109	140	182	206	209	211	213	215	218	220

Appendix 14-5 BALANCE SHEET (Case-6)

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Assets																									
Net Current Assets	288	371	455	553	709	990	1,345	1,801	2,335	2,886	3,416	3,946	4,326	4,709	5,094	5,443	5,764	6,049	6,313	6,580	6,899	7,120	7,393	7,669	7,947
Net Fixed Assets	575	500	539	572	1,842	3,666	5,082	6,977	7,599	7,090	6,621	6,152	5,683	5,214	4,745	4,353	4,020	3,765	3,555	3,345	3,135	2,925	2,715	2,505	2,295
(Fixed Assets	(650	(650	(766	(878	(2,262	(4,318	(6,066	(8,409	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540	(9,540
(Accumulated Depreciation	75	150	227	306	420	652	984	1,432	1,941	2,450	2,919	3,388	3,857	4,326	4,795	5,187	5,520	5,775	5,985	6,195	6,405	6,615	6,825	7,035	7,245
Investment	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Total Assets	873	881	1,004	1,135	2,561	4,666	6,437	8,788	9,944	9,986	10,047	10,108	10,019	9,933	9,849	9,806	9,794	9,824	9,878	9,935	9,994	10,055	10,118	10,184	10,252
Liability and Equity																									
Long Term Loans	0	0	73	156	799	1,795	2,787	4,063	4,562	4,562	4,562	4,562	4,410	4,258	4,106	3,954	3,802	3,650	3,498	3,346	3,194	3,042	2,890	2,738	2,586
Other Liability	0	0	616	645	1,386	2,446	3,202	4,269	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901
Total Liability	573	573	689	801	2,185	4,241	5,989	8,332	9,463	9,463	9,463	9,463	9,311	9,159	9,007	8,855	8,703	8,551	8,399	8,247	8,095	7,943	7,791	7,839	7,487
Equity																									
Capital / Retained Earnings	295	300	308	315	334	376	425	448	456	481	523	584	645	708	774	842	951	1,091	1,273	1,479	1,688	1,899	2,112	2,327	2,545
Net Income after Tax	5	8	7	19	42	49	23	8	25	42	61	61	63	66	68	109	140	182	206	209	211	213	215	218	220
Total Equity	300	308	315	334	376	425	448	456	481	523	584	645	708	774	842	951	1,091	1,273	1,479	1,688	1,899	2,112	2,327	2,545	2,765
Total Liability and Equity	873	881	1,004	1,135	2,561	4,666	6,437	8,788	9,944	9,986	10,047	10,108	10,019	9,933	9,849	9,806	9,794	9,824	9,878	9,935	9,994	10,055	10,118	10,184	10,252

Appendix 14-6 SOURCE & APPLICATION OF FUNDS (Case-6)

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Source (Total)	130	138	268	286	1,601	2,337	2,103	2,799	1,665	551	530	530	532	535	537	501	473	437	416	419	421	423	425	428	430
Subsidy from Central Government																									
Net Income after Tax	5	8	7	19	42	49	23	8	25	42	61	61	63	66	68	109	140	182	206	209	211	213	215	218	220
Depreciation	125	130	145	155	175	232	332	448	509	509	469	469	469	469	469	392	333	255	210	210	210	210	210	210	210
Loans from Central Government	0	0	116	112	1,384	2,056	1,748	2,343	1,131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loans from Long Term Loans	0	0	73	83	642	996	993	1,275	499	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Application (Total)			184	188	1,445	2,056	1,748	2,343	1,131	0	0	0	152	152	152	152	152	152	152	152	152	152	152	152	152
Addition to Fixed Assets	0	0	116	112	1,384	2,056	1,748	2,343	1,131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Repayment of Long Term Loans	0	0	0	0	0	0	0	0	0	0	0	0	152	152	152	152	152	152	152	152	152	152	152	152	152
Net Income before Tax																									
Other Assets Increment	50	55	68	76	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Increase	75	83	84	98	156	281	355	456	534	551	530	530	380	383	385	349	321	285	264	267	269	271	273	276	278
Accumulated Total	75	158	242	340	496	777	1,132	1,588	2,122	2,673	3,203	3,733	4,113	4,496	4,881	5,230	5,551	5,836	6,100	6,367	6,636	6,907	7,180	7,456	7,734

Chapter-15 Environmental Assessment

15. Environmental Assessment

15-1. General

As stated above, the Port of Bitung faces the calm Lembeh Straits and is sheltered by Lembeh Island. Most of the people in the area are engaged in fishery on the calm Lembeh Strait, and in cultivating coconuts, bananas and papayas etc. on the coastal land area for livelihood.

The development plan of the Port of Bitung will be carried out simultaneously with the industrial development and urban planning of the hinterland.

It is envisaged that the development work will stimulate environmental changes. The Bitung area is bestowed with a splendid natural environment and it is necessary not only to maintain the living conditions but also to preserve the sound environment. For this reason it is important to formulate a fundamental policy to establish a pollution-free development plan.

With the development of the Port of Bitung, it is projected that there will be an increase in population and an increase in traffic of the City of Bitung. On this basis, it is expected that pollution will increase. Considering this, careful and detailed countermeasures against pollution will have to be considered in the preparation of the development plan. However, since no standard has been established in evaluating the effects of industrialization on environment, it is envisaged that the study will require an enormous amount of material and time. In this report, only major items on anti-pollution required for the Port of Bitung are discussed.

15-2. Air Pollution

The adjacent area west of the Port of Bitung is being considered as an industrial site. No industrial complex such as heavy chemical industries is expected but only light industries such as copra processing plants and construction materials fabricating plants are expected to be built.

Insofar as they are not special industries, future industries will not become a source of air pollution to affect the lives of the citizens. However, it is necessary to take positive preventive measures for both industries and public sectors.

With increasing traffic volume, emissions from motor vehicles will directly affect people and plants alongside the roads, but they may be prevented administratively by, for example, emission controls. Vehicle traffic is related to the urban planning of the City of Bitung and City of Menado and consideration should be made from the standpoint of urban planning.

Air pollution is largely reduced through the dispersing action of wind, the cleaning effect of rain, and other atmospheric phenomena. At the Port of Bitung, the dominant wind directions in one year are N.E. winds with a velocity of 5m/sec., and such winds have the effect of spreading air from the port and city toward the ocean. Wind data from May through October (Fig. 3-2) show mostly SW winds with a velocity of 5m/sec. - 10m/sec. The wind direction is from the planned industrial site to the city but fortunately because of little higher velocity of the wind, it is assumed that air will be more dispersed.

Rain in this area is not very distinctive of the rainy season from the dry season as in Java Island, and the precipitation is about 200 - 400 mm/month. Therefore, the rain will help clean the air at a certain interval throughout the year.

15-3. Water Pollution at Port

There are many causes of water pollution, such as flow of dirty water from the urban river and streams and from sewers or floating dirt, waste water and waste liquids from industrial development, spill of cargo from vessels, sewage and waste oil from vessels, litter and trash around the piers, etc.

The bottom soil in the Port of Bitung and neighboring coast consists mostly of layers of sand with a relatively large granular size of 0.05 mm - 0.4 mm. Because of the strong current around the waters, floating soil containing organic matter does not settle on the sea bed. It shows that the sea bed has a good air permeating condition.

In the Lembeh Strait, there are two tides a day, and the average velocity ranges from 0.5 m/sec. to 0.7 m/sec.

The tide flows uniformly from the surface to the bottom and is thus considered to largely help purify the water quality in the area. It is necessary for both users of ships and users of the land to exert efforts for conservation of water quality so that the naturally good water quality of this area will not be polluted as the result of regional development. Prevention of water pollution will also be effected, as described later, by providing, cleaning boats, oil collecting boats and waste oil disposal facilities in the port.

On the other hand, on land, it may be effected by disposing waste water, urban waste water, sewer and garbage within the urban area, and in the industrial area by strict supervision to prevent unrestricted discharge of waste water and solutions in compliance with certain regulations. In any event, both the Government and the public together must take every possible measure to maintain water quality.

As described earlier, the Port of Bitung has a feature of being cleaned

by the current flowing into the open sea, and it is expected that serious water pollution will be prevented.

In this project, as a -5.5 m basin for coastal ships to be built at the northeast side of the existing concrete pier is surrounded by quay walls except at the harbor entrance, a study must be made of the maintenance of water quality in the interior water area.

Generally, for ascertaining sea water flow in the interior water area, various data and analyses are required.

At the Port of Bitung, as the tidal range is as large as 1.9 m to allow seawater flow to a large extent and as the sea water discharged from inside the basin by ebb tides tends to flow outside the strait on the current of Lembeh Strait, there is little possibility of accumulation of pollution within the basin unless there is excessive discharge of pollutants into the basin. General regulations to prevent the discharge of garbage, sewage, waste oil, etc. in and around the harbor area and from vessels must be enforced.

15-4. Oil Pollution

Oil pollution at the Port of Bitung are likely to be caused largely by ships in the port and from the adjacent oil base of P.N. Pertamina.

Full control is necessary to prevent discharge of waste oil from the ships. With regard to the use of the oil berth, prevention and recovery measures of water ballasts, cleaning water of tanks, bilge and other waste oil discharged from oil tankers are necessary.

At the oil berth, installations of oil fences, oil preventing banks, oil collecting boats and oil disposal facilities are necessary to prevent the spread of oil spills.