FEASIBILITY REPORT

ON THE

GUATEMALA PORT CONSTRUCTION PROJECT

DECEMBER 1974

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In compliance with the request of the Government of Guatemala, the Government of Japan conducted a survey for the New Port Construction Project on the Pacific coast of Guatemala as part of Japan's overseas technical cooperation, and entrusted its execution to the Overseas Technical Cooperation Agency, the predecessor of the International Cooperation Agency.

The Agency sent a 15-man survey team, headed by Mr. Masao Ohno, Director-General of First Ports and Harbours Bureau of the Ministry of Transport, to Guatemala where it carried out a feasibility study of the project from April 16 to May 15, 1974.

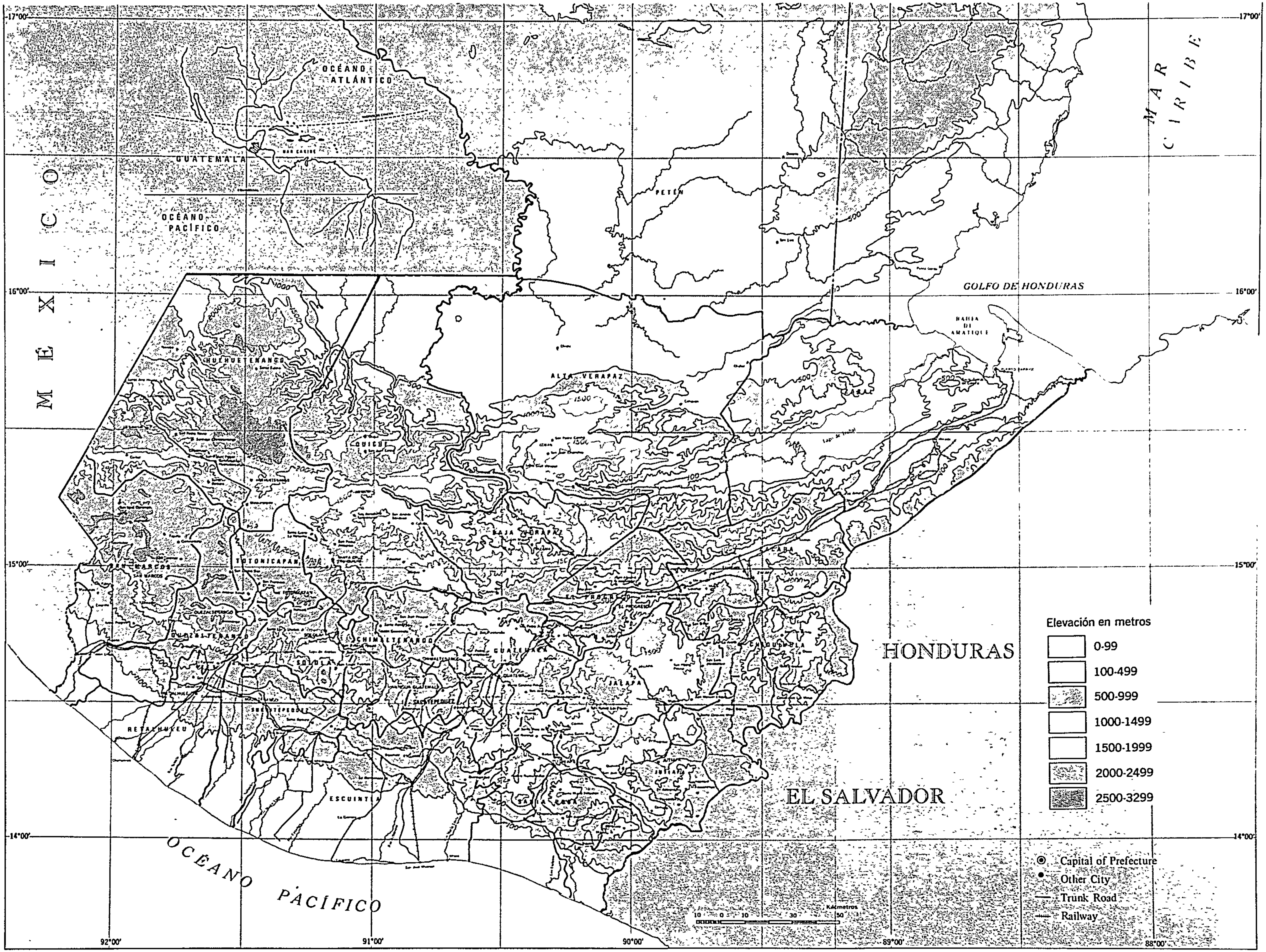
During its study in Guatemala, the team prepared an interim report and submitted it to the Government of Guatemala. After its return to Japan, the team continued to devote its efforts to complete its full report by studying carefully the project and revieweing the collected data.

It gives me a great pleasure if this report, which I am submitting herewith to the Government of Guatemala, proves to be instrumental in prompting the progress of the project and, at the same time, serves to enhance the economic development of Guatemala and the friendly relations now existing between Guatemala and Japan.

I take this opportunity to express my heartfelt gratitude to the Government of Guatemala and the staffs of the Embassy of Japan in Guatemala for the helpful cooperation offered to the team.

Shinsaku Hogen
President
Japan International Cooperation Agency

December 1974



MÉXICO
MAR CARIBE
OCÉANO ATLÁNTICO
GUATEMALA
OCÉANO PACÍFICO
PETÉN
GOLFO DE HONDURAS
BAHIA DE AMATIQUE
HUEHUETENANGO
ALTA VERAPAZ
QUICHÉ
BAJA VERAPAZ
SAN MARCOS
TOTONICAPÁN
QUEZALTENANGO
CHIMALTENANGO
SOLOLÁ
GUATEMALA
ZACAPA
EL PROGRESO
CHIQUIMULA
JALAPA
SACATEPÉQUEZ
SUCHITEPÉQUEZ
RETALHULEU
ESCUINTLA
SANTA ROSA
JUTIAPA
HONDURAS
EL SALVADOR
OCÉANO PACÍFICO
Elevación en metros
0-99
100-499
500-999
1000-1499
1500-1999
2000-2499
2500-3299
Capital of Prefecture
Other City
Trunk Road
Railway
Kilómetros
10 0 10 30 50
17°00'
16°00'
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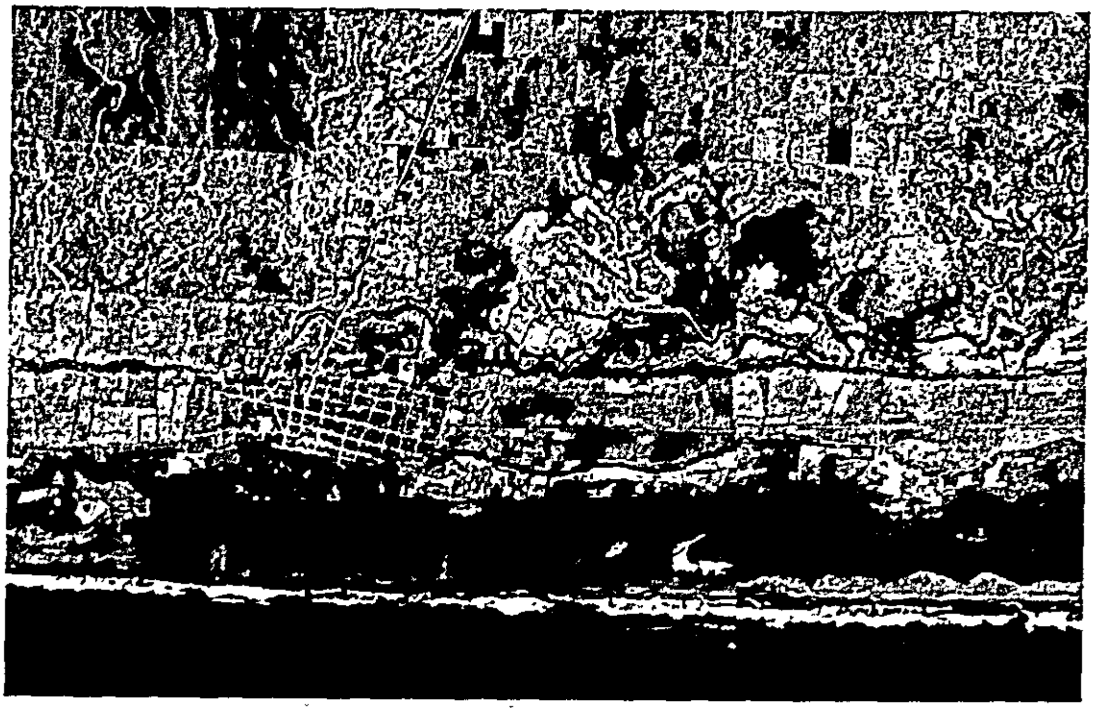
91°00'
90°00'
89°00'
88°00'

Aero Photograph Around Sipacate



(Around Sipacate Village)

(Around Navy Base)

Sipacate

Sand Dune

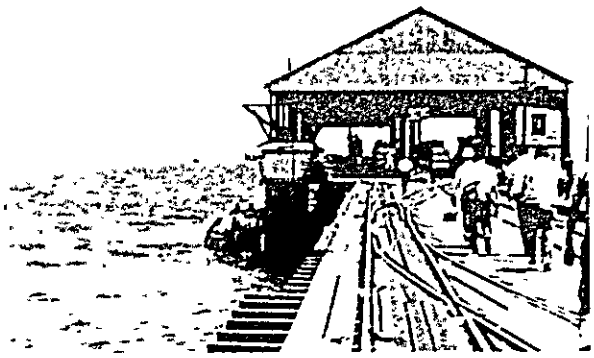
Canal and Forest of Mangrove

Outlet of Canal

Sipacate Village

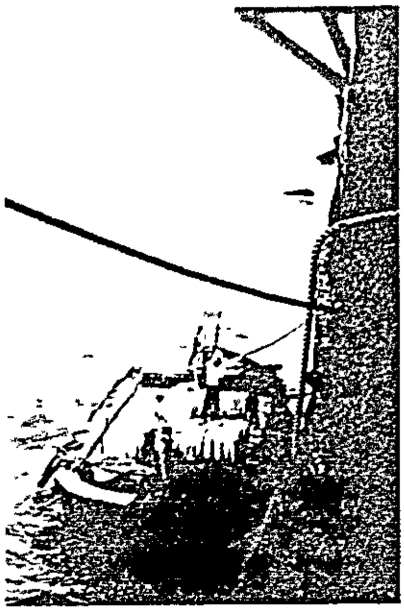
San Jose

Piled Pier



Transit Shed on the Pier

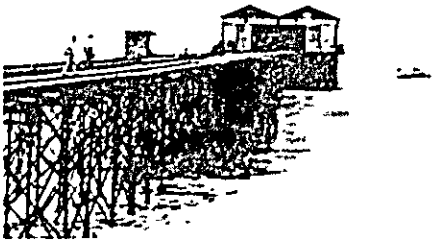
Lighter and
Cargo Handling



Villa on the
Sand Dune

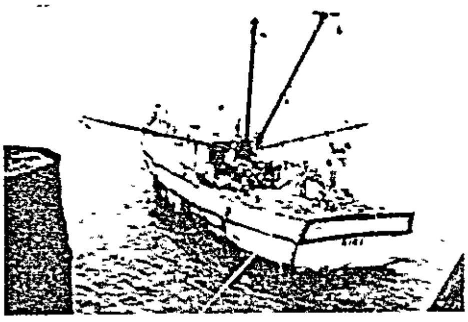
Champerico

Piled Pier



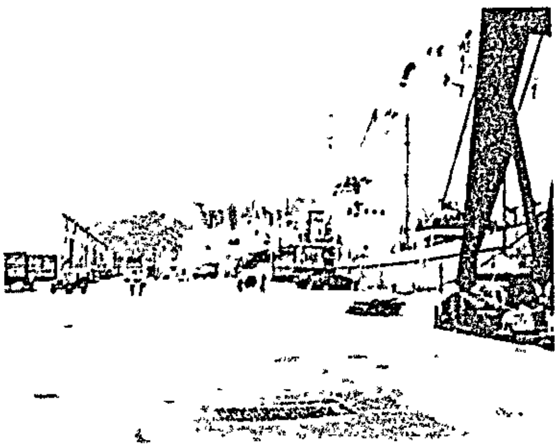
Storage Yard
Full of Raw Cotton

Warehouse



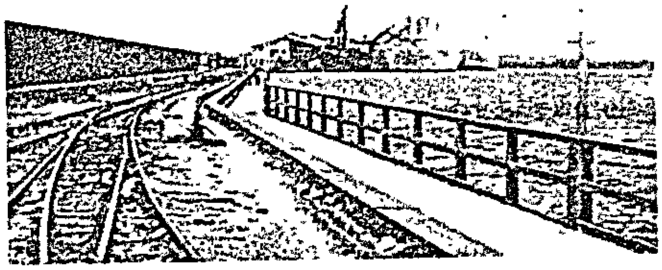
Shrimp Catching Boat

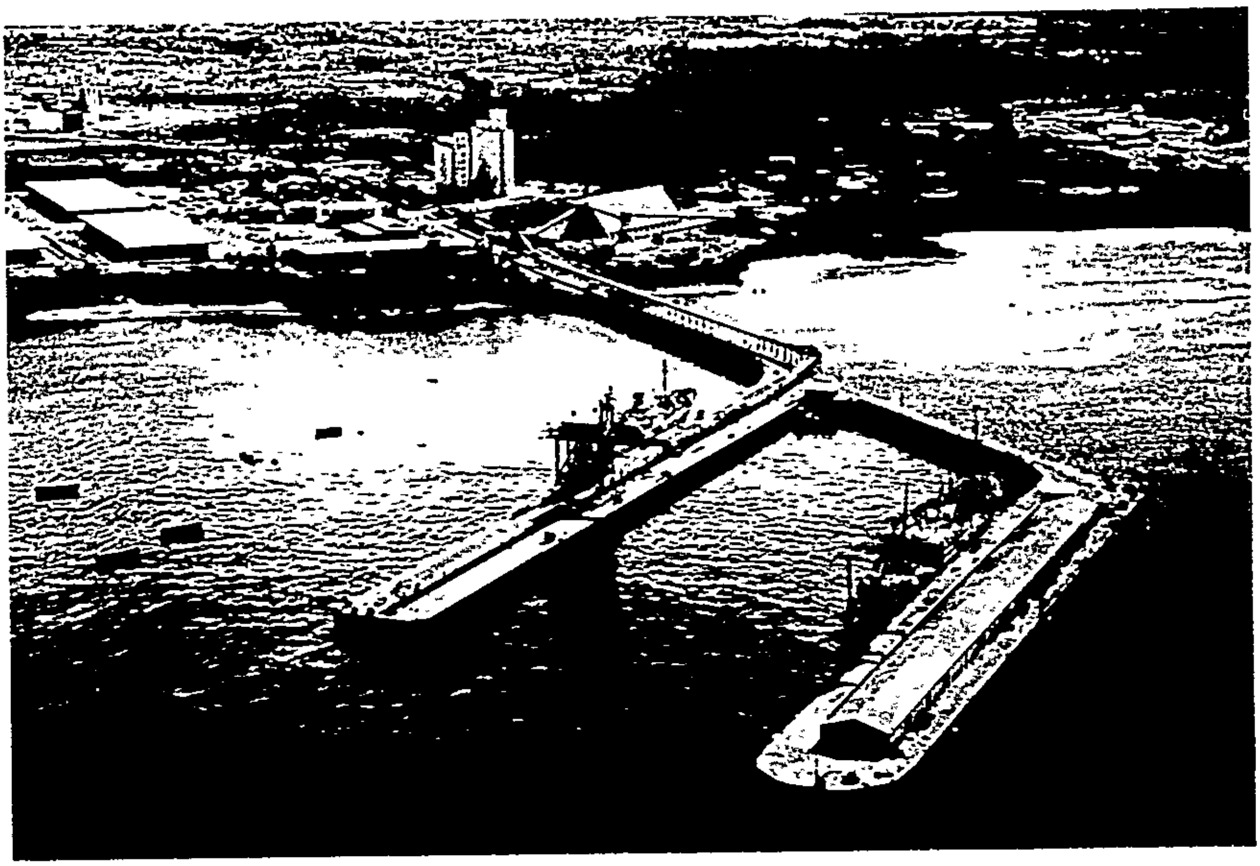
Other Ports



Santo Tomas

Puerto Barrios





Acajutla

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SUMMARY AND RECOMMENDATIONS

1. Summary

(1) Necessity of New Port Construction

On the Pacific coast of Guatemala, sea-borne cargoes are handled as San José and Champerico and via Acajutla in El Salvador. In 1973, the total cargo volume amounted to 350 thousand tons or about 24% of the country's total volume of import and export cargoes (1,440 thousand tons). It is expected that this will increase to 560 thousand tons in 1980 and further to 1,500 - 2,000 thousand tons in 2000.

Development of land use in Guatemala involving agricultural production and construction of cities and transportation networks is concentrated on the Pacific coast. Ports on the Pacific coast therefore carry a heavy weight in the country's foreign trade with the United States, Asia and Oceania as well as with Europe.

However, both San José and Champerico, with their superannuated facilities for lighter operation constructed about 90 years ago, are not capable of handling heavy and bulk cargoes. Further, limits are set on the cargo transportation via Acajulta port. As things stand now, the existing three ports on the Pacific coast cannot be expected to cope with the increasing cargo volume in future.

It follows, therefore, thtat the construction of a new and modern port on the Pacific coast for promotion of Guatemala's foreign trade will bear very closely on the country's future economic development. The new port construction scheme is also justifiable in that it will accelerate the fisheries development and at the same time provide the chance for creating a new sea-side resort.

(2) Selection of Site and Type of New Port

The Pacific coastline of Guatemala is monotonous and has no inlets or gulfs which serve as good natural harbours.

A survey was therefore made on the natural conditions including climatic, oceanographic and geologic conditions, which disclosed that a section extending to the east of Sipacate would be suitable because it is less subjected to littoral drift than other parts of the coastline. This was followed by a comprehensive and overall review covering the distance from the selected site to the producing and consuming areas, transport condition, land use condition at the selected site, difficulty involved in securing the required land, and creation of a new port city. As a result, Sipacate was selected as best satisfying these conditions.

It was also concluded that the new port should be of an artificially excavated type because it will be constructed on the natural coast exposed to severe oceanographic condition and will have to be prevented against wave intrusion and shoaling due to littoral drift and because of existence of its extensive hinterland area in order to ensure safe and smooth moving of vessels and efficient cargo handling.

After due consideration of the geological and land use conditions, it was determined that the new excavation type port would be constructed on the eastern side of the existing Sipacate village.

(3) Scale and Cost Estimation of New Port

In the first construction stage ending in 1980, the following facilities will be completed to handle an estimated total cargo volume of 430 thousand tons excluding the volume to be handled at Champerico port.

-10 m deep quaywall for 15,000 D/W class ships	3 berths
-4 m deep quaywall for fishing boats	350 m
Breakwater	1,430 m
-10 m deep channel	
-10 m and -4 m deep basins	
Other appurtenant facilities	

The total cost required for the construction of these facilities is estimated to amount to about US$58 million (price in May 1974).

Expansion of these new port facilities will become an imperative in future with the increase of cargo volume. Specifically, additional six berths for 15,000 D/W class ships and partial expansion of the breakwater, channel and basin will be required to handle a total of 1.5 to 2 million tons of cargoes estimated for 2000.

(4) Economic Evaluation from the Aspect of National Economy

The project aims at the construction of a new port on the Pacific coast of Guatemala which is safe and highly efficient as well as modern. It will contribute greatly to the future development of the Pacific coast areas as well as Guatemala as a whole. In other words, completion of a new port will bring about a great improvement in the transport system of import/export cargoes, thus expediting speedy handling of all kinds of cargoes at a low cost and in its own port. Furthermore it will help promote domestic industries such as agriculture, fishery and the manufacturing industries, and will promote economic growth. It will also help increase trade with overseas countries.

In respect of the economic appraisal of the new port construction, we have undertaken the cost-benefit analysis viewed from Guatemala's national economy, in making analysis, assessment was made on how much more benefit will be gained by the construction of a new port than if the construction thereof is left unlaunched.

At the same time, the internal rate of return has been obtained by comparing the benefits with the expenses to be incurred in the construction and maintenance of a new port. Among wide-ranging economic benefits which the project will bring, those which can be measured quantatively in the analysis will be limited to the following direct benefits. Accordingly, due consideration must be given to the fact that the findings of this analysis tend to be conservative in the estimate of the economic effects of this Project.

(a) Benefit derived from the extinction of lighter-borne stevedoring.

(b) Benefit derived from obviating the necessity of dependence on ports in the neighboring countries.

(c) Saving in inland transportation cost.

(d) Increase in fishing catch.

The analysis has proved that the internal rate of return for this project is 16% and the cost/benefit ratio 1:1.49. Therefore this development project proves to be highly significant and efficatious to the country of Guatemala.

In the first stage of the new port construction, it pressupposes that the port of Champerico will maintain its function as a complementary port in the western part of the Pacific coast. Likewise, it is highly significant for the neighboring El Salvador in that the port of Acajutla will be able to eliminate serious congestion by increasing Guatemalan cargoes. Viewed in this light, we can say that the Project will make a vast contribution to the desirable development of the two countries of Guatemala and El Salvador.

(5) Financial feasibility of the project

As for financial soundness, most important in this kind of project, if the government could invest more than one half of the total investment, and arrange the repayment period of loan, that is to cover the rest of the investment, for more than 20 years (after 5 years of grace), subsequent government subsidy would be basically unnecessary. If the government's share of the total investment is reduced to 33%, however, maximum government subsidy of $1.4 million could become necessary.

The source of revenue, or the amount of cargo handled, tends to be affected easily by short-term change of exogenous factors, and the cash surplus generated by the project might be found insufficient to cover the loss in revenue. Therefore, governmental support, at least for 10 years after the opening, will be indispensable in addition to viable managerial support of its own.

As far as the profitability is concerned, the project is not an exception for a typical infra-structure project. The financial rate of return of 3.7%, derived from the most basic case of this project, would not be called sufficient, were it an ordinary industrial project. However, if we consider the financial rate of return in view of the pervasive non-financial benefits produced by the project, its financial profitability could be regarded passable.

(6) Future Prospect

The project is expected to provide the basis for a diversity of developments such as -

a. Introduction of containerization and land-bridge transportation.
b. Establishment of a free port zone.
c. Creation of a seaside resort.
d. Creation of a waterfront industrial area.

Considering the existing condition, it may appear a remote possibility to introduce containerization and land-bridge transportation. It is likely, however, that the new port will emerge as a container feeder port in the region of Central America not in the distant future. And when the capacity of Panama Canal falls short of demand, the land-bridge transportation scheme connecting the Pacific and Atlantic coasts of Guatemala may have a fair possibility. These two development plans therefore deserve serious consideration.

As for other development possibilities listed above, positive effort should be made for their realization.

The layout of the new port and its vicinities upon completion of the first stage construction plan and in 2000 is shown separately (See Attached Figure).

2. Recommendations

(1) Government Disbursement

As described in Section 1st (4) the new port construction project promises to provide important and sizable benefit to the national economy. However, since the construction site is exposed to a severe natural condition, and the project implementation presupposes considerable infrastructural improvement, in order for the project to be economically sound, it is recommended that about 50% of the total construction cost be covered by the Guatemalan Government.

In connection with this recommendation, the mission wishes to point out that virtually all fundamental port facilities in Japan are constructed with subsidies provided by the government and local public bodies (which are responsible for the management of such facilities), and that this practice prevails in most countries of the world.

(2) Establishment of a System for Construction and Management

The mission noted that the Guatemalan Government is not well experienced in the construction of modern ports and harbours. The Ministry of Communications and Public Works, which has competence over the project, has no divisions or bureaus directly responsible for the project implementation.

It is therefore recommended that a new division (e.g., Ports and Harbours Division) be established within the ministry at the earliest possible date and assigned to the task of promoting the project and undertaking the improvement and administration of all Guatemalan ports after completion of the new port.

Two systems are conceivable for management and operation of the new port, the one in which a newly established central organization undertakes the management and operation of all Guatemalan sea ports including the new port, and the other in which an independent port authority takes charge of the new port as in the case of the existing ports.

The mission is of the opinion, however, that an efficient and integrated organization should be newly set up for this purpose after careful study of the advantages and disadvantages of the above-mentioned two systems. Such an organization will be required to maintain close contact with the new division established within the Ministry of Communications and Public Works.

(3) Containerization

As described already, introduction of containerization in the new port is still considered immature. It is necessary, however, to pay constant attention to the trend of international marine transportation so that the new port will gain a favourable footing for container transportation when the situation turns for the better.

(4) Training of Engineers

It is believed that the number of engineers specialized in the planning, design and execution of port construction work is relatively small in Guatemala because of the limited number of sea ports constructed in this country.

Smooth progress of the new port construction work will therefore call not only for the creation of a system for port management and operation but also for the training and recruiting of engineers required in different aspects of the construction work.

(5) Data Collection and Preparations for Construction Work

a. Natural Condition

Of the various data required for the new port construction, the results of the following surveys and studies are of particular importance.

i. Field investigation of waves and littoral drift.
ii. Sounding of depth of sea.
iii. Sampling of shore materials.
iv. Sounding of depth of the channel.

b. Preparations for Construction Work

During the present survey, the mission was unable to spare a sufficient time for the survey on stone materials and quarries. Since the progress of the construction work will be seriously affected if a stable supply of cheap stone materials is not assured, it is recommended that a detailed survey be conducted as soon as possible.

c. Data for Economic Analysis

In order to raise the accuracy of future economic analysis, effort should be directed towards collecting all relevant data.

(6) Matters Demanding Special Consideration for Project Implementation

a. Plans for San José and Champerico

The new port project assumes that San José port will handle no cargoes and Champerico will maintain its existing port functions upon completion of the first stage construction plan. The project also assumes that when it is completed in 2000, the two ports will handle no cargoes at all.

Considering the socio-economic confusion which will be inevitable if the accumulated functions of the two ports are reduced in a short period, it is necessary to devise a suitable solution for this problem in advance either politically or otherwise.

The mission is of the opinion that the greater part of the port facilities (including port labourers) of San José can be moved to the new port. Since San José already has some recreation facilities, it is desirable that the port be redeveloped into a sea-side resort in future.

Champerico, on the other hand, calls for prudent consideration because its existence hinges almost solely on the port. It will be necessary to preserve the existing port facilities so that Champerico will survive on the Pacific coast.

b. Rearrangement of Port Facilities

In order to ensure a smooth commodity flow through the new port, it is imperative that the port facilities (particularly commodity distribution route, information network, labour force, and transportation enterprises) be rearranged suitably within a short period of time.

c. Controlled Development of New Urban Area

Construction of the new port will be ensued by the development of a new urban area surrounding it. In developing such a new urban area, endeavours should be made not only to improve port and urban functions, but also to provide a comfortable environment for all the people concerned.

d. Environmental Conservation

Since a sea port is an arena of man's production and distribution activities, lack of environmental conservation effort is sure to invite pollution of its basin due to waste oil and organic substances. Pollution of basin water is liable to occur particularly in an artificially excavated port. In the construction of the new port, therefore, careful preventive measures such as drawing of river water into the basin should be enforced to minimize water contamination.

The new port construction site is one of the most scenic places in whole Guatemala. It is therefore urged that maximum effort be directed towards conserving its environment and scenic beauty.

FOREWORD

1. Background of Survey

(1) In Guatemala the plan for constructing a modern port on the Pacific coast had been conceived more than ten years ago. The demand for its realization has been growing year by year. This has been due to the following circumstances: Despite the fact that agriculture, the major industry of Guatemala, is distributed mainly on the Pacific coast, existing port facilities for cargo-handling at the San José and Champerico ports were established more than 80 to 90 years ago and have now become superannuated and woefully insufficient in functional capacities. In addition, they are incapable of handling heavy cargoes or bulk cargoes. To cover the inadequacy of the functions of these facilities, therefore, Guatemala is forced to relay increasingly on Port Acajutla of its neighbor, El Salvador, enduring all the disadvantages of land transportation to and from the neighbor's port.

(2) In order to realize the above-mentioned plan, several surveys have been undertaken so far. For example, the 1963 survey report made by the U. S. Army Corps of Engineers and report on a survey undertaken in 1972 by Professor J. W. Johnson of the University of California have been made available. However, the Pacific coast of Guatemala is a plain coast composed of violent drifts and unsuitable for port and harbor construction from the technical point of view. Consequently, the idea of constructing any new harbor has not yet been implemented in spite of such surveys.

(3) In February 1972, the Guatemalan Government made an official request in writing to the Japanese Government for technical assistance and cooperation on this matter.

(4) Furthermore, in July 1972, President Arana of Guatemala paid an unofficial visit to Japan and asked for assistance on the same matter.

(5) In December 1972, the Japanese Government sent a team to Guatemala on a technical cooperation project selecting survey. The team consisted of selected members from the Ministry of Foreign Affairs, Ministry of Transport, Ministry of Posts and Telecommunications, Ministry of Agriculture and Forestry, Ministry of Construction and the Overseas Technical Cooperation Agency (OTCA; presently called International Cooperation Agency). After conferring with the officials of Guatemala, the team reported to the Japanese Government as follows:

a) It was confirmed that, among the projects proposed by Guatemala requesting technical assistance from Japan, such as the new port and port construction on the Pacific coast, construction of a highway between the Guatemala City and Escuintla, modernization of railways, etc., the new port construction project was of the top priority in its importance and urgency.

b) It is better to dispatch a survey team to Guatemala immediately for the study of technical and economic feasibility of this project and for making workable plans of constructing the port.

(6) The Japanese Government decided to dispatch harbor engineers by OTCA as the first-phase preliminary survey team to undertake technical field survey of the local conditions and simultaneously to make advance arrangements for further studies at subsequent phases. This was to be followed by the plenary survey team to formulate detailed plans. The preliminary survey team consisted of five officials from the Ministry of Transport; it was sent to the site for three weeks from September to October 1973 (the names of officials are listed elsewhere).

(7) In November 1973, five officials of the Guatemalan Government and the Minister of Communication and Public Works visited Japan and inspected some of the important ports of Japan, including the Port of Kashima.

(8) Based on the results of field studies brought back by the preliminary survey team mentioned in paragraph (6) above, and as a result of exchange of opinions with the officials of Guatemala, the Japanese Government dispatched the plenary survey team to Guatemala in April 1974 for about a month for further field study.

(9) In July 1974, after the presidential change took place in Guatemala, the Minister of Communication and Public Works remaining in the new Cabinet made a request to the Japanese Government for economic cooperation in the new port construction project on the Pacific coast.

(10) Meanwhile, Port of Acajutla of El Salvador, mentioned in paragraph (1) above, began to impose a surcharge of $2.15 per ton on cargoes brought into the port on account of frequent congestion arising from annually increasing cargo. It was forced to handle even beyond its normal capacity. This is regarded as an evidence of the inadequacy of port capacity on the Pacific coast of both Guatemala and El Salvador.

(11) The results of the field survey conducted by the preliminary survey team in the aforementioned (6) and by the plenary survey team in (8) as well as the findings of the deliberations held in Japan, were incorporated in the "Feasibility Report on the Guatemala Port Construction Project (Draft)" which was completed in September of 1974.
Thus, as of September 25, the Japanese Government organized a survey team composed of the separately listed 4 members to go to Guatemala, where it exchanged views with the competent officials of Guatemalan Government in respect to the Report Draft.

(12) There the survey team came to a mutual agreement in respect to the broad principles of the Report Draft and after some modifications were made to necessary particulars, Report was prepared and submitted to the Japanese Government.

2. Objective and Scope of Survey

As stated above, the Japanese Government organized and sent to Guatemala through OTCA the preliminary and plenary survey teams for feasibility study of the project of constructing a new port on the Pacific coast of that country.

The survey can be divided into two phases: the field study in Guatemala and the planning study in Japan on the basis of previous studies. The objectives are as follows:

(1) Field study

1) To discuss with the Guatemala Government its project for constructing a new port.

2) To make field study and collect information on the Pacific coast of Guatemala, (including Acajutla).

3) To collect data and analyze economic and natural conditions related to the project and to formulate an original plan.

4) To know the administrative organization of Guatemala and its capability of implementing the project.

5) To discuss with the Guatemala Government the results of the field survey and to reach a basic understanding between Guatemala and Japan.

(2) Plan-making study in Japan

1) To make a plan for the new port construction project (scale, location, type, facility plan, etc.).

2) To study methods of execution and to estimate the construction cost.

3) To estimate benefits from the project.

4) To study methods of management of the new port.

5) Future outlook for the new port.

The ultimate goal of the survey lies in the comprehensive study of the feasibility of constructing a new port on the Pacific coast of Guatemala, which will be based on the results of the above-mentioned studies.

3. Members of the Survey Teams

3-1 Preliminary Survey Team

Team leader: Mr. Masao Ohno
Deputy Director-General,
First District Port Construction Bureau,
Ministry of Transport.

Assistant to leader: Mr. Haruo Inoue
Deputy Director of Planning Division,
Bureau of Port & Harbor,
Ministry of Transport.

Other members: Mr. Katsutoshi Tanimoto
(Natural conditions)
Chief, Breakwaters Laboratory,
Hydraulic Engineering Division,
Port and Harbour Research Institute,
Ministry of Transport.

Mr. Satoshi Inoue
(Economic conditions)
Chief Clerk, Planning Section,
First District Port Construction Bureau,
Ministry of Transport.

Mr. Takao Ryuno
(Harbor management)
Chief Clerk, Management Division,
Bureau of Ports and Harbors,
Ministry of Transport.

3-2 Plenary Survey Team

Team leader: (*)Mr. Masao Ohno
Deputy Director-General,
First District Port Construction Bureau,
Ministry of Transport.

Assistant to leader: (*)Mr. Shun-ichi Onodera
Director, Development Division,
Bureau of Ports and Harbors,
Ministry of Transport.

Other members: Mr. Satoshi Inoue
(Economic analysis),
Chief Clerk, Development Division,
Bureau of Ports and Harbors,
Ministry of Transport.

Mr. Soichiro Imotani (ditto),
General Research Institute,
Nihon Tsuun Co., Ltd.

Mr. Ryuichi Sakio (ditto),
Mitsui O.S.K. Lines Ltd.

Mr. Tsuneki Hara (ditto),
Nihon Kogyo Bank.

Mr. Mototsugu Izawa
(Facility planning)
Chief Clerk, Management Division,
Bureau of Ports and Harbors,
Ministry of Transport.

Mr. Jiro Izumiya (ditto),
Head, Kobe Machinery Equipment Office,
Third District Ports Construction Bureau,
Ministry of Transport.

(*)Mr. Yasuhiro Kawashima (ditto),
Special Assistant of Planning Division,
Bureau of Ports and Harbors,
Ministry of Transport.

Mr. Toshio Sato (ditto),
Deputy Director of Planning Section
Fishing Port Department,
Fisheries Agency.

Mr. Toshihiro Uno (Construction planning)
Deputy Head of Niigata Investigation
and Design Office,
First District Ports Construction Bureau,
Ministry of Transport.

Mr. Yasufumi Umehara (ditto),
Chief of Soil Mechanics Laboratory,
Soils Division,
Port and Harbour Research Institute,
Ministry of Transport.

(*)Mr. Katsutoshi Tanimoto (ditto),
Chief, Breakwaters Laboratory,
Hydraulic Engineering Division,
Port and Harbour Research Institute,
Ministry of Transport.

Mr. Akira Yamamoto (ditto),
Deputy Head,
Construction Office of Port of Kobe,
Third District Ports Construction Bureau,
Ministry of Transport.

Mr. Minoru Takase (General affairs)
Counsellor, Japan International
Cooperation Agency.

Note: The titles of the above members are of the time when the survey was being conducted.
The asterisk sign (*) denote those members who proceeded to Guatemala with the Report Draft during the period from September 25 to October 8, to hold discussion with the officials of Guatemalan Government there.

4. Schedule of the Survey Teams

The schedules of the preliminary and plenary survey teams have been as shown in Table 1 and Table 2 below.

Table 1. Schedule of preliminary survey team (1973)

September:

17 (Mon):	Leave Tokyo
18 (Tue):	Arrive in Guatemala
19 (Wed):	Make arrangements with Japanese Embassy
20 (Thurs):	Confer with officials of Guatemala, collect and arrange data
21 (Fri):	(ditto)
22 (Sat):	Arrange and study data
23 (Sun):	Survey of hinterland
24 (Mon):	Survey at the site (San José)
25 (Tues):	(ditto) (Sipacate)
26 (Wed):	(ditto) (Champerico)
27 (Thurs):	Interview with Minister of Communication and Public Works of Guatemala
28 (Fri):	Survey at the site (Puerto Barrios and Santo Tomas)
29 (Sat):	Arrange data
30 (Sun):	(ditto)

October:

1 (Mon):	Survey at the site (Acajutla)
2 (Tues):	Arrange data
3 (Wed):	Aerial survey of the Pacific coast Report in writing
4 (Thurs):	Report in writing
5 (Fri):	Submit summary of report to Minister of Communication and Public Works
6 (Sat):	Leave Guatemala
8 (Mon):	Arrive at Tokyo

Table 2. Schedule of plenary survey team (1974)

April:

16 (Tues):	Team head and 12 members leave Tokyo (via Los Angeles to Guatemala) (Mr. Sakio proceeds alone via Mexico)
17 (Wed):	Arrive in Guatemala
18 (Thurs):	Make arrangements with Japanese Ambassador Greet Guatemala Government officials (Mr. Sakio arrives in Guatemala)
19 (Fri):	Confer with Vice Minister of Communication and Public Works and other officials of Guatemala Government
20 (Sat):	Collect data Confer with officials of Guatemala
21 (Sun):	Survey of hinterland
22 (Mon):	Collect data (Mr. Sakio, Imotani, Izawa inspect Santo Tomas)
23 (Tues):	Collect data
24 (Wed):	Survey at the site (Acajutla) (Mr. Onodera arrives in Guatemala)
25 (Thurs):	Survey at the site (San José)
26 (Fri):	(ditto) (Sipacaté)
27 (Sat):	(ditto) (Sipacate and quarry) (The economic analysis group arranges data in Guatemala City)
28 (Sun):	Survey at the site (Champerico) (Mr. Sakio, Imotani and Izawa leave Guatemala for Japan)
29 (Mon):	Arrange data Make arrangements with Guatemalan officials
30 (Tues):	Aerial survey of the Pacific coast Collect and arrange data

May:

1 (Mon) - 5 (Sun):	Arrange data Make original draft of interim report (Mr. Hara arrives in Guatemala on May 4)
6 (Mon):	Confer with Guatemalan Officials on the original interim report submitted by the team
7 (Tues):	(ditto)
8 (Wed):	Reach mutual agreement on the above-mentioned report with Vice Minister of Communication and Public Works
9 (Thurs):	Draft an interim report
10 (Fri):	Submit the interim report to the Minister of Communication and Public Works of Guatemala
11 (Sat):	Inspect Antigua Guatemala
12 (Sun):	Prepare for return
13 (Mon):	Leave Guatemala
15 (Wed):	Arrive in Tokyo

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CHAPTER 1. THE PRESENT STATUS OF THE REPUBLIC OF GUATEMALA

Chapter 1. The Present Status of the Republic of Guatemala

1-1 *Outline of the Land*

1-1-1 Location and Land Surface of Guatemala

The Republic of Guatemala is located in the north of Central America (N Lat. 13°50' - 17°45', W Long. 88°30' - 92°15'), bounded by Mexico in the north, and Honduras and El Salvador in the south, and is facing the Pacific Ocean in the west and the Atlantic Ocean in the east. (Fig.-1.1)

The land surface is 108,890 square kilometers and the approximate stretch of land is 400 kilometers east and west by 450 kilometers south and north. The coast line of Guatemala is approximatly 260 kilometers on the Pacific side monotonously stretching from northwest to southeast, and on the Atlantic side facing the Gulf of Honduras the coast line is approximately 140 kilometers.

1-1-2 Utilization of the Land

As shown in Table - 1. 1, the caltivated area is 15,000 square kilometers, and the agricultural land, including the stock farms, accounts for approximatly 25 per cent of the whole land. The plain lies mainly along the Pacific coast and in the northern district, and the central part of the country is almost mountainous district, the elevation of which is from 1,500 meters to 3,000 meters. This is because the Sierra Madre mountains are ranging from northwest to southeast, and there are many active and dormant volcanoes in this district.

In the southern plain facing the Pacific Ocean the utilization of land is improved mainly as agricultural land, but in the northern district the vast forest and grassland are still remained unexploited, and in the central highland district there are many important cities including Guatemala City, Capital of the Republic of Guatemala. The Republic of Guatemala consists of 22 prefectures (departamento) and the size of each prefecture is from 2,000 square kilometers to 4,000 square kilometers.

The distribution of population is concentrated in the central highland district and in the southern plain district, and it is very thinly populated in the northern district. The distribution of cities with accumulation of over a definit scale is grouped as follows: As the central city group, there are Guatemala City and its surrounding cities as Amatitlan, Antigua Guatemala, and Escuintla, as the western city group there are Quezaltenango and its surrounding cities as Mazatenango, Retalhuleu, Coatepeque, Huehuetenango, and as the eastern city group there are Chiquimula, Zacapa, Jalapa, and Puerto Barrios. (Fig.-1.2)

1-2 Outline of National Economy

1-2-1 Scale of Economic Activities

In the recent ten years from 1960 to 1970, Guatemala's real gross domestic product (G.D.P.) in terms of the price level in 1958 grew as much as 1.7 times with an annual average growth rate of 5.5 per cent, and also since 1970 the high growth rate of approximately 6.5 per cent is being continued. In 1973, G.D.P. reached approximately 2,200 million quetzals in terms of the price level in 1958. (Table-1.3)

> The quetzal is the unit of currency of Guatemala, and it is kept to be equal to one United States dollar.

G. N. P. of Guatemala is the largest among five Central American countries. In 1971, G. N. P. of Guatemala was 1.7 times as much as that of El Salvador which ranked second among five Central American countries, but G. N. P. per capita was as low as 300 quetzals. (Table-1.4)

The scale of finance is approximately 200 million quetzals per year and it is the largest among five Central American countries.

1-2-2 Industrial Organization

Table-1.3 shows the industrial organization of Guatemala in terms of G. D. P. As shown in Table-1.3, the fact that the share of the first industry continues to be approximately 30 per cent compared to the share (15 - 19%) of the second industry proves that this country is an agricultural country. Therefore, although the industrialization of this country has been remarkably improved in recent years, the economic dependency of the manufacturing industry is in a relatively low position in this country. But, on the contrary, the commercial activities are being done very briskly and its productivity can be compared with that of agricultural industry. In this connection, it is estimated to be largely depending on the business transaction of agricultural products.

The industrial organization in terms of the labour population is as shown in Table-1.5. An overwhelming majority of approximately 65 per cent is engaging in the agricultural industry followed by 11 per cent in the manufacturing industry and 6 per cent in the commerce. This will mean that this country is typically an agricultural country where the agricultural labour productivity is very low and the economic growth is being strongly influenced by the production of coffee, bananas and raw cotton, and by their international prices.

1-2-3 Scale of National Finance

The national finance of this country in 1970 was 165 million quetzals in revenue and 148 million quetzals in expenditure, and it is increasing with the same tempo as the economic growth of the country. Among the financial expenditures in 1970, the financial investment into social overhead capital was 34.2 million quetzals equivalent to a little under 2 per cent of G. N. P. of this country. (Table-1.6, 1.7) As to the public investment, 70 per cent of which was invested in the transportation, traffic and agriculture, and especially the investment into transportation and traffic was 13.4 million quetzals equivalent to 50 per cent of the public investment.

1-2-4 Economic Development Plan

Table-1.8 shows the progress of the 5 - year plans for economic development of Guatemala. The Government has been keeping to put emphasis on the improvement of agricultural productivity, promotion of industrialization and expansion of export, and for these purposes the Economic Planning Committee (Consejo Nacional de Planificacion) was organized in 1954, and since then the first and second 5-year plan (1955 - 1964), the third 5-year plan (1965 - 1969) and the fourth 5-year plan (1970 - 1974) have been carried out in succession. In the fourth 5-year plan, the total 454 million quetzals investment into social overhead capital was appropriated in the budget, and an average 7.8 per cent annual growth rate of G. D. P. was decided to be realized. The outline of the fourth 5-year plan for economic development is as follows:

- Increase in tax revenue by means of the tax system reformation, and sufficient public investment.
- Improvement of transportation, agriculture, public hygiene and social services by adjusting the order of priority of the departmental public investments.
- Improvement of income distribution.
- Improvement of agricultural productivity and structural reformation of agriculture by means of a preferential policy for small and medium farmers.
- Promotion of development of manufacturing industry, especially export industry and manufacturing industry of national resources.
- Improvement of domestic industry, reduction of dependency on foreign investment and more effective utilization of foreign loan.

The fourth 5-year plan is proceeding with an economic growth rate of 6.5 per cent, and now the fifth 5-year plan (1975 - 1979) for the improvement of agriculture, the expansion of export and the completion of basic transportation facilities is being devised aiming at the completion of November, 1974.

1-3 Outline of Foreign Trade

1-3-1 Trade Balance

The foreign trade of this country is now increasing fabourably. Although unfabourable balance of foreign trade continued in the first half of the 1960's, but in the second half of the 1960's the export increased at a rate of 10 per cent every year, sometimes even exceeding the import. In 1972, export recorded 300 million quetzals. But as the margin of an excess of export was only one fifth or one tenth of the margin of an excess of import, the balance of foreign trade of this country has always been in the state of a chronic excess of import. (Table-1.9)

The detailed statistics concerning the foreign trade of this country is being published by the Statistic Bureau, the Ministry of Economy (Direccion general de Estadistica, Ministerio de Economia). But unfortunately, the latest edition we obtained was one for 1969. Guatemalan foreign trade published in this edition represents all the trade not only by sea but also by land and air, therefore the trade by sea only will be taken up in Chapter 2.

1-3-2 Export

The important items of the export goods are coffee, raw cotton and fruits. (Table-1.10, 1.11)

The export of these three items in 1969 is as follows:

Coffee	83 million quetzals	(32.5%)
Cotton	40 million quetzals	(16.0%)
Fruit	13 million quetzals	(5.2%)

The export of these three items accounts for 50 per cent of the total export in 1969, but when compared with 70 per cent in 1960, it is showing a considerable decline in its export percentage. And this is estimated to have been caused by the rapid expansion of export of manufacturing industrial goods which increased thirteen times during seven years from 1962 to 1969. The main export items other than three items mentioned above are sugar, meat and articles of clothing.

The export in terms of weight was 730,000 tons in 1969. The main items of which were fruits (170,000 tons), coffee (100,000 tons), raw cotton and sugar (170,000 tons). These four items account for 60 per cent of the total export in 1969.

The breakdown of export by destination in 1971 is as follows:

United States	34%
El Salvador	16%
West Germany	12%
Costa Rica	10%
Japan	8%

But recently the export to the United States is showing somewhat a stagnated tendency, and in contrast with this, the export to the Central American Common Market is increasing. (Table-1.12)

1-3-3 Import

Import increased 1.8 times during seven years from 1962 to 1969, the main items of which were industrial products. The breakdown of import in 1969 (Table-1.13, Table-1.14) is as follows:

Construction machinery	26 million quetzals (8.9% of all import)
Motor car	20 million quetzals (7.9%)
Steel	15 million quetzals (6.0%)
Electric machine and apparatus	14 million quetzals (5.7%)

The principal items other than those mentioned above are pharmaceutical products, yarn and thread, and chemical materials.

As to the import in terms of weight, steel (93,000 tons, 13.8% of the total import) comes first followed by fertilizer (86,000 tons, 12.7%), petro-chemical products (57,000 tons, 8.4%), and wheat (54,000 tons, 8.0%). According to the annual report on trade statistics of the Statistic Bureau, the Ministry of Economy, the import of clude oil is reported to be very small in quantity, but judging from the quantity refined at the refineries, it is estimated that another half million tons of clude oil must have been imported into this country. Therefore a further investigation will be necessary in this respect.

The breakdown of import by origin in 1971 (Table-1.15) is as follows:

United States	32.1%
El Salvador	14.0%
Japan	10.6%
West Germany	10.3%

As to the recent tendency of import by origin, the import share from the United States is declining, and on the contrary, the import share from Japan, West Germany and Central American countries is increasing.

1-3-4 Outline of Foreign Trade with Japan

According to the report published in the "Trade Statistics of Japan", the trade between the republic of Guatemala and Japan in 1972 is as follows:

Export to Guatemala from Japan	26 million dollars
Import from Guatemala to Japan	34 million dollars

Although these trade figures are less than one per cent of Japanese foreign trade, Japan's share in the foreign trade of Guatemala is steadily increasing. (Table-1.16)

The important export items to Guatemala from Japan in 1970 are machinery, products of heavy chemical industry (33.2% of the total export to Guatemala), metal goods (25.7%), and products of light industry (32.9%), and as a recent export tendency, especially the export of heavy chemical industry's products is increasing smoothly. (Table-1.17)

As to the import from Guatemala to Japan, almost all the imports are occupied by the agricultural products, and among them cotton ranks first exceedingly followed by bananas and coffee. (Table-1.18)

1-4 Outline of Agriculture

As mentioned in 1-2, the share of the first industry continues to be high in this country, and its share of percentage in terms of G. D. P. is 30 per cent. The production of the first industry in 1970, excluding the mining industry, is valued at 522 million quezals in terms of the price level in 1958, and its breakdown is as follows:

Agriculture	60.7%
Livestock farming	30.4%
Forestry	7.9%
Fishery	1.0%

- (Table-1.19) -

As a recent tendency, the share of livestock farming is increasing, and on the contrary, the share of agriculture as well as forestery is declining. The important agricultural products are coffee, cotton, maize, beans, sugar cane and bananas.

The production of these important agricultural products is as shown in Table-1.20. Coffee, an important merchandise occupying one third of Guatemala's export, is produced approximately 130,000 tons annually (one million quetzals at the production value), and as far as the data after 1969 shows, the production of coffee is gradually increasing. As shown in Fig.-1.3, almost all the coffee growing districts are concentrated in all over the central mountainous area ranging from the piedmont on the Pacific side to the hillside. Coffee cultivation is predominant in San Marcos prefecture, Quezaltenango prefecture and Retalhuleu prefecture. As the harvest time of coffee ranges from October to next March or April varying with altitude, the harvest proceeds from the lowland to the highland.

Cotton is produced 60,000 - 70,000 tons annually, and the cotton fields are concentrated in the seaside area facing the Pacific Ocean. (Fig.-1.4)

Cotton cultivation is predominat in Escuintla prefecture, Suchitepequez prefecture and Retalhuleu prefecture, and the harvest time ranges from November to next April.

As to the production and the growing districts of bananas, maize, beans, and sugar cane, refer to Fig.-1.5, 1.6, 1.7, 1.8 and Table-1.20 respectively.

1-5 Outline of Manufacturing Industry

The progress of industrial production is as shown in Table 1.3, and even in terms of the value added, it is showing a growth rate of 8 or 9 per cent annually. (Table-1.21)

Guatemala's important industrial activities in 1970 in terms of the value added are as follows:

Foodstuffs	77 million quetzals	(26.1% of the total)
Clothing	34 million quetzals	(11.5%)
Textiles	33.8 million quetzals	(11.5%)
Feedstuffs	32 million quetzals	(10.8%)

In addition to the above mentioned industries, tabacco, leather and wood products are traditional industries of this country. The fact that these traditional industries which accounted for approximately 80 per cent of the total industries in 1960 declined to 63 per cent in 1970 will be considered to be the results of the large scale reformation of industrial organization which has been proceeding in this country. The kind of industries which have made a remarkable progress in the past 10 years are mainly metal industry and machinery, and especially in the case of metal industry, the share of metal industry which accounted for only one per cent of the total industries in 1960 reached 9.6 per cent in 1972, and it is now becoming an axis of industrial activities of this country.

Approximately 90 per cent of the total industrial production is for domestic use, and the plants are small in scale and almost run by small enterprise. The classified distribution of important industrial plants is as shown in Table-1.22. Approximately 70 per cent of the plants is concentrated in and around Guatemala City. The big scale plants employing over 150 employees can scarcely be found in the areas other than in and around Guatemala City. The prefectures with industrial accumulation other than Guatamala prefecture are mainly located along the Pacific coast, the leading industrial prefectures of which are Escuintla prefecture, Quezaltenango prefecture and Retalhuleu prefecture. The industrial characteristic of these prefectures will be sugar refinery in Escuintla prefecture, tabacco cultivation in Zacapa prefecture, clothing and printing in Guatemala prefecture. So as to crude oil refinery, there are two refineries, one is California Refinery Company in Puerto Barrios, another is Texaco Guatemala Inc.. Their capacity is 12,500 BPSD, and 15,000 BPSD respectively.

1-6 Outline of Traffic System

The total kilometers of highways in Guatemala are 13,500 kilometers, and the percentage of pavement is approximately 20 per cent. The trunk highway system consists of three national highways, namely, CA-1, CA-2, and CA-9. (Fig.-1.9)

CA-1 is a part of the Pan American Highway and it is two lanes and 6 meters in width and 504 Kilometers long. CA-2 runs through the lowland along the Pacific coast parallel with CA-1. The total kilometers of CA-2 are 401 kilometers and it is two lanes and 6 meters in width. The highway which runs from south to north crossing CA-1 and CA-2 is CA-9. This highway connects the Pacific coast and the Atlantic coast, and this is the important trunk line which links many cities in the central highland district, and the section between Guatemala City and Escuintla is now under construction to be enlarged to four lanes. The highway which runs from Retahuleu to Champerico crossing CA-2 is the national highway No.9. The total kilometers of the national highway No.9 are 100 kilometers, and it has two lanes. These highways are all paved perfectly.

The traffic volume of the highways is as shown in Fig.-1.10. The traffic volume of CA-9 is 4,500 vehicles per day on the section between Capital and Escuintla, 3,000 vehicles per day on the section between Escuintla and Mazatenango, and 1,000 - 2,000 vehicles per day on the section other than two sections mentioned above.

As shown in Fig.-1.11, the railways in Guatemala are built in all directions starting from Guatemala City as terminus. These railways were constructed long ago by an American capital company, the International railway Company of Central America (Los Ferrocarriles Internacionals de Centro America). But in order to imporve services as well as to cope with the financial difficulty, the railway company has been nationalized several years ago and is now operated by the Railway Corporation called FEGUA. The total kilometers of railway are 820 kilometers and the railway is a narrow gauge of three feet in width and a single track, and it is not yet electrified.

The gross weight of annual freight transportation in 1972 was 622,000 tons, 423,000 tons (68%) of which was the transport of trade freight through harbours, and as to the utilization of railway transport, the export freight utilized the railway transport about two times as much as the import freight.

Fig.-1.1 Location of Guatemala

Table - 1.1 Land Utilization in Central American Countries

(Unit: km^2)

Country Name	Guatemala	El Salvador	Honduras	Nicaragua	Costa Rica
Whole Area (km^2)	(100) 108,890	(100) 21,390	(100) 112,090	(100) 130,000	50,700
Whole Farm Land	(23.2) 25,220	(58.5) 12,520	(37.8) 42,360	(13.8) 17,930	(30.5) 15,450
Cultivated Land	(138) ((59.4)) 14,980	(30.3) ((51.8)) 6,480	(7.3) ((19.4)) 8,230	(6.7) ((48.7)) 8,730	(12.3) ((40.3)) 6,220
Meadow	(9.4) ((40.6)) 10,240	(28.2) ((48.2)) 6,040	(30.4) ((80.6)) 34,130	(7.1) ((51.3)) 9,200	(18.2) ((59.7)) 9,230
Forest Land	(49.6) 54,000	(10.6) 2,260	(26.9) 30,190	(49.6) 64,500	(58.8) 29,810
Miscellaneous	(27.2) 29,670	(30.9) 6,610	(35.3) 39,540	(36.6) 47,570	(10.7) 5,440

Data: 101)

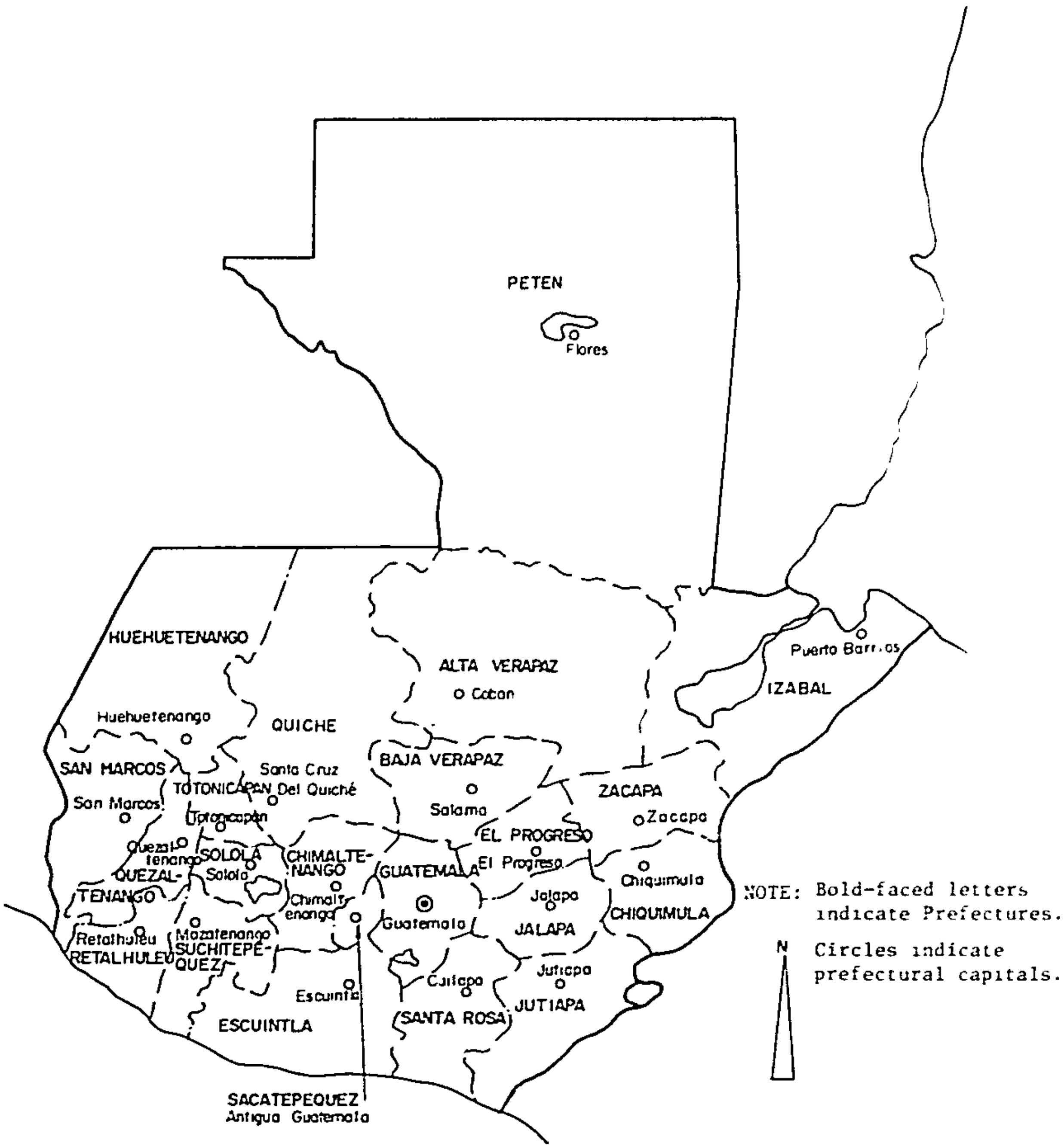

Fig.-1.2 Prefecture and Principal Cities

Table - 1.2 Population by Prefectures

Prefecture	Area	1950		1964		1973			Growth Ratio	
	Km^2	persons	%	persons	%	persons	%	Population Density	73/50	73/64
Whole Country	108,889	2,790,868	100	4,287,997	100	5,211,929	100	47.9	1.87	1.54
Central Area	6,492	668,389	23.9	1,120,535	26.1	1,494,288	28.7	230.2	2.24	1.68
Guatemala	2,126	438,913	15.7	810,858	18.9	1,127,845	21.7	530.5	2.57	1.85
El Progreso	1,922	47,872	1.7	65,582	1.5	73,176	1.4	38.1	1.53	1.37
Sacatepequez	465	60,124	2.2	80,942	1.9	99,710	1.9	214.4	1.66	1.35
Chimaltenango	1,979	121,480	4.3	163,153	3.8	193,557	3.7	97.8	1.59	1.34
South Area	7,339	233,595	8.4	427,307	10.0	476,338	9.1	64.9	2.04	1.83
Escúintla	4,384	123,759	4.4	270,267	6.3	300,140	5.8	68.5	2.43	2.18
Sana Rosa	2,955	109,836	4.0	157,040	3.7	176,198	3.3	59.6	1.60	1.43
West Area	19,630	990,444	35.5	1,449,753	33.8	1,708,036	32.8	87.0	1.72	1.46
Solola	1,061	82,921	3.0	107,822	2.5	126,884	2.4	119.6	1.53	1.30
Totonicapan	1,601	99,354	3.6	141,772	3.3	166,622	3.2	157.0	1.68	1.43
Quezaltenango	1,951	184,213	6.6	270,916	6.3	311,613	6.0	159.7	1.69	1.47
Suchitepequez	2,510	124,403	4.4	186,634	4.4	212,017	4.1	84.5	1.70	1.50
Retalhuleu	1,856	66,861	2.4	117,562	2.7	133,993	2.6	72.2	2.00	1.76
San Marcos	3,791	232,591	8.3	336,959	7.9	388,100	7.4	102.4	1.67	1.45
Huehuetenango	7,400	200,101	7.2	288,088	6.7	368,807	7.1	49.8	1.84	1.44
North Area	65,080	501,948	18.0	750,169	17.5	919,287	17.6	14.1	1.83	1.49
Quiche	8,378	174,911	6.3	249,939	5.8	300,641	5.8	35.9	1.72	1.43
Baja Verapaz	3,124	66,313	2.4	96,485	2.3	106,909	2.0	34.2	1.61	1.45
Alta Verapaz	8,686	189,812	6.8	260,498	6.1	276,370	5.3	31.8	1.46	1.37
Petén	35,854	15,880	0.5	26,562	0.6	64,503	1.2	1.8	4.06	1.67
Izabal	9,038	55,032	2.0	116,685	2.7	170,864	3.3	18.9	3.10	1.46
East Area	10,348	396,492	14.2	540,233	12.6	613,980	11.8	59.3	1.55	1.36
Zacapa	2,690	69,536	2.5	96,554	2.3	106,726	2.1	39.7	1.53	1.39
Chiquimula	2,376	112,841	4.0	149,752	3.5	158,146	3.0	58.8	1.40	1.33
Jalapa	2,063	75,190	2.7	99,153	2.3	118,103	2.3	57.2	1.57	1.32
Jutiapa	3,219	138,925	5.0	194,774	4.5	231,005	4.4	71.8	1.66	1.40

Data: 102)

Table - 1.3 Changes in Gross Domestic Product

Unit: Million Quetzals (1958 Price)

	1960		1965		1966		1967		1968		1969		1970		1971		1972		1973	
		%		%		%		%		%		%		%		%		%		%
Domestic Gross Product	1,049.2	100	1,355.2	100	1,430.0	100	1,488.4	100	1,573.9	100	1,684.2	100	1,792.7	100	1,892.8	100	2,031.6	100	2,185.4	100
(Growth over Preceding Year)					(1.06)		(1.04)		(1.06)		(1.07)		(1.06)		(1.06)		(1.06)		(1.08)	
Primary Industry	319.9	30.5	392.0	28.8	409.4	28.6	409.9	27.5	432.5	27.5	457.6	27.2	491.4	27.4	526.0	27.8	576.2	28.4	618.2	28.3
Agriculture	318.1	30.3	389.4	28.7	407.6	28.5	408.1	27.4	431.2	27.4	456.2	27.1	489.7	27.3	524.3	27.7	574.7	28.3	616.5	28.2
Mining	1.8	0.2	1.6	0.1	1.8	0.1	1.8	0.1	1.3	0.1	1.4	0.1	1.7	0.1	1.7	0.1	1.5	0.1	1.7	0.1
Secondary Industry	163.5	15.6	229.4	17.0	253.2	17.7	274.4	18.4	295.1	18.7	320.8	19.1	332.8	18.6	354.4	18.7	377.9	18.6	414.5	19.0
Manufacturing	135.5	12.9	190.8	14.1	210.7	14.7	228.4	15.3	249.2	15.8	272.2	16.2	282.9	15.8	303.2	16.0	319.8	15.7	345.8	15.8
Construction	20.7	2.0	24.5	1.8	26.6	1.9	29.3	2.0	27.6	1.7	28.5	1.7	28.4	1.6	28.5	1.5	32.4	1.6	40.4	1.8
Utilities	7.3	0.7	14.1	1.1	15.9	1.1	16.7	1.1	18.3	1.2	20.1	1.2	21.5	1.2	22.7	1.2	25.7	1.3	28.3	1.3
Tertiary Industry	565.7	53.9	724.8	54.2	767.4	53.7	804.1	54.1	846.3	53.8	905.8	53.7	968.5	54.0	1,012.4	53.5	1,077.5	53.0	1,152.7	52.7
Transportation & Communications	50.3	4.8	73.8	5.5	75.5	5.3	78.1	5.3	79.9	5.1	91.3	5.4	98.2	5.5	105.5	5.6	118.2	5.8	132.2	6.0
Commercial Services	274.5	26.1	376.5	27.8	397.2	27.8	417.6	28.1	448.4	28.5	477.5	28.3	518.0	28.9	542.1	28.6	569.6	28.1	612.8	28.1
Financial Services	18.7	1.8	32.7	2.4	33.4	2.3	35.0	2.3	36.2	2.3	38.2	2.3	42.3	2.3	43.6	2.3	46.6	2.3	53.3	2.4
Housing	94.4	9.0	107.6	7.9	111.5	7.8	114.9	7.7	118.2	7.5	121.8	7.2	124.8	7.0	127.4	6.7	129.9	6.4	132.3	6.0
Public administration	63.7	6.1	65.1	4.8	66.8	4.7	72.2	4.9	73.3	4.7	82.6	4.9	86.9	4.8	88.1	4.7	97.5	4.8	99.7	4.6
Misc.	64.1	6.1	79.1	5.8	83.0	5.8	86.3	5.8	90.3	5.7	94.4	5.6	98.3	5.5	105.7	5.6	113.7	5.6	122.4	5.6

Data: 103)

Table - 1.4 Economic Index of 5 Central American Nations

	Guatemala	El Salvador	Honduras	Nicaragua	Costa Rica
Area (1000 sq.Km)	109	21	112	148	51
Population (1000 persons)	(1971) 5,400	(1970) 3,690	(1970) 2,610	(1971) 1,920	(1971) 1,780
G.N.P. (1971: Mil.$)	1,835.0	1,060.8	743.0	874.3	1,030.6
Economic Growth Ratio Per Year (1971: %)	6.0	4.5	5.7	4.0	3.1
G.N.P. per Capita(1971: $)	330	285	256	435	490
Financial Scale (1971: Mil.$)	202.2	(1970) 132.8	104.0	(1972) 113.3	161.2
Foreign Currency Reserves (1971 end: Mil.$)	95.5	64.9	21.8	58.8	28.4

Data: 104)

Table - 1.5 Population of Employment by Sector

	1950	1960	1961	1962	1963	1964	1965	1966
Employment Population (head)	967,814	1,172,652	1,187,731	1,215,318	1,338,222	1,317,140	1,359,500	1,403,400
Agriculture, Forestry Fishery	659,550	773,807	773,626	790,758	893,471	861,140	888,800	917,600
Mining	1,441	2,035	1,347	1,390	1,626	1,720	1,800	1,800
Industry	111,538	133,742	137,768	141,421	151,228	149,460	154,300	159,300
Construction	26,427	26,977	33,688	28,839	26,340	34,220	35,300	36,500
Electricity	1,244	1,461	1,546	1,567	1,848	1,680	1,600	1,700
Commerce	52,561	67,349	68,353	71,491	80,934	82,280	85,000	87,700
Transportation	15,352	23,870	25,713	30,738	26,494	28,180	29,100	30,000
Services	99,701	143,411	145,690	149,114	156,281	158,460	163,600	168,800
Percentage (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture, Forestry Fishery	68.1	66.0	65.1	65.1	66.8	65.4	65.4	65.4
Mining	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Industry	11.5	11.4	11.6	11.6	11.3	11.3	11.3	11.3
Construction	2.7	2.3	2.8	2.4	2.0	2.6	2.6	2.6
Electricity	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Commerce	5.4	5.7	5.7	5.9	6.0	6.2	6.2	6.2
Transportation	1.6	2.0	2.2	2.5	2.0	2.1	2.1	2.1
Services	10.3	12.2	12.3	12.3	11.7	12.0	12.0	12.0

Data: 105)

Table - 1.6 Central Government Revenue and Expenditure

(Unit: 1 Mil. Quetzals)

REVENUE

	1968		1969		1970		Growth Ratio (1970/1968)
		%		%		%	
TAX REVENUE	122.9	90.2	134.4	89.8	147.9	89.5	1.20
Direct Taxes	22.1	16.2	22.1	14.8	24.7	14.9	1.12
Income Tax	16.0	11.7	16.6	11.1	18.7	11.3	1.17
Personal	(3.7)	(2.7)	(4.0)	(2.7)	(4.3)	(2.6)	(1.16)
Company	(12.3)	(9.0)	(12.6)	(8.4)	(14.4)	(8.7)	(1.17)
Property Tax	6.1	4.5	5.5	3.7	6.0	3.6	0.98
Indirect Taxes	100.8	74.0	112.3	75.0	123.2	74.6	1.22
Foreign Trade	34.4	25.2	39.9	26.6	46.1	27.9	1.34
Export Duty	4.8	3.5	6.3	4.2	8.7	5.3	1.81
(Coffee)	(4.4)	(3.2)	(5.9)	(3.9)	(8.3)	(5.0)	(1.89)
Import Duty	26.1	19.1	29.5	19.7	32.7	19.8	1.25
(San Jose protocol)	(0.5)	(0.4)	(5.7)	(3.8)	(6.9)	(4.1)	(13.80)
Misc.	3.5	2.6	4.1	2.7	4.7	2.8	1.34
Domestic Transactions	66.4	48.7	72.4	48.4	77.1	46.7	1.16
Stamp Tax	30.6	22.5	32.8	21.9	35.6	21.6	1.16
Petroleum Products	9.8	7.2	10.9	7.3	11.5	7.0	1.17
Tobacco	5.1	3.7	6.4	4.3	6.6	4.0	1.29
Alcohl	15.1	11.1	15.7	10.5	16.4	9.9	1.09
Misc.	5.8	4.2	6.6	4.4	7.0	4.2	1.21
Non-Tax Revenue	13.4	9.8	15.3	10.2	17.3	10.5	1.29
Services	7.9	5.8	8.2	5.5	8.8	5.3	1.11
(Tele-communications)	(3.0)	(2.2)	(3.1)	(2.1)	(3.5)	(2.1)	(1.17)
Transfers	3.1	2.3	1.9	1.2	2.3	1.4	0.74
(GUATEL)	(0.7)	(0.5)	(0.5)	(0.3)	(0.7)	(0.4)	(1.00)
Misc.	2.4	1.7	5.2	3.5	6.2	3.8	2.58
Total Revenue	136.3	100%	149.7	100%	165.2	100%	1.21

EXPENDITURE

	1968		1969		1970		Growth Ratio (1970/1968)
		%		%		%	
Economic Branch	15.2	12.8	17.2	13.3	18.0	12.2	1.18
Agriculture	2.7	2.3	3.0	2.3	3.7	2.5	1.37
Transportation	6.9	5.8	8.0	6.2	7.3	4.9	1.06
Communications	4.1	3.4	4.2	3.2	4.4	3.0	1.07
Misc.	1.5	1.3	2.0	1.6	2.6	1.8	1.73
Social Welfare Branch	50.9	42.8	57.5	44.5	61.1	41.4	1.21
Education	26.6	22.4	29.3	22.7	30.4	20.6	1.14
Health	13.9	11.7	17.4	13.5	19.7	13.4	1.42
Welfare	8.2	6.9	7.0	5.4	8.3	5.6	1.01
Misc.	2.2	1.8	3.8	2.9	2.7	1.8	1.23
Administration Branch	51.9	43.7	54.1	41.8	68.2	46.1	1.33
Administration	17.9	15.0	18.7	14.4	19.6	13.3	1.09
Defence	24.3	20.4	24.4	18.9	37.3	25.2	1.53
Justice	2.5	2.0	3.3	2.5	3.3	2.2	1.32
Interest	7.5	6.3	7.7	6.0	8.0	5.4	1.07
Unclassified	0.5	0.4	0.5	0.4	0.5	0.3	1.00
Total Expenditure	118.8	100%	129.3	100%	147.8	100%	1.24

Data: 105)

Table - 1.7 Social Overhead Capital Investment

(Unit: 1 Mil. Quetzals)

	1968		1969		1970		Growth Ratio (70/68)
		%		%		%	
Total Investment	25.6	100	30.0	100	34.2	100	1.34
Public Investement	18.2	71.1	23.3	77.7	27.5	80.4	1.51
Economic Br.	13.7	53.5	18.0	60.0	21.8	63.7	1.59
Agriculture	1.6	6.3	4.1	13.7	5.9	17.2	3.69
Transportation	11.4	44.5	13.4	44.7	13.4	39.2	1.18
Communications	0.7	2.7	0.5	1.6	0.6	1.8	0.86
Misc.					1.9	5.5	-
Social Br.	4.0	16.0	4.8	16.0	3.2	9.4	0.78
Education	1.0	3.9	1.7	5.7	1.1	3.2	1.10
Health	3.1	12.1	3.1	10.3	2.1	6.2	0.68
Misc.							
Misc.	0.4	1.6	0.5	1.7	2.5	7.3	6.25
Treasury Loan & Investment	7.4	28.9	6.7	22.3	6.7	19.6	0.95
Agriculture	1.0	3.9	1.5	5.0	1.7	5.0	1.70
Construction	0.2	0.8	0.3	1.0	0.5	1.5	2.50
Power Supply	3.0	11.7	3.1	10.3	2.5	7.3	0.83
Misc.	3.2	12.5	1.5	6.0	2.0	5.8	0.63
Percentage to GDP	1.6		1.7		1.8		

Data: 105)

Table -1.8 Economic Development Project

1st & 2nd 5-year Development Plan

(1955-1964) (1,000 Quetzals)

Branch	Amount	Ratio
Transportation	122,500	25 %
Agriculture	98.000	20
Energy	63,700	13
Education	58,800	12
Housing	49,000	10
Misc.	98,000	20
Total	490,000	100

3rd 5-year Development Plan

(1965-69) (1,000 Quetzals)

Branch	Amount	Ratio
Power Supply	69,400	16 %
Highway Construction	126,400	29
Communications	17,000	4
Housing	34,500	8
Wellbeing-Welfare	68,800	16
School-Construction	13,500	3
Misc.	101,700	24
Total	431,300	100

4th 5-year Development Plan

(1970-74) (1,000 Quetzals)

Branch	Amount	Ratio
Public Investment	403.000	(100) 88.8
Transportation	84,630	(21) 18.6
Agriculture	60,450	(15) 13.3
Public Sanitation	56,420	(14) 12.4
Electricity	48,360	(12) 10.7
Autonomous Organization	44,330	(11) 9.8
Treasury Loans & Investment	51,000	(100) 11.2
Agriculture	38,250	(75) 8.4
Manufacturing	12,750	(25) 2.8
Total	454,000	100%

Data: 106)

Table-1.9 Changes of Trade

(1 mil.Quetzals)

Year	Export (FOB)		Import (CIF)		balance
1961	110	Growth Ratio over Prec. Yr.	134	Growth Ratio over Prec. Yr.	24
1962	115	105	136	101	21
1963	152	132	171	126	19
1964	161	106	202	118	41
1965	186	116	228	113	42
1966	226	122	207	91	19
1967	198	88	247	119	79
1968	227	115	249	101	22
1969	255	112	250	100	5
1970	290	114	284	114	6
1971	283	98	303	107	20
1972	327	116	324	107	3
1973	440	135	363	112	77
1973/1962	3.8		2.7		

Data: 107)

Table - 1.10 Changes of Exportation by Items

(1,000 Quetzals)

		1962			1963			1964			1965			1966			1967			1968			1969		
			%			%			%			%			%			%			%			%	
0	Foodstuffs	86,845	76	100	105,620	70	122	102,850	63	118	116,685	63	134	135,796	60	156	112,078	57	129	119,193	53	137	136,895	53	158
1	Beverage, Tabacco	147	0	100	346	0	235	779	0	530	1,210	1	823	1,386	0	943	2,015	1	1,371	1,755	1	1,194	2,322	1	1,580
2	Leather, Pulp, Raw Contton,etc.	18,908	17	100	30,141	20	159	38,077	23	201	41,134	22	218	51,274	23	271	40,134	20	212	50,485	22	267	50,925	20	269
3	Fuel Oil,etc.	6	0	100	-	-	-	-	-	-	6	0	100	68	0	1,133	105	0	1,750	86	0	1,433	107	0	1,783
4	Edible Oil, etc.	283	0	100	466	0	165	507	0	179	712	0	252	1,637	1	578	1,649	1	583	1,760	1	622	861	0	304
5	Chemicals	4,314	4	100	5,946	4	138	6,385	4	148	6,408	3	149	8,167	4	189	9,865	5	229	11,948	5	277	14,525	6	337
6	Industrial Products	2,385	2	100	5,426	4	228	9,460	6	397	12,139	7	509	18,509	8	776	21,460	11	900	28,017	12	1,175	32,080	13	1,345
7	Machinery	2	0	100	242	0	1,210	1,479	1	73,950	1,957	1	97,850	1,995	1	99,750	2,177	1	108,850	2,890	1	144,500	4,030	2	201500
8	Other Industrial Products	1,612	1	100	3,317	2	206	4,802	3	298	5,531	3	341	7,286	3	452	8,453	4	524	11,119	5	690	13,608	5	844
9.	Misc.	8	0	100	8	0	100	8	0	100	12	0	150	2	0	25	3	0	38	2	0	25	1	0	13
	Total	114,510	100	100	151,512	100	132	164,347	100	144	185,794	100	162	226,120	100	198	197,939	100	173	227,255	100	199	255,354	100	223

Data: 108)

Table - 1.11 Volume of Exportation by Goods

(Unit: Ton, 1,000 Quetzals)

		1967						1968						1969					
		Weight	%		Amount	%		Weight	%		Amount	%		Weight	%		Amount	%	
071	Coffee	81,920	15.4	100	69,593	35.2	100	94,985	15.0	116	74,672	32.8	107	100,759	13.7	123	82,968	32.5	119
263	Cotton	67,053	12.6	100	31,493	15.9	100	75,128	11.9	112	41,034	18.0	130	84,191	11.5	126	40,373	16.0	128
051	Fruits (Fresh)	73,422	13.8	100	4,924	2.5	100	144,493	22.9	197	9,316	4.1	189	172,741	23.5	235	13,305	5.2	270
011	Frozen Meat	8,780	1.7	100	7,967	4.0	100	9,388	1.5	107	8,646	3.8	109	12,293	1.7	140	12,013	5.0	151
061	Sugar	106,237	20.0	100	9,768	4.9	100	92,216	14.6	87	8,612	3.8	88	84,299	11.5	79	7,703	3.0	79
841	Clothing (except leather goods)	513	0.1	100	4,322	2.2	100	747	0.1	146	5,985	2.6	138	1,104	0.2	215	6,749	3.0	156
541	Medicines	661	0.1	100	1,722	0.9	100	704	0.1	107	4,077	1.8	237	1,006	0.1	152	6,126	0.4	356
292	Vegetables that cannot be made foodstuffs	3,254	0.6	100	5,613	2.8	100	3,070	0.5	94	4,685	2.1	83	4,375	0.6	134	6,094	2.4	109
653	Ordinary cloth	1,014	0.2	100	4,315	2.2	100	1,506	0.2	149	4,477	2.0	104	1,824	0.2	180	5,671	2.2	131
652	Cotton Fabrics	1,293	0.2	100	3,486	1.8	100	1,728	0.3	134	4,488	2.0	129	1,674	0.2	129	4,458	2.0	128
552	Toilet Goods, Soap	3,440	0.6	100	3,595	1.8	100	3,608	0.6	105	4.269	1.9	119	3,091	0.4	90	4,038	1.6	112
681	Iron & Steel							10,491	1.7	100	2,641	1.2	100	14,754	2.0	141	4,034	1.6	153
629	Rubber goods	1,399	0.3	100	2,722	1.4	100	2,198	0.3	157	4,139	1.8	152	2,063	0.3	147	3,781	1.5	139
721	Electric Machinery & Appliances	2,208	0.4	100	2,109	1.1	100	2,551	0.4	116	2,748	1.2	130	3,222	0.4	146	3,563	1.4	169
851	Shoes	728	0.1	100	1,913	1.0	100	995	0.2	137	2,236	1.0	117	1,257	0.2	173	3,123	1.2	163
665	Glass wares	6,749	1.3	100	1,428	0.7	100	11,270	1.8	167	2,327	1.0	163	13,456	1.8	199	2,888	1.1	202
081	Feed for Domestic Animals	46,243	8.7	100	3,441	1.7	100	29,108	4.6	63	2,439	1.1	71	40,234	5.5	87	2,753	1.1	80
699	Metal Goods	2,052	0.4	100	1,515	0.8	100	2,452	0.4	119	1,835	0.8	121	3,649	0.5	178	2,526	1.0	167
054	Vegetable (except Bulbs)	30,677	5.8	100	2,580	1.3	100	28,353	4.5	92	2,258	1.0	88	29,838	4.1	97	2,666	1.0	103
062	Pastery							3,044	0.5	100	2,676	1.2	100	2,767	0.4	91	2,325	0.9	87
221	Oiled Nuts	5,891	1.1	100	1,018	0.5	100	30,747	4.9	522	2,953	1.3	290	24,830	3.4	421	2,135	0.8	210
899	Handcrafts	1,077	0.2	100	1,453	0.7	100	1,687	0.3	157	2,315	1.0	159	1,490	0.2	138	1,948	0.8	134
013	Canned Meats	697	0.1	100	1,082	0.5	100	1,027	0.2	147	1,580	0.7	146	1,203	1.6	173	1,894	0.7	175
551	Spices	936	0.2	100	2,060	1.0	100	614	0.1	66	1,657	0.7	80	538	0.1	57	1,791	0.7	87
053	Canned Fruits	4,016	0.8	100	1,297	0.7	100	4,080	0.6	102	1,311	0.6	101	5,242	0.7	131	1,702	0.7	131
031	Fishes (except Canned Goods)	1,974	0.4	100	2,171	1.1	100							1,124	0.2	57	1,652	0.6	76
099	Processed Foodstuffs													3,454	0.5	100	1,619	0.6	100
641	Paper							4,361	0.7	100	1,356	0.6	100	4,893	0.7	112	1,554	0.6	115
651	Yarn (for Fabrics)							739	0.1	100	1,374	0.6	100	866	0.1	117	1,524	0.6	110
055	Canned Vegetables	3,425	0.6	100	1,593	0.8	100	2,605	0.4	76	1,202	0.5	75	3,543	0.5	103	1,508	0.6	95
642	Pulp	2,867	0.5	100	1,193	0.6	100	3,491	0.6	122	1,196	0.5	100	4,085	0.6	142	1,484	0.6	124
656	Textile Goods (except Clothings & Shoes)	939	0.2	100	1,111	0.6	100	1,039	0.2	111	1,369	0.6	123	1,558	0.2	166	1,409	0.6	127
122	Tobacco	680	0.1	100	1,129	0.6	100	461	0.1	68	1,076	0.5	95	600	0.1	88	1,316	0.5	117
599	Chemical Meterial & Goods	3,511	0.7	100	1,465	0.7	100							2,793	0.4	80	1,225	0.5	84
533	Paints													1,306	0.2	100	1,123	0.4	100
243	Lumber	10,433	2.0	100	1,071	0.5	100	11,874	1.9	114	1,094	0.5	102	17,917	2.4	172	1,027	0.4	96
661	Lime & Cement, etc.													36,566	5.0	100	1,022	0.4	100
-	Other Products	57,756	10.9	100	14,978	7.6	100	51,123	8.1	89	12,211	5.4	82	44,057	6.0	76	12,265	5.0	82
	Total	531,845	100	100	197,940	100	100	631,883	100	119	227,253	100	116	734,664	100	138	255,355	100	132

Data: 108)

Table - 1.12 Main Nations for Exportation

(Unit: 1,000 Quetzals)

	Exportation	1966 Trade	1966 %	1966 Index	1967 Trade	1967 %	1967 Index	1968 Trade	1968 %	1968 Index	1969 Trade	1969 %	1969 Index	1970 Trade	1970 %	1970 Index	1971 Trade	1971 %	1971 Index
1	U. S. A.	70,094.2	30.9	100	61,098.8	30.9	87	62,987.3	27.7	90	71,814.6	28.1	102	81,603.9	28.1	116	86,706.6	30.7	124
2	El Salvador	28,481.5	12.6	100	28,730.5	14.5	101	32,453.8	14.3	114	35,415.6	13.9	124	38,834.1	13.4	136	40,801.9	14.4	143
3	West Germany	30,272.7	13.4	100	23,722.0	12.0	78	21,683.1	9.5	72	25,783.7	10.1	85	32,888.7	11.3	109	30.542.8	10.8	101
4	Costa Rica	7,256.4	3.2	100	9,153.7	4.6	126	14,337.2	6.3	198	17,862.7	7.0	246	20,131.5	6.9	277	25,728.6	9.1	355
5	Japan	19,403.9	8.6	100	17,023.6	8.6	88	25,247.5	11.1	130	20,948.8	8.2	108	19,876.1	6.9	102	19,486.1	6.9	100
6	Nicaragua	7,857.9	3.5	100	10,635.1	5.4	135	11,263.7	5.0	143	12,711.8	5.0	162	14,527.9	5.0	185	16,741.2	5.9	213
7	Netherlands	5,380.3	2.4	100	5,502.8	2.8	102	5,799.9	2.6	108	6,427.0	2.5	119	4,912.4	1.7	91	9,742.6	3.4	181
8	Honduras	7,230.5	3.2	100	9,425.7	4.8	130	12,722.6	5.6	176	17,710.3	6.9	245	28,865.8	10.0	399	8,866.3	3.1	123
9	Finland	3,316.8	1.5	100	4,051.5	2.0	122	3,589.5	1.6	108	4,188.0	1.6	126	7,059.8	2.4	213	6,086.7	2.2	184
10	Italy	5,530.2	2.4	100	5,211.9	2.6	94	4,019.6	1.8	109	11,555.6	4.5	209	4,731.0	1.6	86	8,621.6	3.0	156
11	Miscellaneous	41,295.9	18.3	100	23,384.3	11.8	57	33,148.6	14.6	80	30,936.5	12.1	75	36,623.7	12.6	89	29,487.0	10.4	71
	Total	226,120.0	100	100	197,939.9	100	88	227,252.8	100	101	255,354.6	100	113	290,182.0	100	128	283,107.0	100	125

Data: 108)

Table - 1.13 Changes of Importation by Items

(Unit: 1,000 Quetzals)

		1962			1963			1964			1965		
			%			%			%			%	
0	Foodstuffs	15,130	11	100	19,493	11	129	20,204	10	134	20,590	9	136
1	Beverage, Tabacco	1,204	1	100	969	1	81	1,211	0	101	1,243	0	103
2	Leather, Pulp, Raw Cotton,etc.	2,339	2	100	3,084	2	132	3,867	2	165	4,076	2	174
3	Fuel Oil, etc.	12,813	9	100	13,504	8	105	15,360	8	129	15,872	7	124
4	Edible Oil, etc.	1,556	1	100	2,011	1	120	2,344	1	151	2,018	1	130
5	Chemicals	21,828	16	100	29,342	17	134	32,433	16	149	38,549	17	177
6	Industrical Products	34,685	26	100	44,495	26	128	52,170	26	150	60,991	27	176
7	Machinery	36,890	27	100	45,695	27	124	58,689	29	159	65,822	29	178
8	Other Industrial Products	9,504	7	100	12,515	7	132	15,811	8	166	19,073	8	201
9	Miscellaneous	16	0	100	12	0	75	20	0	125	44	0	275
	Total	135,965	100	100	171,120	100	126	202,109	100	149	228,278	100	168

		1966			1967			1968			1969		
			%			%			%			%	
0	Foodstuffs	20,455	10	135	26,145	10	173	22,497	9	149	20,534	8	136
1	Beverage, Tabacco	814	0	68	1,534	1	127	1,274	1	106	1,109	0	92
2	Leather, Pulp, Raw Cotton,etc.	4,042	2	173	6,411	3	274	5,364	2	229	4,971	2	213
3	Fuel Oil, etc.	11,033	5	86	9,414	4	74	5,985	3	47	5,337	2	42
4	Edible Oil, etc.	2,375	1	153	3,363	1	216	3,313	1	213	2,478	1	159
5	Chemicals	32,940	16	151	44,279	18	203	46,917	19	215	48,729	20	223
6	Industrical Products	56,872	27	164	69,762	28	201	72,820	29	210	75,404	30	217
7	Machinery	59,179	29	160	64,234	26	174	70,622	28	191	69,596	28	189
8	Other Industrial Products	19,838	10	209	21,905	9	231	20,513	8	216	21,953	9	231
9	Miscellaneous	31	0	194	49	0	306	106	0	663	54	0	338
	Total	207,579	100	153	247,290	100	182	249,411	100	183	250,165	100	184

Data: 108)

Table - 1.14 Volume of Importation by Goods

(Unit: Ton, 1,000 Quetzals)

		1967						1968						1969					
		Weight	%		Amount	%		Weight	%		Amount	%		Weight	%		Amout	%	
716	Industrial Machinery for Mine Construction	8,537	1.4	100	19,487	7.9	100	13,792	1.9	162	21,564	8.7	111	9,389	1.4	110	22,202	8.9	114
732	Automobiles	12,226	2.1	100	17,334	7.0	100	14,819	2.1	121	20,634	8.3	119	13,740	2.0	112	19,863	7.9	115
681	Iron & Steel	73,119	12.3	100	11,756	4.8	100	95,324	13.2	130	13,979	5.6	119	93,337	13.8	128	15,054	6.0	128
721	Electric Machinery & Appliances	4,872	0.8	100	12,796	5.2	100	4,924	0.7	101	13,337	5.4	104	5,557	0.9	114	14,142	5.7	111
541	Medicines	1,542	0.3	100	9,431	3.8	100	1,634	0.2	106	10,566	4.2	112	2,070	0.3	134	12,141	5.0	129
651	Yarns made of Fibers	7,826	1.3	100	13,404	5.4	100	6,751	0.9	86	11,579	4.6	86	6,700	1.0	86	11,717	4.7	87
599	Chemical Materials & Products	19,697	3.3	100	12,005	4.9	100	15,849	2.2	84	10,304	4.1	86	16,938	2.5	86	11,076	4.4	92
699	Metal Goods	10,519	1.8	100	10,395	4.2	100	11,308	1.6	108	10,305	4.1	99	10,251	1.5	97	10,614	4.2	102
641	Paper	26,885	4.5	100	6,069	2.5	100	39,179	5.4	146	7,764	3.1	128	44,358	6.5	165	8,287	3.3	137
512	Organic Chemical Products	10,005	1.7	100	6,651	2.7	100	12,729	1.8	127	8,611	3.5	129	11,317	1.7	113	7,655	3.1	115
561	Artificial Fertilizer	63,190	10.7	100	5,561	2.2	100	77,492	10.7	123	7,026	2.8	126	86,244	12.7	136	7,118	2.8	128
899	Handcrafts	2,641	0.4	100	5,848	2.4	100							5,429	0.8	206	6,140	2.5	105
841	Clothings (Leather Goods excepted)	737	0.1	100	5,562	2.3	100	658	0.1	89	4,281	1.7	77	952	0.1	129	4,931	2.0	85
653	Ordinary Fabrics	771	0.1	100	3,338	1.4	100	964	0.1	125	3,784	1.5	113	1,098	0.2	142	4,654	1.9	139
313	Oil Products	46,126	7.8	100	4,027	1.6	100	54,307	7.5	118	4,789	1.9	119	56,653	8.4	123	4,583	1.8	114
652	Cotton Cloth	1,913	0.3	100	4,732	1.9	100	2,077	0.3	109	4,845	1.9	102	1,721	0.3	90	4,282	1.7	90
041	Wheat	59,644	10.1	100	4,786	1.9	100	65,619	9.1	110	4,754	1.9	99	54,025	8.0	95	4,036	1.6	84
711	Engines	894	0.2	100	2,325	0.9	100	1,404	0.2	157	4,092	1.6	176	1,646	0.2	184	3,685	1.5	158
552	Toilet Goods, Perfumes & Soap	3,429	0.6	100	2,695	1.1	100	3,634	0.5	106	2,577	1.0	96	7,086	1.0	207	3,451	1.4	128
642	Pulp	10,211	1.7	100	4,425	1.8	100	9,794	1.4	96	4,262	1.7	96	6,946	1.0	68	3,422	1.4	77
713	Tractors	1,472	0.2	100	2,550	1.1	100	2,304	0.3	157	3,515	1.4	138	1,930	0.3	131	2,960	1.2	116
511	Inorganic Chemical Products	25,942	4.4	100	3,426	1.6	100	23,185	3.2	89	3,114	1.3	91	31,752	4.7	122	2,955	1.2	86
861	Precision Scientific Machinery													267	0	0	2,240	0.9	-
001	Animals (except Fishes)	12,693	2.1	100	5,968	2.4	100	9,878	1.4	78	2,694	1.1	45	9,995	1.5	78	2,209	0.9	37
081	Feed for Domestic Animals	17,479	3.0	100	2,328	0.9	100	19,268	2.7	110	2,155	0.9	93	18,316	2.7	105	2,032	0.8	87
661	Raw Materials for Cement													43,329	6.4	-	1,179	0.5	-
048	Cereal Goods													7,734	1.1	-	2,094	0.8	
655	Special Textiles, etc.	1,121	0.1	100	2,504	1.0	100	1,027	0.1	92	2,459	1.0	98	810	0.1	72	2,012	0.8	83
714	Business Machines													210	0.	-	1,996	0.8	-
684	Aluminum													1,277	0.2	-	1,987	0.8	-
629	Rubber Goods													1,121	0.2	-	1,958	0.8	-
892	Printed Matters													1,106	0.2	-	1,881	0.8	-
712	Agricultural Machinery and Tools													1,286	0.2	-	1,754	0.7	-
812	Medical Supplies													1,240	0.2	-	1,624	0.6	-
411	Animal Oils	14,866	2.5	100	2,443	1.0	100	18,452	2.5	124	2,447	1.0	100	8,868	1.3	60	1,520	0.6	62
656	Textile Goods													757	0.1	-	1,505	0.6	-
022	Cow's Cream													2,445	0.4	-	1,487	0.6	-
665	Glas Weres	6,444	1.1	100	2,097	0.8	100							3,821	0.6	59	1,473	0.6	70
533	Pets													1,615	0.2	-	1,473	0.6	-
851	Shoes													583	0.1	-	1,391	0.6	-
091	Butter & Cheese													2,081	0.3	-	1,205	0.5	-
551	Clothings													314	0.	-	1,141	0.5	-
751	Metal Goods & Machines													448	0.1	-	1,096	0.4	-
891	Musical Instruments, etc							3,871	0.5	100	8,473	3.4	100	174	0.	4	1,038	0.4	12
686	Zinc													3,278	0.5	-	1,011	0.4	-
112	Liquors													1,079	0.2	-	1,006	0.4	-
-	Other Products	147,431	24.9	100	58,466	23.7	100	212,386	29.4	144	55,502	22.3	95	95,557	14.1	65	25,853	10.3	44
	Total	592,232	100	100	247,290	100	100	722,629	100	122	249,434	100	103	677,699	100	114	250,163	100	103

Data: 108)

Table - 1.15 Main Nations for Importation

(Unit: 1,000 Quetzals)

		1966			1967			1968			1969			1970			1971		
1	U. S. A	86,571.4	41.9	100	100,030.1	40.5	116	101,578.2	40.7	117	85,456.8	34.2	99	99,842.0	35.1	115	97,278.6	32.1	112
2	El Salvador	23,521.3	11.4	100	29,331.0	11.9	125	27,936.9	11.2	119	33,242.0	13.3	141	39,474.1	13.9	168	42,533.4	14.0	181
3	Japan	15,445.6	7.5	100	22,047.3	8.9	143	22,534.5	9.0	146	25,536.5	10.2	165	29,308.2	10.3	190	32,224.3	10.6	203
4	West Germany	17,721.6	8.6	100	24,772.0	10.0	140	25,925.0	10.4	146	25,947.1	10.4	146	27,299.3	9.6	154	31,301.9	10.3	177
5.	Britain	9,888.9	4.8	100	9,477.6	3.8	96	11,794.7	4.7	119	10,000.2	4.0	101	10,424.4	3.7	105	13,999.2	4.6	142
6	Costa Rica	4,269.7	2.1	100	5,223.4	2.1	122	6,767.1	2.7	158	7,533.2	3.0	176	11,225.6	4.0	263	13,571.9	4.5	312
7	Nicaragua	2,100.1	1.0	100	2,135.0	1.0	102	2,652.2	1.1	126	4,590.7	1.8	219	7,223.9	2.5	344	8,565.2	2.8	408
8	Mexico	4,930.4	2.4	100	6,883.8	2.8	140	6,603.0	2.6	134	9,156.7	3.7	186	8,768.2	3.1	178	8,004.4	2.6	162
9	Switzerland	2,910.3	1.4	100	4,077.1	1.6	140	4,311.8	1.7	150	6,064.3	2.4	208	4,405.5	1.6	151	3,841.4	1.3	132
10	Honduras	3,946.5	1.9	100	5,414.6	2.2	137	5,781.8	2.3	147	6,033.7	2.4	153	7,058.4	2.5	179	1,766.1	0.6	45
11	Miscellaneous	35,552.3	17.2	100	37,706.1	15.3	106	33,471.0	13.4	94	36,604.1	14.6	103	38,982.4	13.7	110	49,831.1	16.5	140
	Total	206,858.0	100	100	247,098.0	100	119	249,411.2	100	121	250,165.3	100	121	284,012.0	100	137	302,815.5	100	146

Data: 108)

Table-1.16 Japan's Trade with Guatemala

(unit: 1000$)

	Exportation (F.O.B.)	Importation (C.I.F.)	Revenue & Expenditure
1968	18,545	27,938	-9,393
1969	24,032	24,242	- 210
1970	28,574	22,397	+6,177
1971	29,468	25,092	+4,376
1972	25,646	34,380	-8,734

Data: 109)

Table - 1.17 Japan's Exportation to Guatemala

Item	1967		1968		1969			1970			
	Quantity	Price ($1,000)	Quantity	Price ($1,000)	Quantity	Price ($1,000)	Percentage(%)	Quantity	Price ($1,000)	Percentage(%)	Ratio to Prec. Yr.
Foodstuffs	-	88.6	-	16.0	-	132.9	0.6	-	84.4	0.3	63.5
Raw Materials	-	385.3	-	483.1	-	512.2	2.1	-	1,007.2	3.5	196.6
Raw materials unfit for Food, Mineral Fuel,	326,899 kg	385.3	395,046 kg	483.1	291,727 kg	507.2	2.1	691,498 kg	951.1	3.3	187.5
Lubricant Oil, and the Like	0	0	0	0	32,988 kg	5.0	0	345,250 kg	56.0	0.2	11.2
Light Industrial Products	-	7,995.8	-	7,041.7	-	8,058.5	33.5	-	9,413.7	32.9	116.8
Woolen Yarn	119,820 kg	552.4	92,699 kg	403.3	119,784 kg	542.0	2.3	114,740 kg	513.5	1.8	94.7
Synthetic Fiber Yarn	514,985 kg	1,612.6	526,857 kg	1,118.7	636,817 kg	1,875.5	7.8	912,344 kg	2,533.2	8.9	135.1
Artificial Fiber Yarn	665,816 kg	936.8	339,161 kg	534.3	545,979 kg	892.7	3.7	856,266 kg	1,394.6	4.9	156.2
Cotton Fabrics	570,034 kg	1,685.0	506,422 kg	1,576.1	277,119 kg	947.1	3.9	1,201,231 M	469.7	1.6	49.6
Synthetic Fiber Long-staple Fabrics	112,234 kg	638.6	119,353 kg	614.1	397,528 kg	1,181.0	4.9	2,266,631 M	1,328.9	4.7	112.5
Synthetic Fiber Short-stable Fabrics	58,017 kg	362.4	75,953 kg	466.0	80,990 kg	488.4	2.0	779,423 M	620.4	2.2	127.0
Pottery & Percelain	60,602 kg	44.8	189,395 kg	114.6	173,514 kg	161.1	0.7	211,146 kg	156.9	0.5	97.4
Toys & Playthings	262,349 kg	231.7	169,650 kg	182.9	-	242.9	1.0	-	220.2	0.8	90.7
Fancy Goods, Including Buttons & Slight Fastners	1,241,675 kg	197.3	711,103	128.1	815,881	145.7	0.6	986,220 z	217.8	0.8	150.0
Heavy Industrial Chemicals	-	10,043.2	-	11,003.1	-	15,326.8	63.8	-	18,041.4	63.1	117.7
Industrial Chemicals	-	785.2	-	537.1	-	803.0	3.3	-	1,206.9	4.2	150.3
Nitrogenous Functional Compound	450,705 kg	82.8	297,667 kg	98 0	109,771 kg	192.2	0.8	-	131.5	0.5	68.4
Polyethylene, Polystyrene, Polyvinyl Derivatives	594,761 kg	234.2	413,576 kg	126.7	741,518 kg	195.9	0.8	2,418,686 kg	590.2	2.1	301.3
Metal Goods	-	4,567.1	-	4,650.2	-	7,392.9	30.8	-	7,353.3	25.7	99.5
Iron & Steel Coil	1,761 t	165.7	3,286 t	287.2	6,849 t	624.8	2.6	2,259 t	292.0	1.0	46.7
Thin Iron & Steel Plates	21,834 t	3,228.1	21,154 t	2,771.0	30,522 t	4,337.3	18.1	22,872 t	3,514.6	12.3	81.0
Iron and Steen Bands	145 t	35 4	408 t	58.9	951 t	248.4	0.6	1,098 t	239.7	0.8	148.0
Pipe Joints	166 t	81.5	207 t	109.2	302 t	156.7	0.7	292 t	112.9	0.4	72.0
Zinc and its alloys	-	-	437 t	126.9	1,896 t	545.8	2.3	-	166.2	0.6	30.5
Cutleries	199,696 kg	303.3	289,122 kg	492.6	319,835 kg	560.9	2.3	-	576.6	2.0	102.8
Machinery & Transportation Equipment	-	4,690.9	-	5,603.6	-	7,130.9	29.7	-	9,481.3	33.2	133.0
Internal Combustion Engine	11,493 kg	47.7	13,305 kg	115.4	12,139 kg	156.4	0.2	92,733 kg	352.0	1.2	225.1
Coputors	245	16.4	302	31.6	1,367	173.2	0.7	778	135.5	0.5	78.2
Radio Receivers	47,951	512.8	53,961	533.6	67,606	644.0	2.7	81,741	764.9	2.7	118.8
Battery	26,567 kg	205.6	15,356 kg	172.5	25,475 kg	148.5	0.6	-	212.7	0.7	143.2
Passenger cars	621	727.0	1,132	1,344.6	1,293	1,448.4	6.0	1,679	1,942.3	6.8	134.1
Special Automobiles & Motor Trucks	773	982.9	1,068	1,492.9	1,679	2,309.8	9.6	7,040	2,641.3	9.2	114.4
Chassis & Auto Parts Motor	55,623 kg	99.8	49,386 kg	103.4	63,973 kg	152.5	0.6	72,838 kg	177.7	0.6	116.5
Motor-cycle, Autocycle & Parts	11,205 kg	595.2	69,250 kg	345.7	14,361 kg	577.3	2.4	-	607.6	2.1	105.2
Precision Machine, Optical Instruments & Medical Instruments, etc.	-	134.9	-	197.2	-	231.4	1.0	-	242.2	0.9	104.7
Special Merchandises	-	1.6	-	1.3	-	1.7	0	-	27.6	0.1	16.2
Total Amount	-	18,514.5	-	18,545.3	-	24,032.1	100.0	-	28,574.3	100.0	118.9

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Table - 1.18 Japan's Importation from Guatemala

Item	1967 Quantity	1967 Price ($1,000)	1968 Quantity	1968 Price ($1,000)	1969 Quantity	1969 Price ($1,000)	1969 Percentage(%)	1970 Quantity	1970 Price ($1,000)	1970 Percentage(%)	1970 Ratio to Prec. Yr.
Fishes & Processed Goods	161,864 kg	354.9	9,979 kg	33.1	-	-	0	51,116 kg	131.9	0.6	-
Banana (Fresh)	-	-	216,670 kg	44.9	9,984,495 kg	1,991.8	8.2	7,623,888 kg	1,435.5	6.4	72.1
Fruits & Processed Goods	-	-	-	-	443 kg	0.3	0	-	-	-	-
Natural Honey	-	-	1,000 kg	0.3	-	-	0	3,149 kg	1.3	0.0	-
Coffee Beans & Peas (Unrasted)	530,637 kg	410.7	1,807,896 kg	1,168.6	2,055,845 kg	1,481.7	6.1	1,628,666 kg	1,380.1	6.2	93.1
Instant Coffee	154,449 kg	424.5	107,240 kg	291.8	53,504 kg	146.7	0.6	86,965 kg	237.8	1.1	162.1
Spices	-	-	597 kg	2.5	960 kg	7.3	0	3,092 kg	23.9	0.1	326.0
Oil Seeds, Nuts & Cores	655 t	177.3	1,188 t	310.4	24 g	6.4	0	214 t	70.9	0.3	11.1
Cotton Seeds (except powder & meals)	-	-	5,400 t	515.6	-	-	0	-	-	-	-
Natural Rubber (Raw and others)	377,346 kg	924.8	645,132 kg	1,249.7	308,130 kg	702.1	2.9	358,603 kg	774.2	3.5	110.3
Logs and Balks, other timbers (Softwood)	239 t	19.2	1,422 t	78.1	1,174 t	79.2	0.3	-	-	-	-
Ditto (Other than softwood)	197 t	75.2	-	-	65 t	7.0	0	-	-	-	-
Raw Cotton	26,016,663 kg	15,789.0	34,796,055 kg	23,873.6	30,625,330 kg	19,257.0	79.4	28,358,131 kg	17,231.2	76.9	89.5
Cotton Linter	2,989,395 kg	493.3	1,174,343 kg	177.9	2,767,931 kg	379.2	1.6	4,486,927 kg	561.9	2.5	148.2
Stone & Sand	111 t	9.7	-	-	-	-	0	164 t	15.0	0.1	-
Non-ferrous ores and dust	60 t	57.8	29 t	21.4	4 t	5.8	0	1,156 t	166.0	0.7	28.6
Vegetable Raw Materials	-	-	1,916 kg	1.7	28,670 kg	15.1	0.1	-	2.0	0.0	13.2
Essential Oil and Perfumery	12,631 kg	33.8	49,776 kg	161.3	33,927 kg	156.5	0.7	70,029 kg	331.7	1.5	211.9
Fiber yarns for Textile Use, Fabrics and Textile Goods	-	-	107 kg	0.7	142 kg	1.2	0	87 kg	0.9	0.0	75.0
Jewells and Semijewells (except diamond goonds)	-	-	410,300	0.4	-	-	0	-	-	-	-
Clothing (except furs)	-	-	42 kg	0.4	-	-	0	110 kg	1.1	0.0	-
Films for Motion Picture	1,250 m	0.3		-	-	-	0	-	-	-	-
Fine Arts, Collections and *Curios*	-	-		-	1	0.2	0	-	-	-	-
Special Merchandises	14,677 kg	25.7	3,059 kg	5.4	210 kg	1.3	0	8,861.	22.4	0.1	17.2
Total Amounts	-	18,796.2	-	27,937.7	-	24,241.6	100.0	-	22,396.9	100.1	92.4

Data: 106), 110)

Table - 1.19 Changes of Primary Industry Products

(Unit: 1,000 Quetzals (1950 price))

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Distr. Ratio by Items		Growth Ratio 1960/70
												1960	1970	
Total Agriculture	226,813.9	226,612.6	237,310.4	286,797.1	289,787.0	295,507.9	312,215.2	287,266.9	310,235.1	310,457.8	320,256.8	100%	100%	1.41
Products for Export	121,126.0	119,288.7	127,912.3	154,572 9	151,892.0	156,505.6	168,681.0	142,058.0	158,952.0	159,989.6	162,908.8	53.4	50.8	1.34
1. Coffee	87,657.5	85,628.2	88,333.8	103,021.2	97,846.7	105,300.9	104,843.4	87,765.8	95,188.4	98,355.5	108,499.4	38.7	33.9	1.24
2. Cotton (Linting)	8,895.4	11,941.9	18,119.5	30,472.4	35,840.5	40,090.2	46,557.8	36,866.8	40,698.0	37,078.5	29,574.2	3.9	9.2	3.32
3. Banana	20,237.5	17,554.7	11,472.2	15,687.6	12,197.6	4,408.8	9,849.5	8,305.0	15,243.0	16,198.8	16,848.5	8.9	5.3	0.32
4. *Cotton (Seeds)*	950.3	1,299.4	1,975.4	3,309.5	3,905.2	4,376.4	5,085.6	3,950.6	4,544.9	4,167.6	3,285.0	0.4	1.0	3.46
5. Cardamom	1,524.0	769.7	1,400.9	1,262.3	1,323.9	1,216.1	1,231.5	1,770.3	1,847.3	2,016.6	3,278.9	0.7	1.0	2.15
6. Chicle	1,861.3	2,094.8	610.5	819.9	778.1	1,113.2	1,113.2	3,399.5	1,430.4	2,172.6	1,422.8	0.8	0.4	0.76
Products for Domestic Consumption	83,749.6	86,262.9	89,029.9	102,950.3	107,837.4	108,826.6	112,304.4	112,313.5	118,031.3	16,945.4	121,230.8	36.9	37.9	1.45
7. Maize	24,713.6	25,234.2	26,363.2	32,795.7	34,797,4	34,396.3	35,321.9	32,811.8	30,959.9	33,097.0	36,271.4	10.9	11.3	1.47
8. Peas & Beans	15,326.4	15,570.8	15,833.1	20,237.2	21,472.0	21,214.2	21,766.7	25,725.0	30,197.6	26,601.5	25,836.1	6.8	8.1	1.69
9. Potatoes	1,218.9	1,335.4	1,567.9	1,343.2	1,652.3	1,948.5	2,181.5	1,414.2	2,229.1	1,344.5	1,479.1	0.5	0.5	1.21
10. Fruits	15,798.8	16,798.4	17,531.0	17,962.6	18,684.0	19,271.1	19,876.8	19,539.4	20,145.1	20,769.6	21,413.6	7.0	6.7	1.36
11. Vegetables	14,863.2	15,541.8	15,414.6	15,923.4	16,417.2	16,926.0	17,451.0	17,956.8	18,513.6	19,087.5	19,679.4	6.5	6.1	1.32
12. Lima Beans	860.3	887.6	914.9	920.4	900.1	928.2	957.1	1,065.5	1,098.2	1,132.6	1,167.7	0.4	0.4	1.36
13. Peanuts	95.7	98.7	99.8	105.9	108.9	112.0	115.0	115.0	118.1	122.2	126.2	0.0	0.0	1.32
14. Lens Beans	4.9	4.9	4.9	4.9	6.1	6.1	6.2	6.4	6.6	6.8	7.0	0.0	0.0	1.43
15. Misc.	10,867.8	10,791.1	11,300.5	13,657.0	13,799.4	14,024.2	14,608.3	13,679.4	14,773.1	14,783.7	15,250.3	4.8	4.8	1.40
Products for Industrial Materials	21,954.3	21,061.0	26,368.2	29,274.4	30,057.6	29,175.7	31,235.8	32,886.7	33,221.8	33,522.8	36,117.2	9.7	11.3	1.65
16. Sugarcane	14,388.6	13,987.4	17,904.4	18,221 9	18,255.4	16,430.9	17,614.6	20,733.4	20,743.0	21,150.9	22,645.1	6.3	7.1	1.57
17. Wheat	2,591.4	3,011.2	3,152.3	4,163.9	4,408.3	4,856.2	4,504.6	3,139.3	4,571.9	3,091.0	4,074.5	1.1	1.3	1.57
18. Rice	1,473.6	1,359.5	1,713.1	1,967.7	2,632.9	3,054.2	3,316 6	2,490.0	1,550.3	2,870.0	2,453.6	0.7	0.8	1.67
19. Tobacco	1,019.8	1,000.8	1,028.2	1,443.3	1,491.8	1,637.1	1,755.1	1,978.5	1,881.6	1,692.1	2,121.8	0.5	0.7	2.08
21. Lemon Grass	1,091.7	584.8	919 3	1,235.9	970.1	729.1	792.3	743.0	525.1	614.8	930.5	0.5	0.3	0.85
22. Flax	80 0	96.0	460.8	534.4	562.4	671.2	697.6	752.0	720.0	744.8	761.6	0.0	0.2	9.52
23. Citronellal	602.0	212.8	269.5	421.3	439.8	478.6	398.2	356.5	216.7	161.1	146.6	0.3	0.0	0.24
24. Sesame	123.8	141.7	195.4	289.0	216.7	197.5	197.5	582.0	619.2	427.9	419.7	0.1	0.1	3.39
25. Cacao	320.1	404.1	174.2	257.8	181.2	188.1	195.1	202.1	209.0	216.0	223.0	0.1	0.1	0.70
26. Barley	13.6	13.0	12.3	14.3	16.4	17 4	16.4	19.7	20.4	21.8	23.6	0.0	0.0	1.75
Total Stock-Raising	81,536.5	88,462.4	89,126.3	92,153.7	92,145.7	94,040.1	99,847.1	118,972.8	121,290.1	147,642.9	158,227.2			1.94
Total Forestry Products	28,660.6	29,798.3	30,598.9	31,729.7	34,175.2	36,038.5	37,172 8	38,181.2	38,289.4	39,530.9	41,032.0			1.43
Total Fishery Products	3,176.9	3,393.9	3,876.0	3,942.2	4,803.0	4,165.7	4,493.2	5,064.4	4,653.5	4,818.9	5,447.1			1.71
Grand Total	340,189.7	348,267.2	360,911.6	414,622.7	420,910.9	428,757.9	453,728.3	449,485.5	474,468.1	502,450.5	521,817.1			1.53
Percentage														
Agriculture	66.7	65.1	65.8	69 2	68.8	68.9	68.8	63.9	65.4	61.8	60.7			
Stock Raising	24.0	25.4	24.7	22.2	21.9	21.9	20.0	26.5	25.6	29.4	30.4			
Rorestry Products	8.4	8.6	8.5	7.7	8.1	8.4	8.2	8.5	8.1	7.7	7.9			
Fishery Products	1.0	1.0	1.1	1.0	1.1	1.0	1.0	1.1	1.0	1.0	1.0			
Total	100	100	100	100	100	100	100	100	100	100	100			

Data: 103), 105)

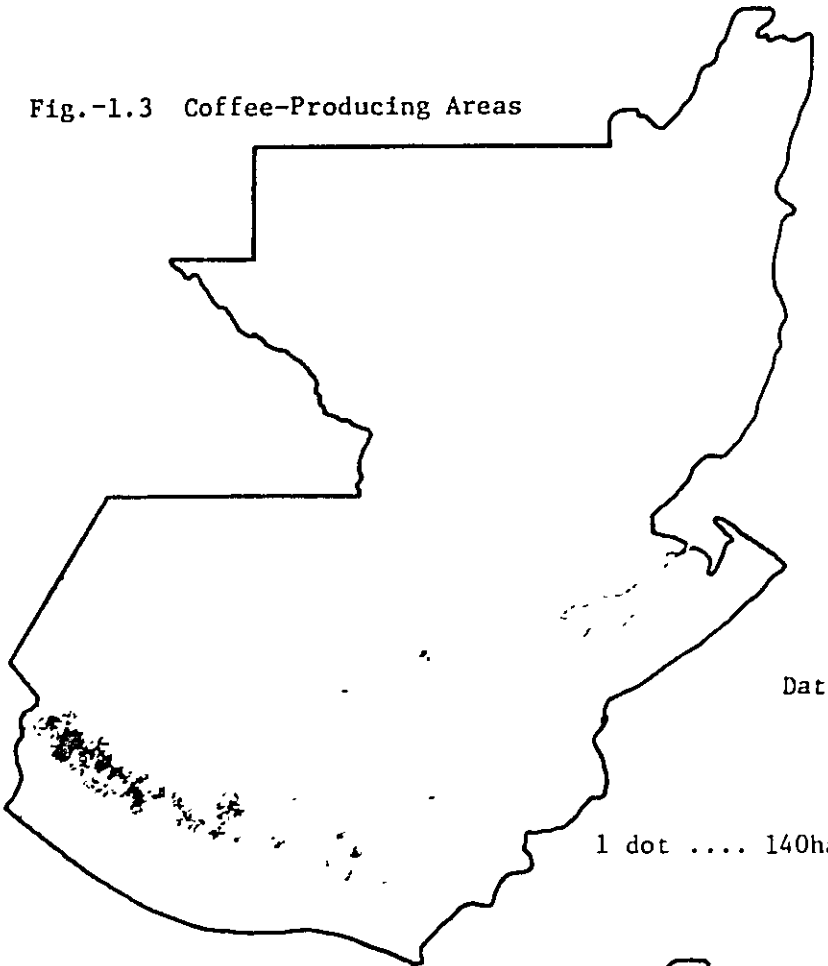
Table-1.20 Major Agricultural Products

(Unit: 1,000 tons)

Item	1969	1970	1971	1972
Coffee	114.7	126.5	128.4	138.2
Raw Cotton, Linting	68.5	54.1	62.1	84.1
Cotton Seeds			102.1	137.1
Maize	704.8	772.4	755.6	718.9
Sugacane	1,830.9	1,960.4	2,059.6	2,478.8
Peas & Beans	137.6	133.7	134.5	135.0

Data: 103)

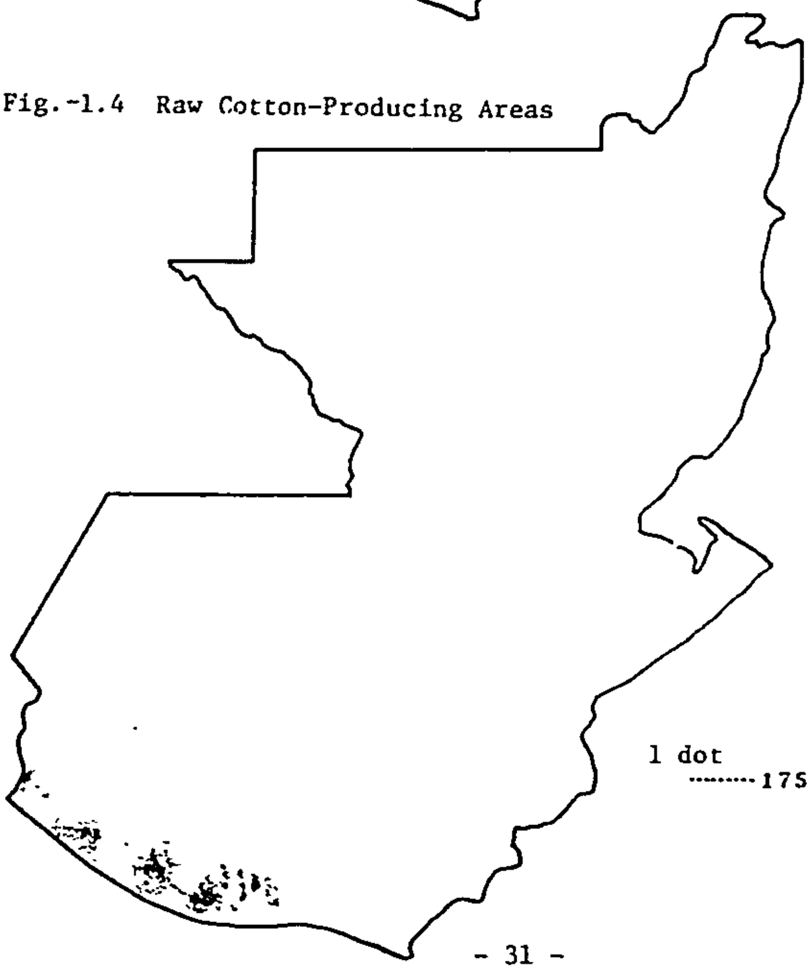
Fig.-1.3 Coffee-Producing Areas



Data : 111)

1 dot .... 140ha(200MANZANAS)

Fig.-1.4 Raw Cotton-Producing Areas



1 dot
.........175ha(250MANZANAS)

Data: 111)

Fig.-1.5 Banana-Producing Area

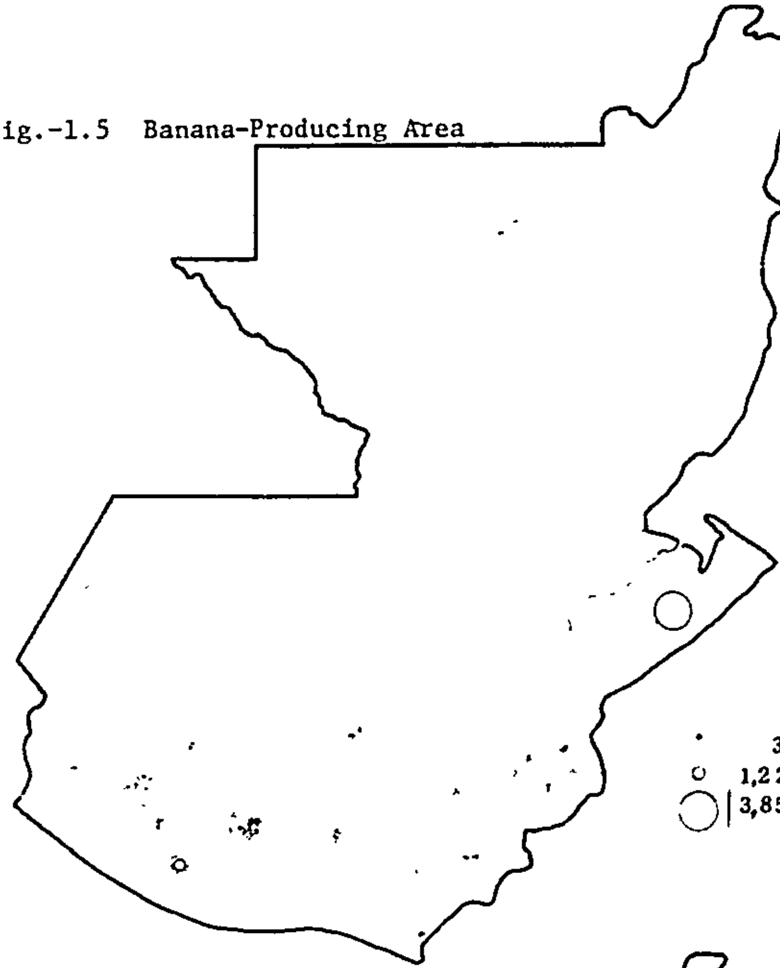


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Fig.-1.6 Maize-Producing Areas

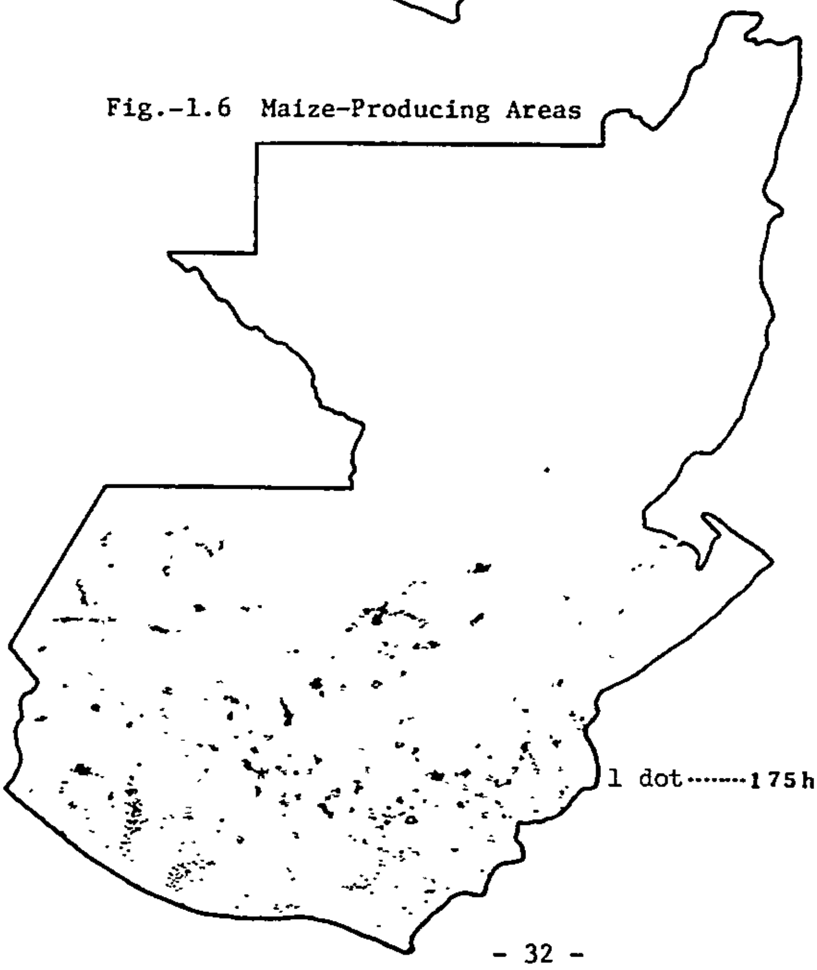

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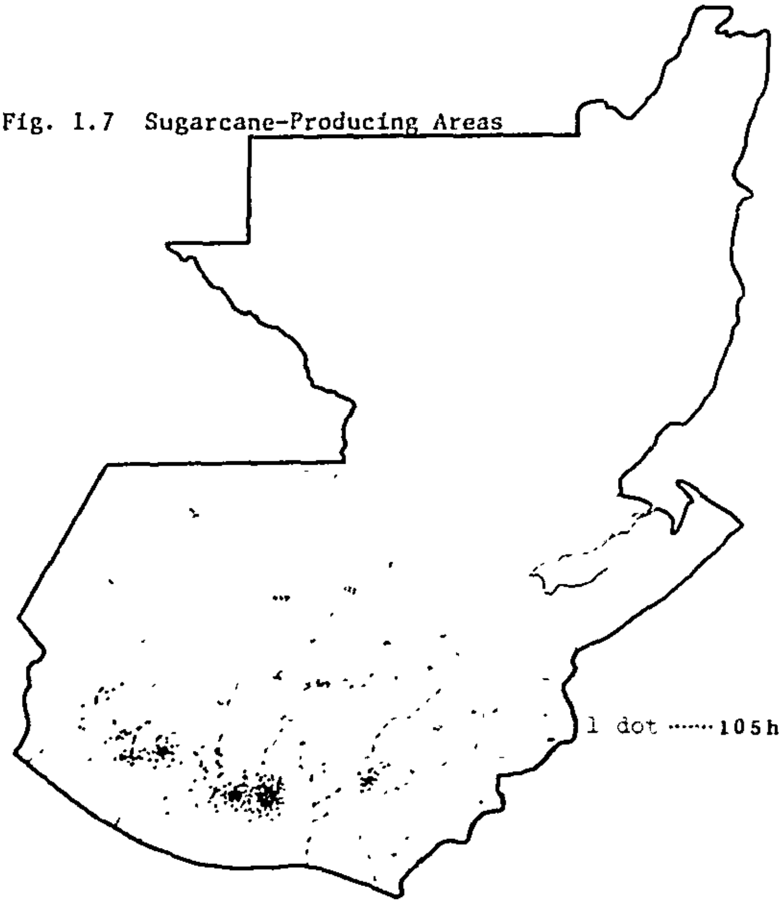
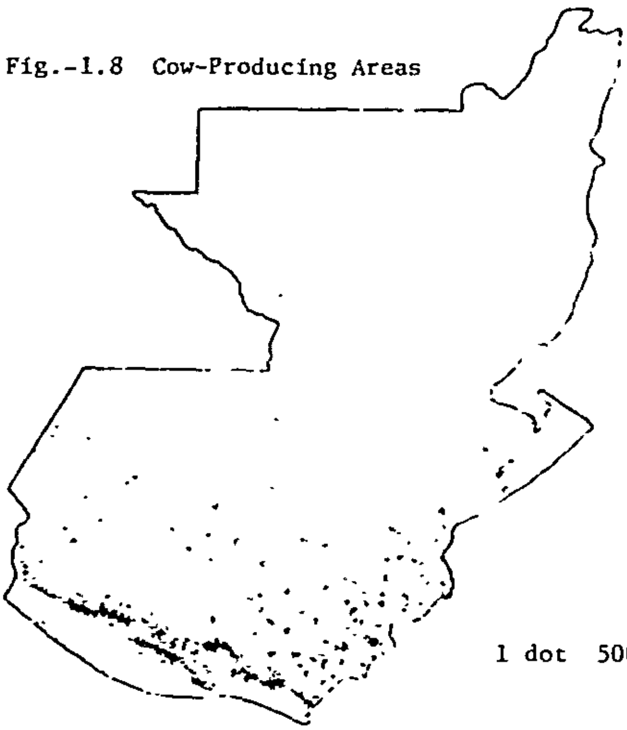
Fig. 1.7 Sugarcane-Producing Areas



1 dot ······105ha(150MANZANAS)

Data: 111)

Fig.-1.8 Cow-Producing Areas



1 dot 500Heads

Data: 111)

Table - 1.21 Amount of Added Value for Industrial Product by Industry Group

(Unit: Million Quetzals)

Group of Industry	1950	1955	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Distr. Ratio by Ind.				Increasing Ratio 70/60
														1960	1960	1965	1970	
Processed Foodstuffs	26.2	29.5	39.9	41.0	43.8	48.2	51.7	53.5	54.9	58.3	62.4	71.3	77.0	30.3	30.1	24.5	26.1	1.93
Feed	19.1	19.7	24.6	23.8	22.5	23.8	24.9	26.3	26.5	26.6	27.2	30.2	32.0	22.1	18.6	12.0	10.8	1.30
Tobacco	9.4	9.6	11.2	11.1	11.4	11.9	12.5	13.7	14.3	16.5	15.2	15.8	17.6	10.9	8.5	6.3	6.0	1.57
Textiles	4.7	6.4	10.4	11.9	15.7	21.0	30.8	37.9	26.6	29.4	31.9	31.7	33.8	5.4	7.9	17.3	11.4	3.25
Articles of Clothing	11.1	13.2	18.9	20.2	24.1	29.0	34.5	38.9	26.8	27.8	30.9	33.4	34.0	12.8	14.3	17.8	11.5	1.80
Wooden Manufacture	2.0	2.5	2.5	3.0	3.2	3.2	3.8	3.8	4.2	4.1	3.9	5.0	5.4	2.3	1.9	1.7	1.8	2.16
Furniture	3.6	4.1	4.8	4.9	5.1	5.2	5.4	5.6	5.8	6.0	6.2	6.4	6.6	4.2	3.6	2.6	2.2	1.38
Paper	–	0.1	0.6	1.1	1.4	1.7	1.9	2.6	2.7	3.0	3.6	4.0	4.9		0.5	1.2	1.7	8.17
Printing	1.2	1.7	2.4	2.4	2.6	2.7	2.9	3.4	3.9	4.0	4.0	4.5	5.4	1.4	1.8	1.6	1.8	2.25
Leather	1.4	1.4	1.6	1.6	1.6	1.7	1.6	1.6	1.8	2.1	2.9	3.7	3.7	1.6	1.2	0.7	1.2	2.31
Rubber Goods	0.1	0.2	1.1	1.3	1.5	1.8	2.0	2.1	3.2	3.6	4.5	4.1	4.4	0.1	0.8	1.0	1.5	4.00
Chemicals	2.7	2.9	4.6	5.1	5.8	6.0	6.4	6.6	7.5	8.6	10.5	9.5	10.0	3.1	3.5	3.0	3.4	2.17
Non-ferrous Metal	3.8	4.8	5.3	6.4	6.2	7.1	9.3	10.1	10.9	10.0	8.9	10.6	10.1	4.4	4.0	4.6	3.4	1.91
Metal Goods	0.4	0.9	1.5	1.9	2.6	3.8	4.8	5.4	11.7	16.1	21.1	23.6	27.9	0.5	1.1	2.5	9.5	18.60
Machinery	0.1	0.1	0.2	0.3	0.4	0.6	0.8	0.9	1.9	2.6	3.5	3.9	4.6	0.1	0.2	0.4	1.6	23.00
Electric Appliances	0.1	0.2	0.3	0.3	0.5	0.7	0.8	0.9	2.0	2.8	3.7	4.1	4.9	0.1	0.2	0.4	1.7	16.33
Transport Equipment	0.6	1.0	1.6	1.7	1.8	1.9	2.2	2.5	2.3	2.3	2.6	2.8	3.0	0.7	1.2	1.1	1.0	1.88
Miscellaneous	0.1	0.2	0.8	1.1	1.4	1.8	2.3	2.9	3.7	4.8	6.1	7.8	10.0	0.1	0.6	1.3	3.4	12.50
Total	86.6	98.5	132.4	139.2	151.6	172.2	198.5	218.7	210.7	228.4	249.2	272.2	295.1	100	100	100	100	2.23
Index 1960=100	65.4	74.3	100.0	105.1	114.5	130.0	149.9	165.1	159.1	172.5	188.2	205.5	222.8					

Data: 105)

Table - 1.22 Distribution of Factories by Industry Group

Name of Pref.	Food-stuff	Feed	Tobacco	Fiber	Leather	Wooden Mfr. Furniture	Paper Printing	Brick, Cement	Rubber	Chemi-cals	Metal Goods	Misc.	Total
Guatemala	150	10	3	146	6	82	52	15	17	84	104	34	703
(Guatemala)	(145)	(8)	(2)	(138)	(5)	(82)	(52)	(13)	(17)	(79)	(95)	(34)	(670)
El Progreso	1						5			1			7
Sacatepequez	1			6	3	1					3	2	16
Chimaltenango	2			5		3		10			1		21
Escuintla	34	3		17	1	7	2			11	3	1	79
Santa Rosa	2												2
Solola						2							2
Totonicapan	1			1									2
Quezaltenango	11	3		12	8	4	5		1	3	5	1	53
Suchitepequez	8	3		3					1	2	5		22
Retalhuleu	10	2		10		12	1			6	4		45
San Marcos	2		1	3			1						7
Huehuetenango	2	1									1	1	5
Quiche		2											2
Baja Verapaz				1		2							3
Alta Verapaz						2						2	4
Peten						3							3
Izabal	11	1				3	1		2	1			19
Zacapa	8	1	13			5		1					28
Chiquimula	2	1		3		1					1		8
Jalapa	1					3							4
Jutiapa	6		1	3		3							13
	252	27	18	210	18	138	62	26	21	108	127	41	1,048

Data: (11)

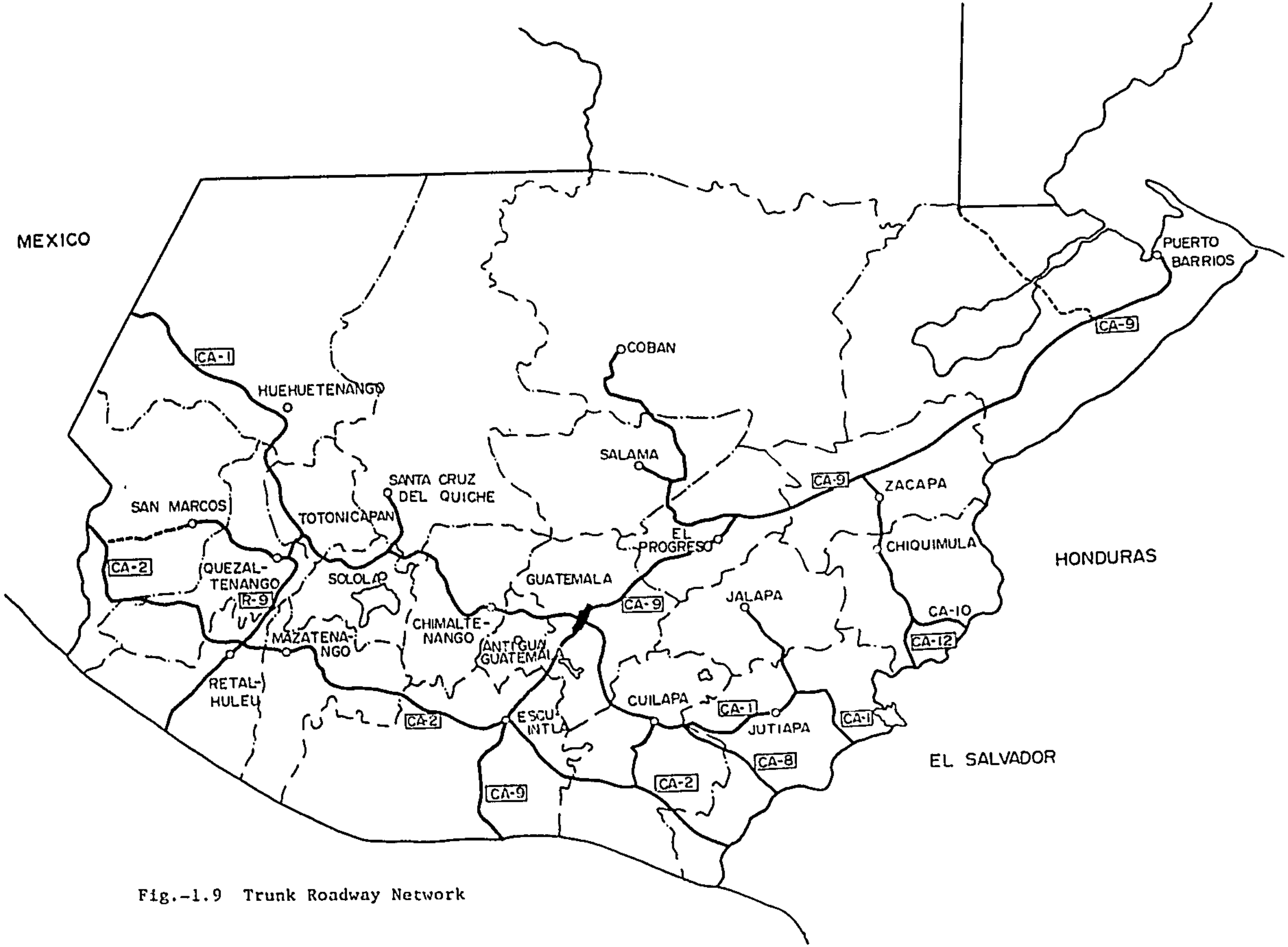


Fig.-1.9 Trunk Roadway Network

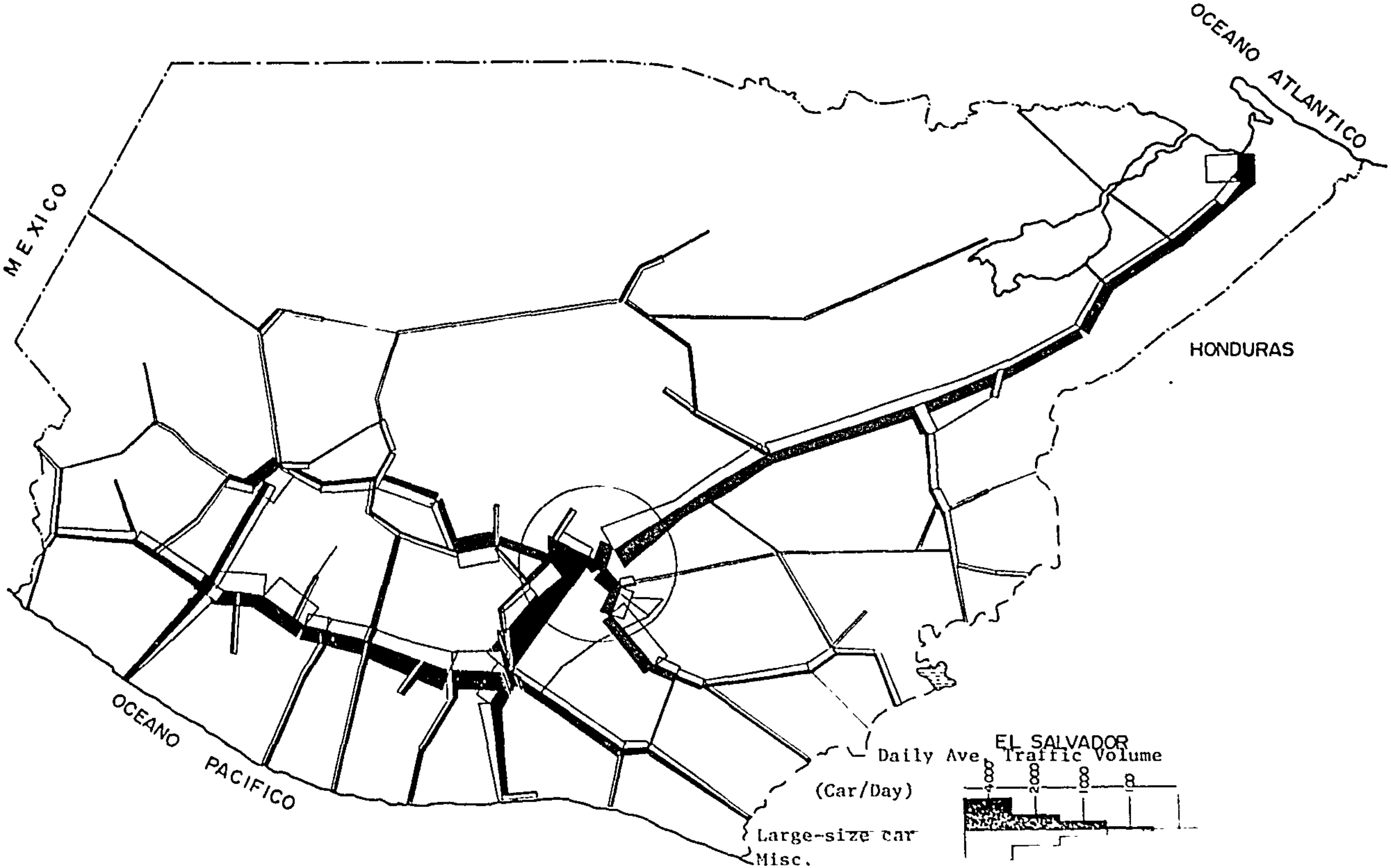


Fig.-1.10 Traffic Volume of Main Roadways

Data: 121)

Data: 418)

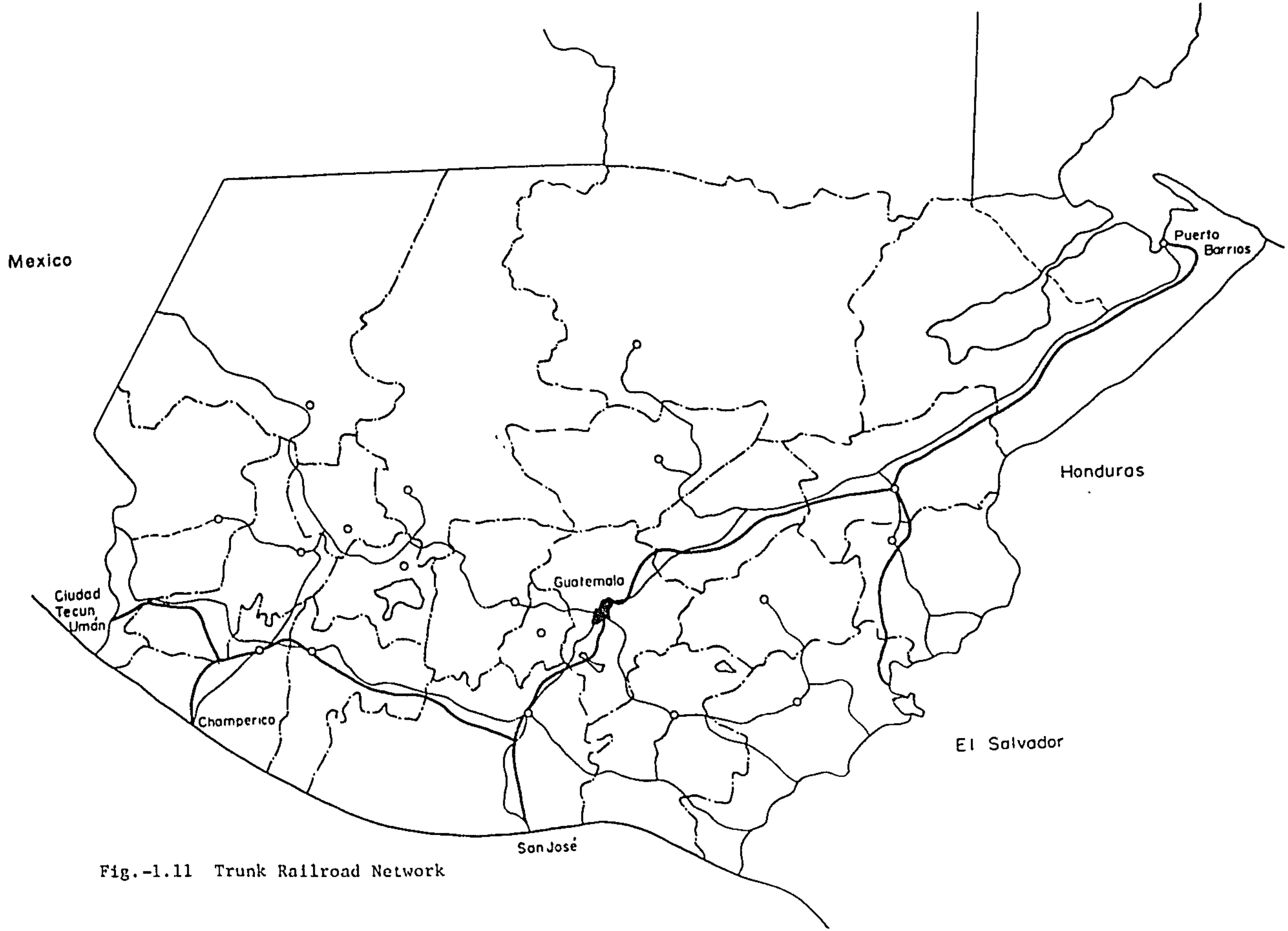


Fig.-1.11 Trunk Railroad Network

CHAPTER 2. PRESENT SITUATION OF PORTS

Chapter 2. Present Situation of Ports

2-1 General Port Situation in the Republic of Guatemela

The Republic of Guatemala is a country stretching over both the Pacific and Atlantic Oceans. It has at present two ports on the Atlantic coast and two ports on the Pacific. (See Fig.-2.1). The distance between each of these ports and Guatemala City, the center of economic activities, is 110 km from San José Port, the shortest, and 225 km from Champerico Port, 295 km from Puerto Barrios and 299 km from Santo Tomas, respectively.

According to the statistics year book published by the Bank of Guatemala, out of 1,635,000 tons, the total goods transported for its foreign trade in 1971, the volume handled in ports and harbors amounted to 1,119,000 tons, accounting for 68.5 per cent of the total tonnage. Other tonnages than the above numerals are 499,000 tons (30.5%) by land transportation, and 17,000 tons (1%) by air-borne cargoes. (See Table-2.1)

Even though this percentage is estimated by a classification by export and import ratios, there is almost no noticeable difference. However, when compared with days of 1960, a reduction by 20 per cent is noted in the share of sea transport. This was resulted mostly from her trade which has recently grown vigorously active within the Central American Common Market, particularly with El Salvador, her neighbor to the east.

Furthermore, the greater part of the imported goods has been transported via Port Acajutla, due to a delay in the improvement of harbor facilities on the Pacific.

In the next, when seen from the port state of each port, the total cargo tonnages handled in harbors for Guatemala in 1973, including those via Port Acajutla, were approx. 1,440,000 tons while those handled by Santo Tomas and Puerto Barrios were 590,000 tons and 500,000 tons, respectively, accounting for approximately 76 per cent of the total tonnage. On the contrary, when compared with those cargoes transported through San José and Champerico on the Pacific and furthermore, with those through Acajutla in El Salvador, they are between 110,000 ~ 120,000 tons per each port, and the goods transported through the Pacific and the Atlantic showed a ratio of 1 to 3.

However, due to irregular statistics given by each port, the units used here for expressing goods were converted and standardized into metric ton for appearing in this report. Moreover, some differences between the data given by the Bank of Guatemala and total volumes of cargoes handled by each port are caused by discrepancies between the units in statistics and the handling of imported crude oil.

What the ports on the Caribbean coast, despite their location remote from the capital which is the center of nation's economic activities, are dominant over their counterparts on the Pacific which have a background of rich farm-lands and are located comparatively near the metropolis, can be attributed to a fact that the formers are affected by a brisk foreign trade with the east coast of the United States and West European countries in the past and they were affected by domestic commercial practices. However, it is most provable that the difference in the improvement of harbor facilities in the both coasts was a great factor that affected these ports. In another word, ports on the Caribbean coast are located inside large inlets and in particular, Santo Tomas Harbor has up-to-date facilities while the two ports on the Pacific are located on the open sea and they have no breakwaters nor quays where large ships can be moored and moreover they are not provided with effective cargo handling facilities.

2-2 General Situation of Each Port

2-2-1 Champerico Port

(1) Short History

About 80 years ago Champerico Port had its piled pier built by a civil enterprise of German origin and at the same time a railroad was laid by the Central American International Railroad Co. Later, in 1955 by the president ordinance, it was designated as the state port. At present it is under administration of the Ministry of Finance and it is practically managed as the complete state port by the Champerico Port Public Corporation.

(2) Conditions of Location

Champerico Port is the only port on the west district of the Pacific coast and located on the beach in Retalhuleu Prefecture, to approx. 40 km east of the border of Mexico and Guatemala.

The population of Champerico City where this port is located, is a little over 10,000. Its main industry includes farming, port activity, and lobster fishing industry by a Japan-Guatemalan joint stock (PESCA S.A.). In particular, the plain at its behind and the tableland are a main center of farm products such as raw cotton and coffee.

State highway No.9 with a 2-lane width is stretching from the port and leading to CA-2 via Retalhuleu City.

As seen from Fig.-2.2, Champerico Port commands a very superior location as the door to the sea of the west area.

Since the railroad is leading to the capital, cargo transportation is facilitated by this railway. A composite train of passenger cars and freight trains shuttles only once a day.

(3) Port Facilities

Champerico Port has a piled pier jutting out directly into the Pacific Ocean and this is the only mooring arrangement. The pier was built of steel pipe and is now regarded as passing its life-time. Since large ships cannot be moored, tug boats, barges and small-sized fishing boat are used on this purpose but, due to its cope level which rises 5 ~ 6 meters above the sea level, cranes are used on the pier. Railway sidings are led onto the pier and its warehouse at its behind is large and new. (See Fig.-2.3)

Piled Pier	Length:	320m (Transit Shed: 67m)	
	Width :	Pointed end: 25m	Middle: 8m
	Depth :	Pointed end: -7m	

Cargo Handling Equipment	5-ton crane	2 units
	15-ton "	4 "
	40-ton "	1 unit
Lighter	30-ton burden	10
Tug Boat	20HP	1
"	245 "	2
"	250 "	1
Transit Shed	37,200m^2	
Open Storage Yard	20,000m^2	

(4) Present State of Port Utilization

Merchant vessels lie at anchor at a point approx. 12 m deep, 1.5 km offshore and loading and unloading is conducted by offshore cargo handling. There are 6 gangs consisting of more than 20 laborers and they work on 2 shifts. Their loading capacity is between approx. 13~15 tons/hour per gang.

Cargoes handled by Champerico Port are shown in Table-2.3. According to the results for 1973, raw cotton accounted for 92 per cent of the entire exports which totaled 66,000 tons, and other main items are coffee, sesame seeds, etc. On the other hand, imports amounted to 50,000 tons, of which fertilizer accounted for 80 per cent, and this was followed by industrial raw materials, farm-marine products, including wheat.

According to the 1972 results, the number of incoming vessels reached approximately 100. Average of these vessels are of approx. 4,500 G/T type and the nationalities of the incoming ships were Japan, Yugoslavia, and Norway in exportation while West Germany, Greece, Norway, etc., in importation. (See Table-2.4.) Moreover, about 20 small-sized fishing boats are utilizing this port.

2-2-2 San José Port

(1) Short History

San José Port is a port located on the east coast of the Pacific and its piled pier was constructed about 90 years ago by the Central American International Railroad Company. The construction of this pier aimed at shipping of crops produced on the farm-land at the back of this port, in cooperation with the railroad which stretches from the port to its hinterland. The port was nationalized by the government a few years ago. However, port operations such as cargo handling, etc. are conducted by Agencia Maritima S. A., a port operation company.

(2) Conditions of Location

San José Port is located on the coast of Escuintla Prefecture, about 80 km away from the border of El Salvador. The population of San José, a town which owns this port, is approximately 20,000. Its main industry is agriculture including banana, coffee, sugarcane and raw cotton which are also chief export items. Particularly, as for sugarcane, around Escuintla Prefecture, the center of sugar manufacturing industry, many sugar refineries of Guatemala are located. Besides, it is near to Guatemala City, the capital, and occupies a very important position compared with other ports on the Caribbean coast.

State highway CA-9 as one of the most important transportation facilities runs to the capital via Escuintla City. On the other hand, by state highway CA-2 which intercrosses at Escuintla City, the port is connected with principal cities in the plain region on the Pacific. In parallel to State highway CA-2, the railroad stretches to the capital. Usually, a railway train is composite with 2-3 passenger cars and 6-8 freight trains and the train runs only once a day.

(3) Port Facilities

As in the case of Chamerico Port, a steel piled wharf jutting into the Pacific is the only external public service equipment and no other facilities are provided.

Since merchant vessels cannot be moored in the port, offshore cargo handling system is adopted. Moreover, a transit shed and cargo handling equipments are provided on the pointed end of the piled pier, but due to its high cope level, unloading is carried out by cranes and lighters. The pier is so old that it is regarded as passing its life-time. Principal facilities are given as follows:

Piled Pier	Length: 300m (Transit shed: 50m) Width : Pointed end: 22m Middle: 8m Depth : Pointed end: -8.5m	
Cargo Handling Equipment:	5-ton crane	3
	20-ton "	1
Lighter	35-ton burden	9
Tug Boat		4
Launch		1

Other than these shown above, there is a sea berth located at a point 20 km to the west of the piled wharf for discharging to an oil refinery situated in Escuintal City. However, as the sea berth is capable for 30,000 DWT oil tankers (of 11 m draft) to use, a pipeline connects the berth with the refinery.

(4) Present State of Port Utilization

As stated above, since the harbor is incapable of mooring merchant vessels which lie at anchor at a point approximately 500 m off the pointed end of the piled pier, cargo handling is by means of off shore cargo handling system. Though the harbor is not made available for use in some time of the year, and especially in the rainy season when Chubascos is prevalent, its cargo handling activity is suspended for about 30 days. Cargo handling capacity per gang is 15 tons/hour. Moreover, stevedoring by lighter causes great damages to cargoes, and has been posing problems such as weight cargoes can not be handled.

Actual results of cargoes handled in the port during 1973 indicate that exports totaled 46,000 tons, of which coffee, raw cotton and cotton linter are chief products totalling approx. 45,000 tons. On the other hand, of the imported goods amounting to 77,000 tons, metal works and goods accounted for about half of the amount, and this is followed by industrial raw materials and fertilizer as chief items. (See Table-2.5.)

The number of incoming vessels during the year totaled approx. 200. Average of these incoming ships were of approx. 5,400 G/T type and the nationalities by the ships can be classified into Greece, Japan and West Germany in exportation while in importation they can be arranged as Liberia, Norway and the Netherlands, accoridng to large numbers of entry. (See Table-2.6.)

2-2-3 Puerto Barrios

(1) Short Histry

Puerto Barrios Port is an old port on the Caribbean coast, and its port was constructed early in this 20th century. The construction was carried out by the Central American International Railroad Company and the port has been prospering as the port for banana shipment by the United Fruits Company which was capitalized by American funds. As the railroad company was nationalized, the port abandoned itself to the same fate of nationalization and it is presently managed by Puerto Barrios Port Public Corporation.

(2) Conditions of Location

Puerto Barrios Port is located at the entrance to Bahia Matias de Galvez, inlet of Bahia de Amatique on the Caribbean coast. Innermost this bay Santo Tomas is situated.

Puerto Barrios City has a population of between approximately 30,000 - 34,000, and it is the site of many factories including those of United Fruits Company and other industries. However, the degree of accumulating farm products of its hinterland is not high when compared with that of the Pacific side and despite the low potentialities possess by this port, the fact that activities of the ports on the Caribbean coast are more intense depends on the other parties of foreign trade who are mostly centered about the United States and Western countries, and furthermore, this harbor is utilized as the only door on the Caribbean coast to El Salvador.

As the transportation system starting from this port, State Highway CA-9 is complete and leading to the capital. Moreover, State Highway CA-9 which intercrosses CA-10 and CA-12, stretches to Honduras and El Salvador. And in parallel to this highway CA-9, the railroad leads to the capital. (See Fig.-2.6.)

(3) Port Facilities

Due to its position located inside the bay, this port has no breakwaters except for a breakwater-type wharf which has 7 berths. The wharf has transit sheds on it and the railway siding is leading to its pointed end. On the other hand, there is no crane but the pier is equipped with belt conveyors for banana shipments for exclusive use by the United Fruits Company. Principal facilities and arrangements are given in the following.

Pier	Length:	633m	
	Width :	42m	
	Depth :	-10.5m (at pointed end)	
Mooring facilities:	Depth :	-10.5m	2 berths
		-7.5m	2 "
		-7.0m	1 berth
		-6.0m	1 "
		-5.0m	1 "
Transit Shed on the Wharf:	120m x 24m		
	170m x 12m		

(4) Port Utilization

In this port, cargo handling alongside quay is capable. Shipping in and out of the wharf is limited to the railroad only and no motor trucks are allowed to enter. Ordinary operation hours are between 7:00 ~ 11:00 hours and 13:00 ~ 17:00 hours but night-time cargo handling can be made.

Due to insufficient data, cargoes handled by this port cannot be given but it is believed that approx. 500,000 tons were handled during the year. Banana is the chief item of exports.

Nationalities of incoming vessels are all European countries such as Britain, West Germany and Greece, and average of these ships are of approx. 2,000 G/T type. (See Table-2.7.)

2-2-4 Santo Tomas Port

(1) Short History

In 1955 the government constructed this port at a site about 10 kilometers away from Puerto Barrios, and later in 1968 pier facilities were completed, and then they were expanded to this day. It is the only up-to-date port in Guatemala. Even though the harbor was constructed in rivalry with Puerto Barrios which had been developed and managed holly by a civil railroad and offered for exclusive use by United Fruits Company, it presently has future plans for opening it as a free port.

(2) Conditions for Location

In geographical conditions, they are exactly the same to those of Puerto Barrios. (See Fig.-2.6.) Santo Tomas is a small town without any industry deserving special mention but at the back of the town, an oil refinery is located.

(3) Port Facilities

As in the case of Puerto Barrios, the port needs no breakwaters but it is equipped with a parallel quay of piled wharf structure by reclamation work. As port traffic facilities, it has dockroads and a dock railway siding.

Main port facilities can be given as follows:
(See Fig.-2.8.)

Mooring facilities	:	Depth : (-9m) 6 berths Length: 914m	
Transit warehouse	:	$35,000m^2$	
Cargo Handling Equipment:		55-ton fixed crane 35-ton travelling crane	1 unit 1 unit

(4) Port Utilization

This port is completely equipped with modern facilities and cargo handling alongside quay is made available for merchant vessels. As a matter deserving special mention, roll-on and roll-off system ships are assigned between Miami and Honduras via Puerto Barrios port and this port. Ships of 7,000 G/T type are placed in commission and they are sailing once in every 5 days.

Cargoes handled in this port during 1973 showed results of 225,000 tons in exportation, including coffee (42%), sugar and meat as main export items. On the other hand, except for crude oil (412,000 tons), imports totaled 364,000 tons, in which farm/marine products (approx. 23%) including wheat, industrial raw materials (pine resins, paraffin, etc. amounting to approx. 23%), and metal works and goods are main items for imports. (See Table-2.9.)

Meanwhile, when incoming vessels are classified by nationality, in exportation they are Britain, West Germany, Panama,etc while in importation the Netherlands, Norway, Liberia, etc. can be enumerated. Average of these incoming ships are of approx. 2,200 G/T type. (See Table-2.10.)

2-2-5 Acajutla Port

(1) Short History

Acajutla Port is located near the Guatemalan border and the nearest port on the Pacific in El Salbador, her neighbor to the east. Cargoes for the Republic of Guatemala handled by this port during a year totaled about 100,000 tons. For planning a new port, the following points shall be stated for information.

The port is managed by a state commission named Comision Ejecutiva Portuaria Autonoma which can be abbreviated as CEPA, meaning Executive Commission for Port Administration. In 1961 the port completed Pier A on the south side of its old port which is a piled wharf of breakwater type, the same to that of ports located on the Pacific of Guatemala, and also Pier B later in 1970. Further as its 3rd expansion project, they are investigating the construction project which includes expansion of the existing Pier A and a new pier for container ships. As a result of increased cargoes handled by the port during 1973, reached 905,000 tons, about 3 times of those handled in 1965, there was a maritime traffic mess in July 1974, and as a solution to this traffic difficulty, it was decided to impose a surcharge at a rate of approx. $2.15 per ton.

(2) Conditons of Location

El Salvador is a small country with its total area of 20,000 km^2 and a population of 3,700,000. Despite these geographical circumstances, it is the most highly industrilized country in Central America. Acajutla is located about 30 km away from the Guatemalan border and connected with Guatemala City by its State highway CA-2 via Escuintla. (See Fig.-2.9.)

The port has many favorable advantages in location such as its coast line direction which is much inclined to the north/south direction when compared with San José, a low degree of washing waves which dash to the shore, and its seabed which is formed of solid rocks having very little sand drift motions.

(3) Port Facilities

The port consists of the wharf section which was constructed 300 - 500 m offshore, and the administrative quarters and also distribution installations built at the back of the port. (Fig.-2.10.) Both facilities are connected by a piled pier, on which a 2-lane road runs and belt conveyors are installed for bulk cargoes. The railroad leads to the distribution installations. Chief port facilities are given in the following.

Wharf A	Length	310m	
	Width	37m	
	Mooring facility:		Underwater depth: 10m, 1 berth
			" " : 12m, 1 "
Wharf B	Length	370m	
	Width	28m	
	Mooring arrmt :		Underwater depth: 10m, 3 berths
			" " : 12m, 1 berth

Cargo Handling Equipment:	25-ton Travelling Crane	1 unit
	35-ton Movable Crane	1 "
	45-ton " "	1 "
	3-ton " "	1 "
	Telescopic Chute (500-t/hr)	1 "
	Clam Shell (500-t/hr)	1 "
	Belt Conveyor (2000-t/hr)	1 set

Cargo Disposal & Storage Facilities:

Open Storage Yard	15,000m^2
Warehouse	22,200m^2
Warehouse for Transit Cargoes	4,500m^2
Warehouse for Bulk Cargoes	12,000m^2
Tank for Liquid Products	4,305,000 gallons

Tug Boat	1,700 HP	1
	1,200 "	1
	800 "	1
	125 "	1

Moreover, the port plans a wharf extention project to enlarge the pointed end of Wharf A to 305 m long, 18 m wide and 14 m deep underwater. This project intends to moor oil tankers. Furthermore, there is a sea berth which is 15 m deep underwater, located at a point about 1.5 km offshore, and this enables to pump out crude oil through pipeline directly to the oil refinery.

(4) Present State of Port Utilization

Since this port has a large-scale quay which is completely equipped with 6 berths, a moorage which was closed by Wharf A can be secured, and due to its complete up-to-date cargo handling equipment, the port has been efficiently utilized. Cargo handling is usually made between 6:00 ~ 19:00 hours. (However, on extra charges, a 24-hour service is made available.) The port has 14 teams of gangs of stevedores.

Due to its position as the only modern harbor of El Salvador and its cargo handling for Guatemala of the annual tonnage of cargoes handled which was 538,000 tons in 1970, rapidly increased to 905,000 tons in 1973. (See Table-2.10.) However, this Table includes no crude oil pumped out at the sea berth. According to actual results of crude oil imported during 1972, it showed that the imported crude oil amounted to 497,000 tons.

Among the import tonnage of 604,000 tons, bulk cargoes were 383,000 tons, according to the 1973 import results, and this sum is overwhelmingly high, accounting for 63.5% of the entire imports. Most of these bulk cargoes are imports of fertilizer and wheat. In general merchandises, on the other hand, fertilizer, paper, industrial goods, iron and steel, automobiles, etc. can be enumerated. Bulk cargoes also gained weight, accounting for 60% (180,000 tons) of export goods which totaled 300,000 tons annually. Among main items of bulk cargoes, sugar ranks first. To cope with these bulk cargoes as stated above, Acajutla Port is very positive as to install the above-stated cargo handling equipment as its investments. (See Table-2.11.)

As the opposite parties of foreign trade, the 1973 results showed the following countries and percentages: the United States (36%), the Netherlands (14%), West Germany (8%) can be named in exportation while in importation, the United States (53%), Japan (16%), the Netherlands (9%), and West Germany (8%) were main countries. Average of the incoming vessels were, according to the 1972 records, of about 5,900 DWT type. The type of tankers moored at the sea berth is approx. 20,000 DWT. (Table-2.13.)

In the second place, the relationship between Acajutla and Guatemala showed results of 58,000 tons of exports and 52,000 tons of imports during 1973 as indicated in Section 2-1. This accounts for about 10 per cent of the total tonnage handled by Acajutla. Main items are raw cotton and cotton seeds in exportation while in importation fertilizer, automobiles, metal goods, etc. This shows that the port is not far away from Guatemala City, but located at a site only 200 km from the capital, and, moreover, a great farm products area of the southern part of Guatemala is near at hand and, compared with other ports on the Pacific of this Republic, Acajutla has the most modernized harbor facilities. These are regarded as favorable factors which have contributed to Acajutla in enjoying its superior position as port.

However, Acajutla has a disadvantage which can be termed as its fate. Due to its port jutting out into the main sea, no matter how advantageous the port may be, it is affected by swellings of heavy surfs which always have been dashing high against the region, and cargo handling cannot necessarily be said as safe, and consequently its cargo handling capacity is compelled to grow low compared with other standard ports. Hence, there is a limit in its capacity after all.

Fig.-2.1 Locations of Ports

Table-2.1 Changes of Volume of Foreign Trade Cargoes (Weight) (Unit: 1,000 tons)

Year	Volume of Trade				Exportation				Importation			
	Total	Sea	Air	Land	Total	Sea	Air	Land	Total	Sea	Air	Land
1961	1,141.0 (100%)	1,042.1 (91.3%)	4.4 (0.4%)	94.5 (8.3%)	378.1 (100%)	313.6 (83.0%)	1.6 (0.4%)	62.9 (16.6%)	762.9 100%	728.5 (95.5%)	2.8 (0.4%)	31.6 (4.1%)
1962	1,120.5 (100%)	1,045.5 (93.3)	10.8 (1.0)	64.2 (5.7)	314.1 (100%)	272.3 (86.7)	2.4 (0.8)	39.4 (12.5)	806.4 100%	773.2 (95.9)	8.4 (1.0)	24.8 (3.1)
1963	1,370.2 (100%)	1,212.1 (88.5)	5.3 (0.4)	152.8 (11.1)	474.2 (100%)	382.0 (80.6)	2.4 (0.5)	89.8 (18.9)	896.0 100%	830.1 (92.7)	2.9 (0.3)	63.0 (7.0)
1964	1,537.5 (100%)	1,301.4 (84.7)	6.7 (0.4)	229.4 (14.9)	465.3 (100%)	314.1 (67.5)	2.6 (0.6)	148.6 (31.9)	1,072.2 100%	987.3 (92.1)	4.1 (0.4)	80.8 (7.5)
1965	1,588.7 (100%)	1,219.6 (76.8)	67.7 (4.2)	301.4 19.0	462.5 (100%)	297.8 (64.4)	1.7 (0.4)	163.0 (35.2)	1,262.2 100%	921.8 (81.8)	66.0 (5.9)	138.4 (12.3)
1966	1,271.9 (100%)	983.2 (77.3)	6.1 (0.5)	282.6 (22.2)	568.7 (100%)	396.2 (69.7)	2.2 (0.4)	170.3 (29.9)	703.2 100%	587.0 (83.5)	3.9 (0.6)	112.3 (15.9)
1967	1,346.3 (100%)	1,001.0 (74.4)	6.8 (0.5)	338.5 (25.1)	547.0 (100%)	373.6 (68.3)	2.9 (0.5)	170.5 (31.2)	799.3 100%	627.4 (78.5)	3.9 (0.5)	168.0 (21.0)
1968	1,342.9 (100%)	896.0 (66.6)	18.2 (1.4)	431.0 (32.0)	611.4 (100%)	404.2 (66.1)	4.3 (0.7)	202.9 (33.2)	733.8 100%	491.8 (67.0)	13.9 (1.9)	228.1 (31.1)
1969	1,402.5 (100%)	857.1 (61.1)	21.1 (1.5)	524.3 (37.4)	713.2 (100%)	453.1 (63.5)	6.3 (0.9)	253.8 (35.6)	689.3 100%	404.0 (58.6)	14.8 (2.1)	270.5 (39.3)
1970	1,533.1 (100%)	923.1 (60.2)	10.2 (0.7)	599.8 (39.1)	782.7 (100%)	486.9 (62.2)	5.4 (0.7)	290.4 (37.1)	750.4 100%	436.2 (58.1)	4.8 (0.7)	309.4 (41.2)
1971	1,635.3 (100%)	1,119.4 (68.5)	16.6 (1.0)	499.3 (30.5)	817.4 (100%)	559.7 (68.5)	5.9 (0.7)	251.8 (30.8)	817.9 100%	559.7 (68.4)	10.7 (1.3)	247.5 (30.3)
Growth Ratio 71/61	1.43	1.07	3.77	5.28	2.15	1.78	3.69	4.00	1.07	0.77	3.82	7.83
71/66	1.11	0.94	1.39	2.99	1.50	1.41	1.38	2.71	0.92	0.81	1.39	3.55

Data: 107)

Table-2.2 Volume of Cargoes Handled by All Ports

(Unit: Ton)

Year	1969	1970	1971	1972	1973
Exportation	472,270	492,606	571,721	657,591	761,082
San José	47,695	37,798	28,833	37,260	46,294
Champerico	80,971	51,560	58,131	77,340	66,196
Via Acajutla	300	1,000	4,665	21,838	58,480
(Pacific Coast)	128,966	90,358	91,629	136,438	170,970
Puerto Barrios	212,662	257,609	288,592	326,896*	364,864*
Santo Tomas	130,642	144,639	191,500	194,257	225,248
(Carib. Coast)	343,304	402,248	480,092	521,153	590,112
Importation	448,738	573,677	558,967	550,442	680,782
San José	76,158	85,583	75,129	57,884	77,321
Champerico	49,942	56,043	43,773	40,855	50,261
Via Acajutla	32,000	48,000	49,517	73,535	51,461
(Pacific Coast)	158,100	189,626	168,419	172,274	179,043
Puerto Barrios	88,270	117,637	109,411	126,704*	137,286*
Santo Tomas	202,368	266,414	281,137	251,464	364,453
(Carib. Coast)	290,638	384,051	390,548	378,168	501,739

Note: Cargoes handled via Acajutla in 1969, 1970 and via Puerto Barrios in 1972, 1973 are estimated values.

This table includes no imports of crude oil.

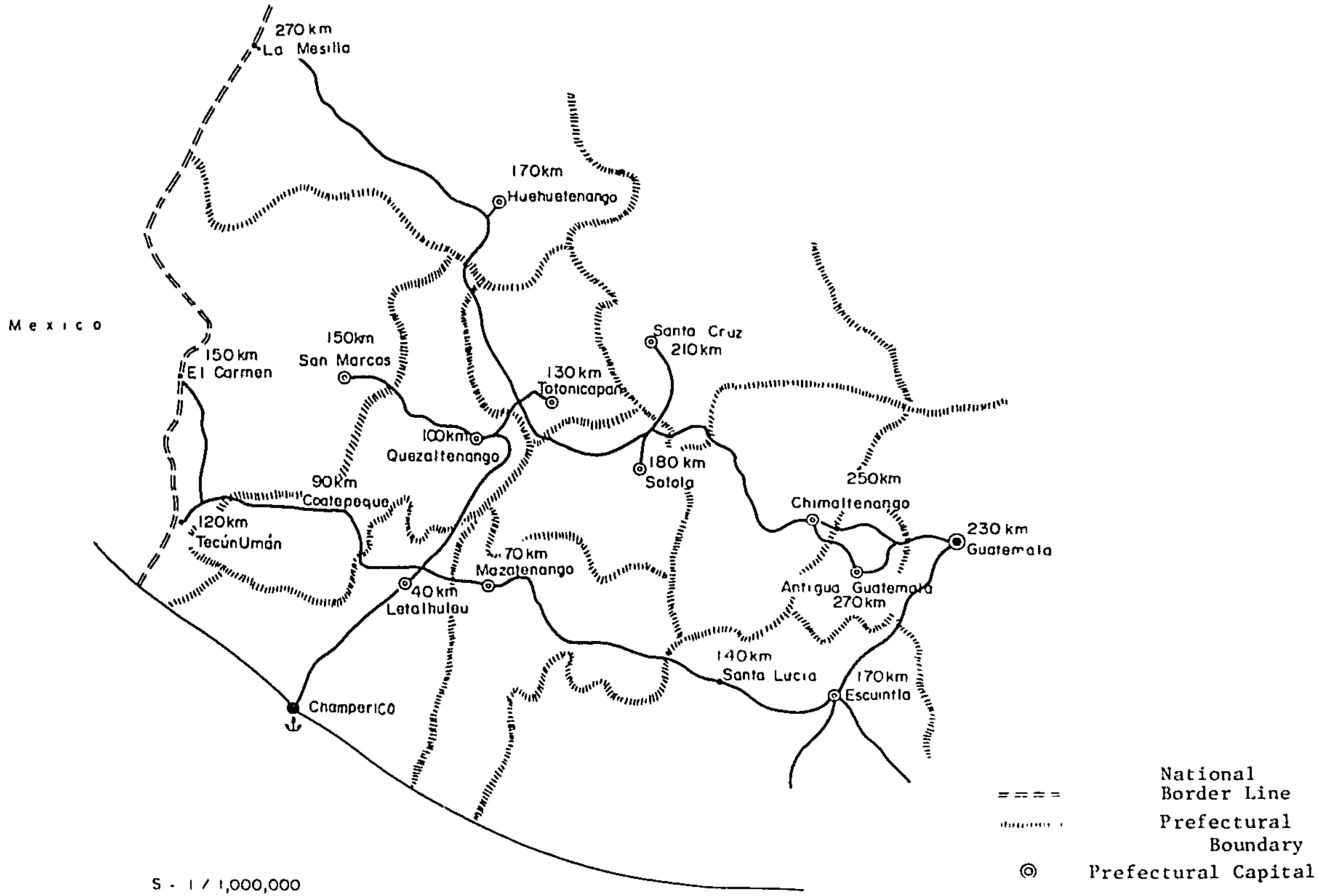


Fig.-2.2 Distances by Roadways Between Champerico and Principal Cities Data: 206)

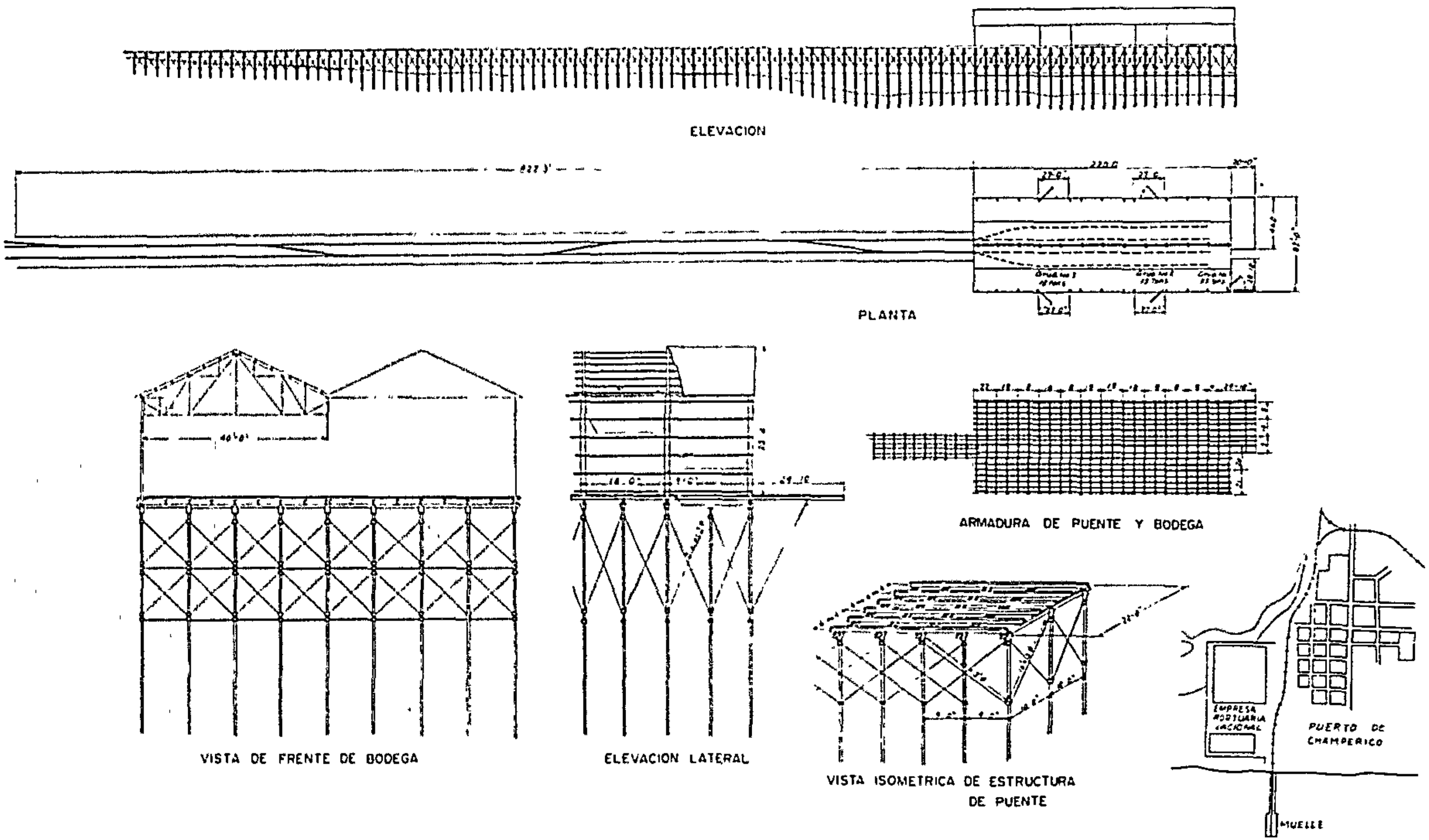


Fig.-2.3 Champerico Port Facilities

Table-2.3 Volume of Cargoes Handled by Cahmperico Port

(Unit: Ton)

Year	1969	1970	1971	1972	1973
Exportation	80,971	51,560	58,131	77,340	66,196
Coffee	5,757	4,008	5,602	5,545	2,862
Raw cotton	59,453	42,470	49,412	69,147	60,716
Cotton linter	10,521 3,507	7,815 2,605	0 0	1,134 378	0 0
Sesame Seeds	547	505	1,990	2,012	2,242
Banana	-	-	-	-	-
Sugar	-	-	-	-	-
Meat	-	-	-	-	-
Miscellaneous	11,707	1,972	1,127	258	376
Importation	49,942	56,043	43,773	40,855	50,261
Farm/Marine products, Foodstuffs	8,912	8,783	5,726	4,210	1,788
Fertilizer	25,078	27,721	31,474	30,829	39,398
Industrial Raw Materials	12,750	3,480	3,073	578	6,334
Metal-Goods	80	4	-	34	0
Automobiles	30	422	-	2	4
Miscellaneous	3,092	15,633	3,500	5,202	2,737
Total Exportation and Importation	130,913	107,603	101,904	118,195	116,457

Data: 201)

Table-2.4 Exportation & Importation by Ships' Nationalities
(Champerico Port, 1972)

E x p o r t a t i o n

Order	Ships' Nationality	Number of Ships	Ave. Type of Ships
1	Liberia	22	4,679 G/T
2	Japan	16	5,030
3	Yugoslavia	9	4,390
4	Norway	7	6,020
5	Italy	7	5,103
6	Greece	5	4,518
Total		108	4,552

I m p o r t a t i o n

Order	Ships' Nationality	Number of Ships	Ave. Type of Ships
1	West Germany	10	4,937 G/T
2	Greece	5	4,518
3	Norway	7	6,020
4	Liberia	22	4,679
5	Panama	3	1,721
12	Japan	16	5,030
Total		108	4,552

Data: 202)

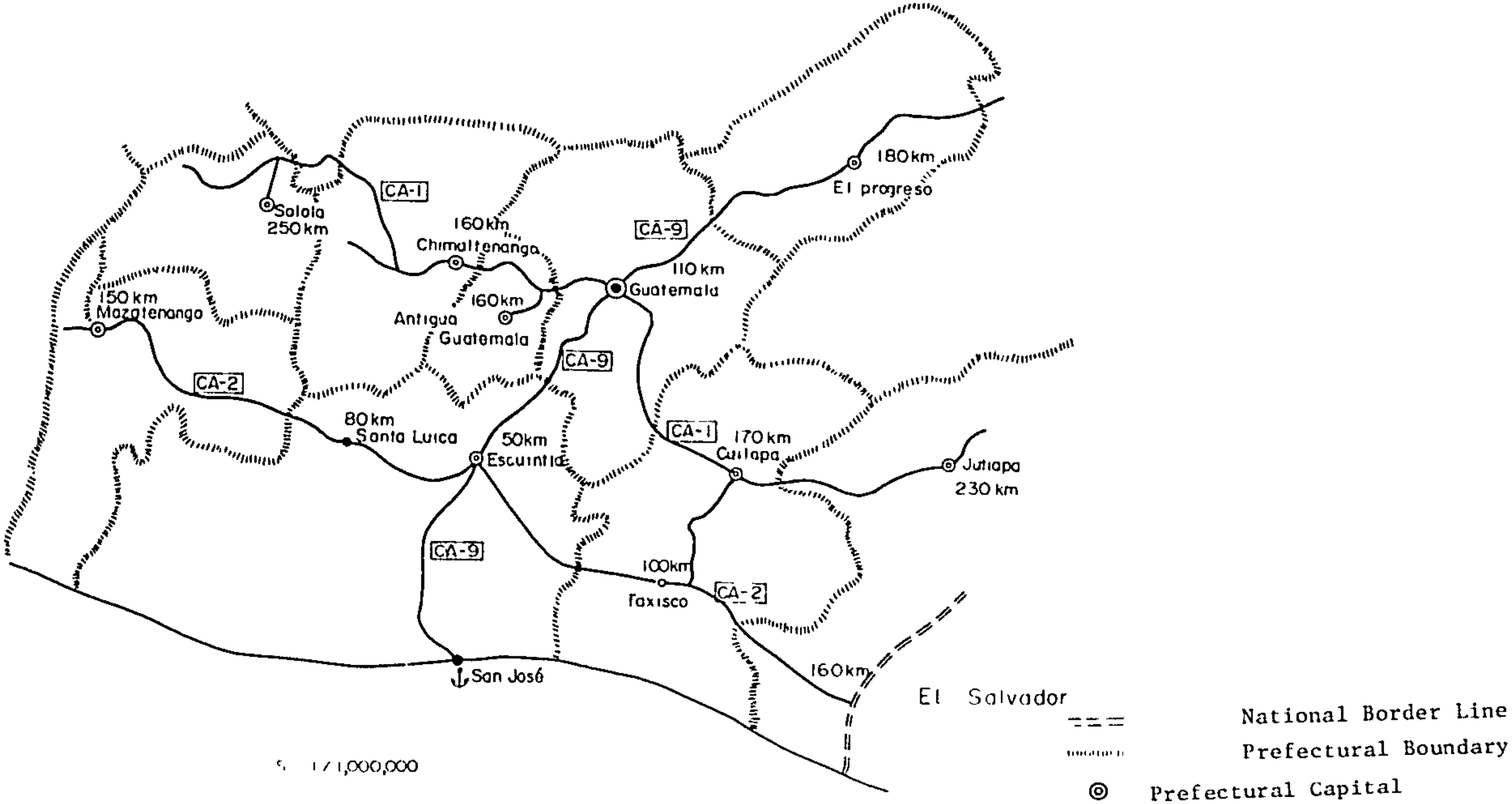


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Fig.-2.4 Distances by Roadways from San José to Principal Cities

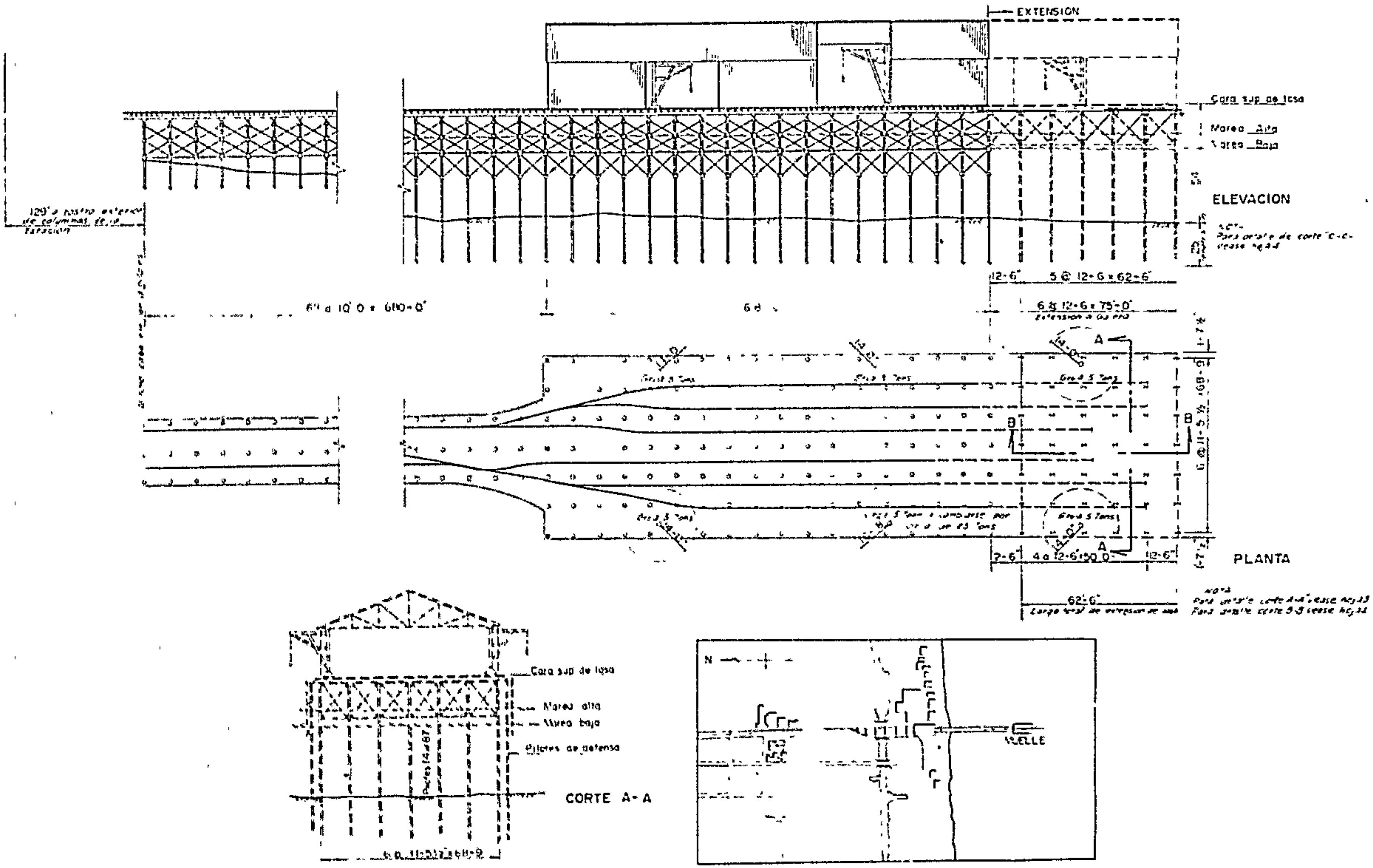

Fig.-2.5 San José Port Facilities

Table-2.5 Volume of Cargoes Handled by San José Port

(Unit: Ton)

Year	1969	1970	1971	1972	1973
Exportation	47,695	37,798	28,833	37,260	46,294
Coffee	15,011	14,999	12,960	15,043	12,054
Raw Cotton	19,036	13,576	5,420	7,678	16,068
Cotton Linter	6,112	5,102	5,822	10,397	13,248
Sesame Seeds	100	159	1,054	1,083	1,249
Banana					
Sugar					
Meat					
Miscellaneous	7,436	3,962	3,577	3,059	3,675
Importation	76,158	85,583	75,129	57,884	77,321
Farm/Marine Products	751	1,391	895	1,604	892
Fertilizer	3,761	4,910	6,273	2,129	2,481
Industrial Raw Materials	7,154	14,348	13,680	12,861	18,889
Metal Goods	40,148	36,163	31,461	23,090	36,564
Automobiles	2,303	3,102	1,488	161	191
Miscellaneous	22,041	25,669	21,332	18,039	18,304
Total Exportation & Importation	123,853	123,381	103,962	95,144	123,615

Data: 203)

Table-2.6 Exportation and Importation by Ships' Nationalities
(San José port, 1972)

E x p o r t a t i o n

Order	Ships' Nationality	Number of Ships	Ave. Type of Ships
1	Greece	6	5,582 G/T
2	Japan	51	4,996
3	West Germany	25	4,576
4	Liberia	16	8,232
5	Ecquador	10	5,655
6	Nicaragua	5	1,159
Total		196	5,383

I m p o r t a t i o n

Order	Ships' Nationality	Number of Ships	Ave. Type of Ships
1	Liberia	16	8,232 G/T
2	Norway	9	9,014
3	The Netherlands	8	8,336
4	Japan	51	4,996
5	Panama	7	5,852
6	Columbia	23	26,566
Total		196	5,383

Data: 202)

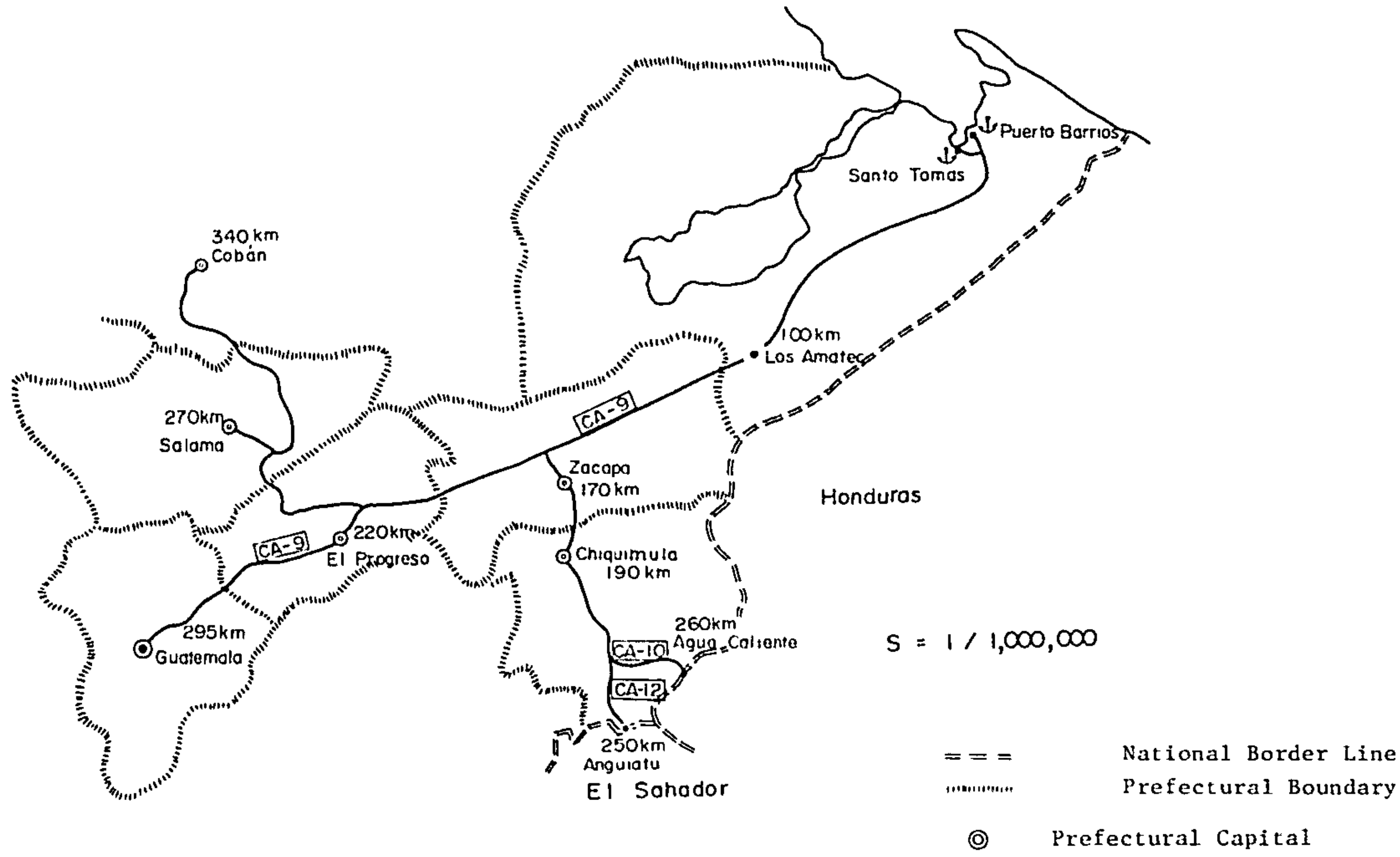

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Fig.-2.6: Distances by Roadways from Puerto Barrios and Santo Tomas to Principal Cities.

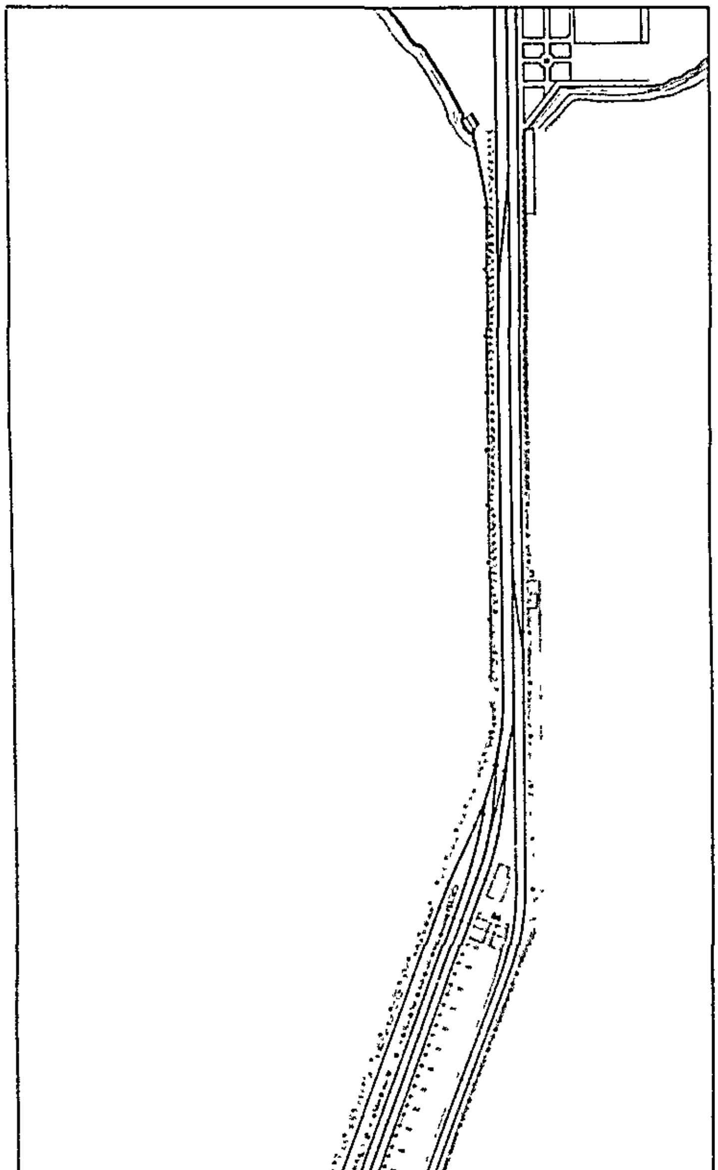

Fig.-2.7 Puerto Barrios Port Facilities

Table-2.7 Exportation and Importation by Ships' Nationalities
(Puerto Barrios, 1972)

Exportation			
Order	Ships' Nationality	Number of Ships	Ave. Type of Ships
1	Britain	91	1,593 G/T
2	Greece	18	3,865
3	West Germany	45	2,229
4	The Netherlands	42	2,441
5	Panama	87	1,069
Total		510	1,931

Importation			
Order	Ships' Nationality	Number of Ships	Ave. Type of Ships
1	West Germany	46	2,210 G/T
2	Panama	88	1,069
3	Norway	31	1,293
4	Britain	90	1,561
5	Greece	17	3,732
Total		511	1,912

Data: 202)

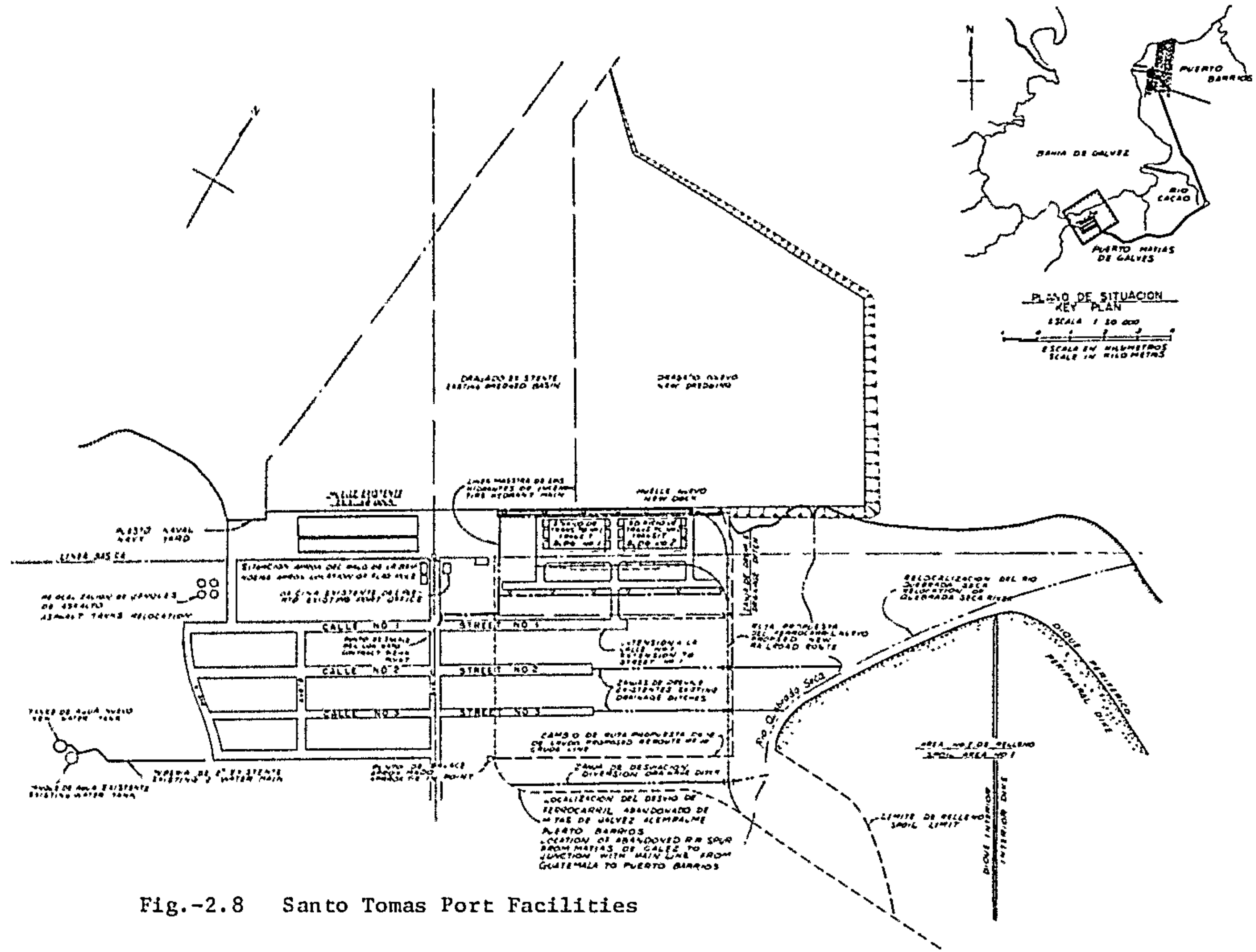

Fig.-2.8 Santo Tomas Port Facilities

Table-2.8 Volume of Cargoes Handled by Santo Tomas Port

(Unit: Ton)

Year	1969	1970	1971	1972	1973
Exportation	130,642	144,639	191,500	194,257	225,248
Coffee	55,760	53,657		88,912	94,536
Raw Cotton		1,103			
Cotton Linter	1,113	645			
Sesame Seeds	2,971	2,703			
Banana		109			
Sugar	20,754	33,105		24,672	34,575
Meat	19,058	22,025		24,857	17,975
Miscellaneous	30,986	31,292		55,815	75,162
Importation (Incl. no crude oil)	202,368	266,414	281,137	251,464	364,453
Farm/Marine Products	8,986	10,518		37,458	84,746
Fertilizer	4,860	4,413		2,251	2,112
Industrial Raw Materials	68,366	110,757		71,789	84,086
Metal Goods	32,728	29,277		43,291	57,471
Automobiles	13,441	15,343		17,605	19,175
Miscellaneous	73,987	96,106		79,070	116,863
Imported Crud Oil	366,003	324,129*	383,489	353,598	412,411
Total Importation	568,371	590,543	664,626	605,052	776,864
Total Import & Export	699,013	735,182	856,126	799,319	1,002,112

NOTE: * means estimated value.

Data: 204)

Table-2.9 Exportation & Importation by Ships' Nationalities
(Santo Tomas Port, 1972)

Exportation			
Order	Ships' Nationality	Number of Ships	Ave. Type of Ships
1	Britain	109	1,756 G/T
2	West Germany	48	3,308
3	Panama	86	921
4	Greece	35	3,852
5	The Netherlands	30	3,674
Total		523	2,251

Importation			
Order	Ships' Nationality	Number of Ships	Ave. Type of Ships
1	The Netherlands	32	3,906 G/T
2	Norway	29	1,785
3	Liberia	34	2,607
4	Britain	107	1,796
5	Chipriota	6	4,547
Total		523	2,251

Data: 202)

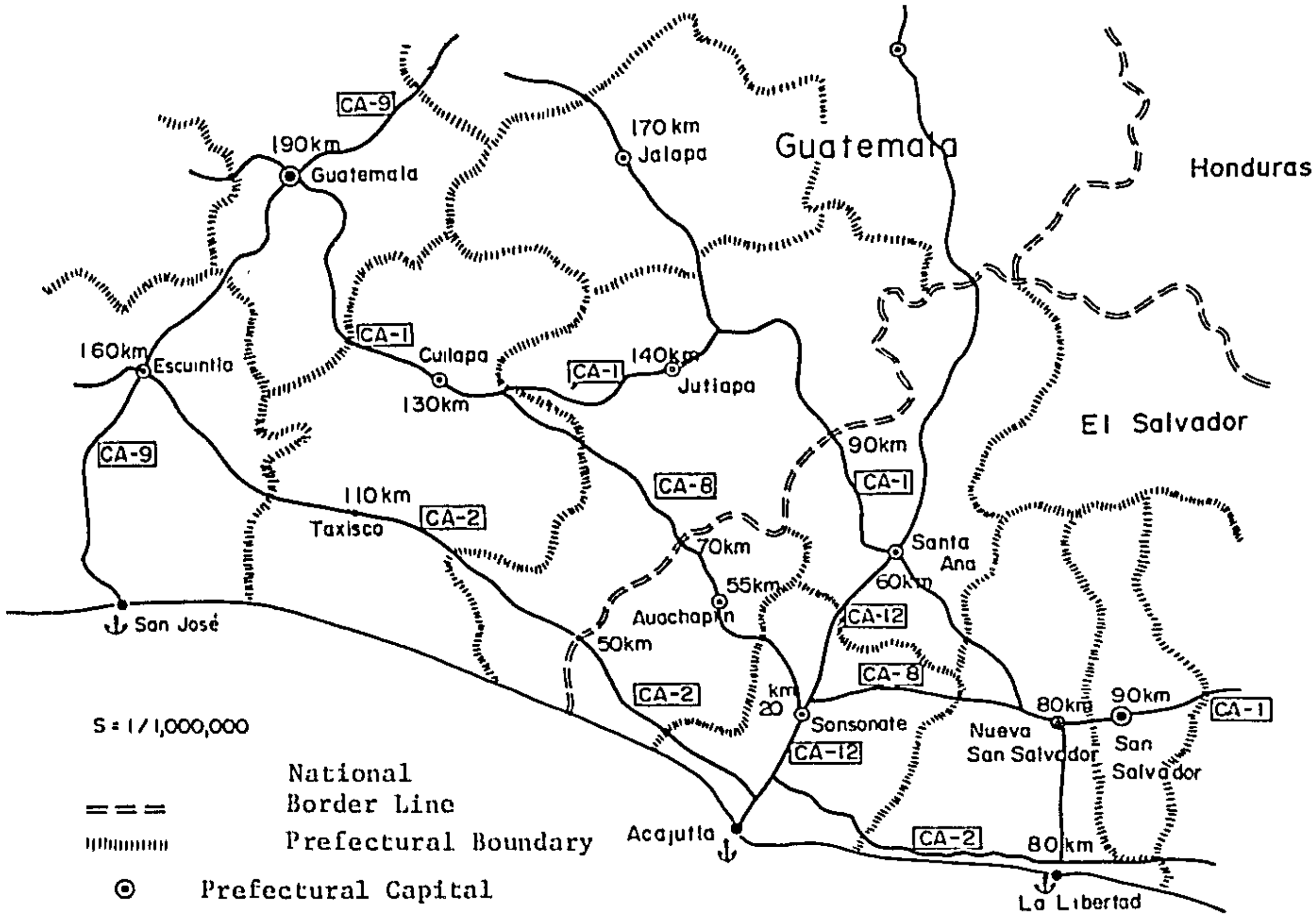

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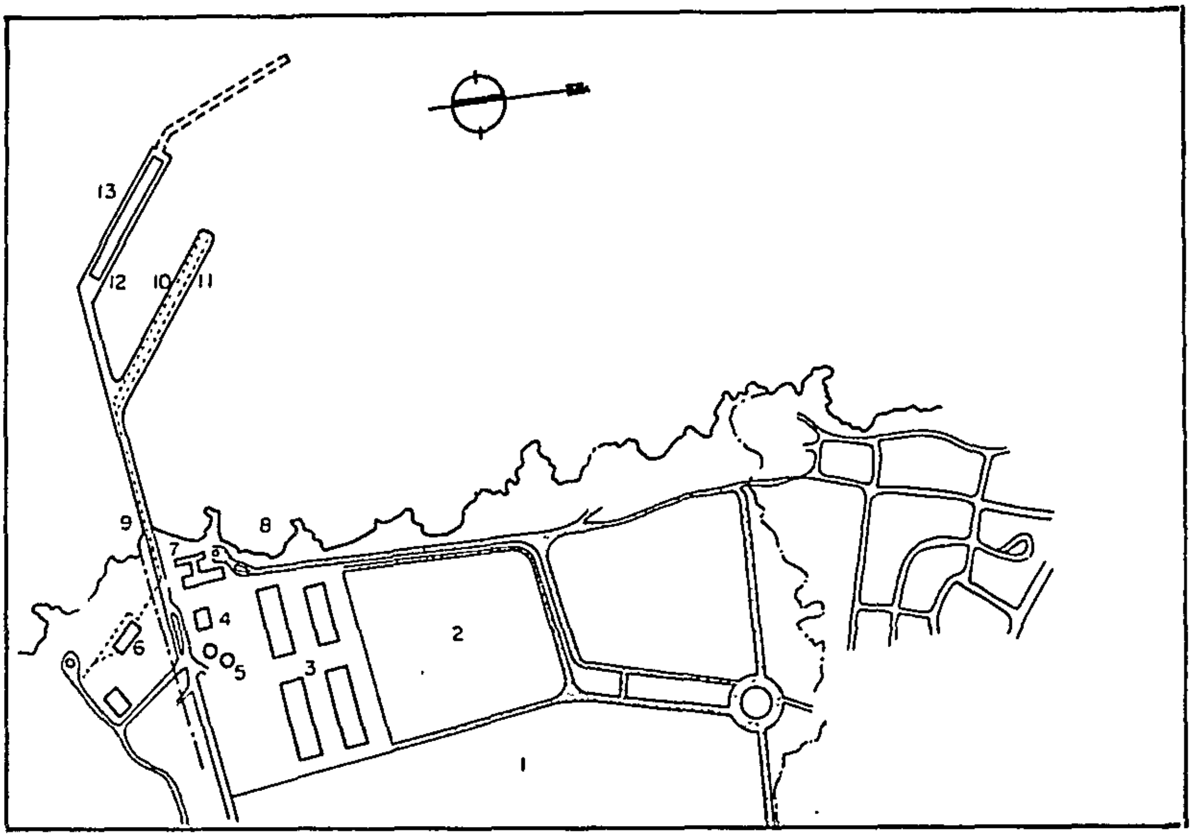
Fig.-2.9: Distances by Roadways from Acajutla to Principal Cities



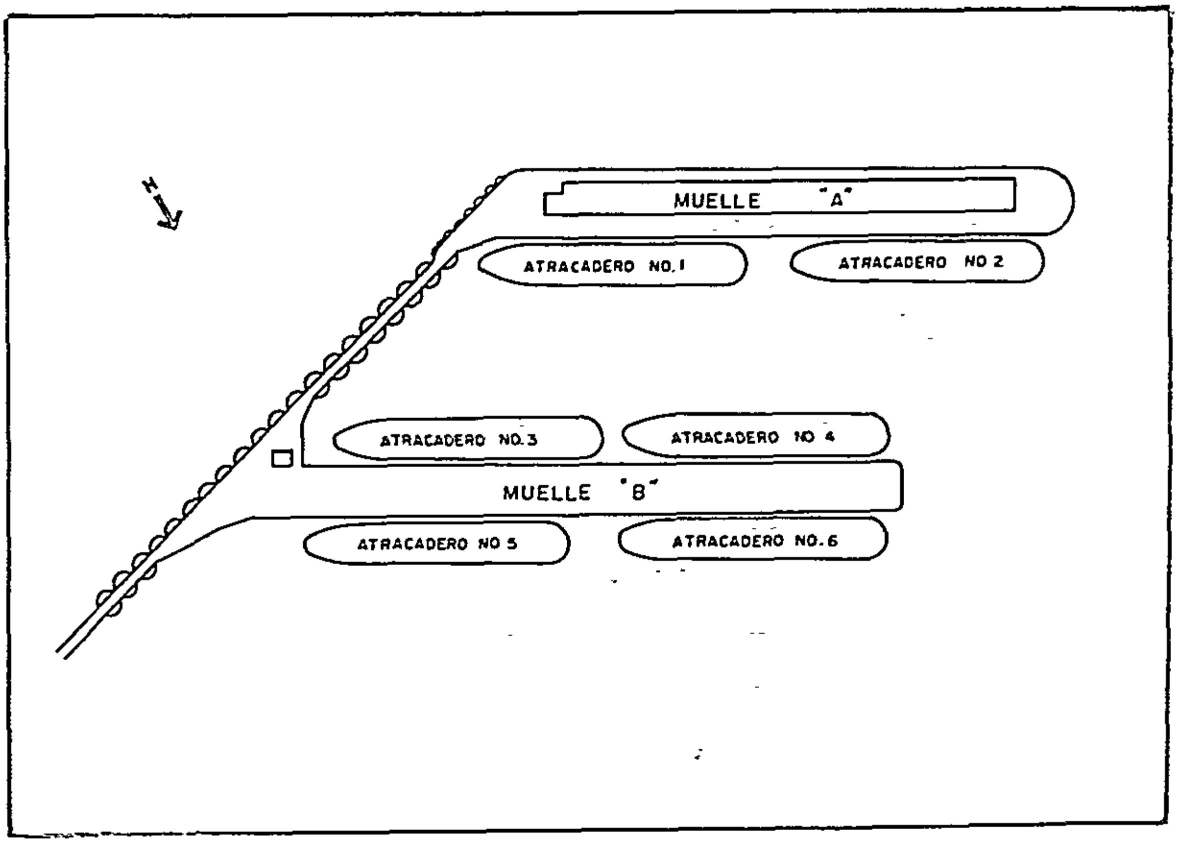


Fig.-2.10: Acajutla Port Facilities

Table-2.10 Changes of Volume of Cargoes Handled by Acajutla Port

(Unit: Ton)

Year	Grand Total	Importation				Exportation			
		General	Bulk	Liquid	Total	General	Bulk	Liquid	Total
1961	27,400	10,565	7,812	-	18,377	9,023	-	-	9,023
1962	138,500	43,926	62,135	-	106,061	32,439	-	-	32,439
1963	194,800	62,852	61,175	7,000	131,027	63,773	-	-	63,773
1964	291,967	123,552	67,399	3,586	194,537	57,539	28,586	11,305	97,430
1965	376,134	160,740	82,759	10,856	254,355	52,777	39,055	29,947	121,779
1966	390,489	169,425	61,685	5,766	236,876	50,265	67,078	36,270	153,613
1967	361,380	159,278	74,282	13,177	246,737	56,902	44,174	13,567	114,643
1968	535,044	182,300	124,163	21,482	327,945	63,225	98,870	45,004	207,099
1969	543,705	166,627	162,116	19,746	348,489	76,813	101,594	16,809	195,216
1970	537,670	202,543	142,555	14,249	359,347	74,360	67,049	36,914	178,323
1971	669,542	200,351	254,637	11,698	466,686	51,013	123,012	28,831	202,856
1972	816,986	193,542	263,234	19,250	476,026	117,173	184,509	39,278	340,960
1973	904,804	201,063	382,593	20,702	604,358	85,095	180,046	35,305	300,446

Data: 205)

NOTE: The table include no crude oil unloaded by the sea berth (497,000 tons in 1972).

Table-2.11 Tonnages of Cargoes Handled Classified by Items by Acajutla Port (1973)

Importation			Exportation		
Item	Tonnage (Ton)	Percentage (%)	Item	Tonnage (Ton)	Percentage (%)
1. General Merchandise	201,063	33.3	1. General Merchandise	85,095	28.3
Agricultural & Marine Products	5,261	0.9	Coffee	51,405	17.1
Fertilizer	59,158	9.9	Raw Cotton	5,237	1.7
Industrial Raw Materials	4,552	0.7	Cotton Linter	4,551	1.5
Metal Goods	66,250	10.9	Other Farm Products	5,035	1.7
Automobiles	11,686	1.9	Sugar	-	0.0
Miscellaneous	54,156	9.0	Meat	190	0.1
2. Bulk Cargoes	382,593	63.3	Miscellaneous	18,677	6.2
Agricultural & Marine Products	146,082	24.2	2. Bulk Cargoes	180,046	59.9
Fertilizer & Raw Materials for Fertilizer	236,516	39.1	Sugar	99,249	33.0
3. Various Liquied Products	20,702	3.4	Miscellaneous	80,797	26.9
			3. Various Liquid Products	35,305	11.8
Total	604,358	100.0	Total	300,446	100.0

Data: 205)

Table-2.12 Tonnages of Cargoes Handled by Acajutla Port, Classified by Countries

Importation			Exportation		
Country	Tonnage (Ton)	Percentage (%)	Country	Tonnage (Ton)	Percentage (%)
U. S. A.	317,338	52.51	U. S. A.	109,568	36.47
Japan	95,969	15.88	The Neter-lands	41,243	13.73
The Nether-lands	56,099	9.28	Denmark	39,639	13.19
West Germany	48,491	8.02	West Germany	23,807	7.92
Belgium	35,222	5.83	U.S.S.R.	22,792	7.59
Canada	16,669	2.76	Malaysia	11,600	3.86
Mexico	10,586	1.75	Marruecos	9,814	3.27
C. American Countries	6,651	1.10	Mexico	7,081	2.36
Miscellaneous	17,333	2.87	C. American Countries	5,485	1.92
			Japan	4,848	1.61
			Miscellaneous	24,569	8.09
Total	604,358	100.00	Total	300,446	100.00

Data: 205)

Table-2.13 Number of Incoming Vessels & Average Type of Ships (Acajustla Port, 1972)

Type of Ships	1972
General Cargo Ship	349
Bulk Carrier	63
Oil Tanker	14
Multi-purpose Ship	20
Total Number of Incoming Ships	446
Total Tonnage of Incoming Ships	2,626,843 D/W
Average Size of Ships	5,889.8 D/W

Data: 205)

Note: Vessels utilizing the Sea Berth (aver. 20,000 D/W) are not included.

CHAPTER 3. NECESSITY FOR NEW PORT AND SITE OF CONSTRUCTION

Chapter 3. Necessity for New Port and Site of Construction

3-1 Future Demand for Ports on the Pacific Coast

(1) Method of Estimation

In order to study the scales of ports needed in 1980, the demand for export and import cargoes at ports on the Pacific coast is estimated. In undertaking estimation, the following points need be taken into consideration:

a) Estimates of export and import volumes should be made by principal items and study of the propriety of the future demand for ports with respect to line up of items should be made.

b) Because of the shortage of period during which reliable real data have been made available, study should be made also from the macroscopic viewpoint.

c) As no unified statistics related to volumes of cargoes handled at various ports are available in the country and as what are available are diverse in unit values, statistics should be unified in metric tons.

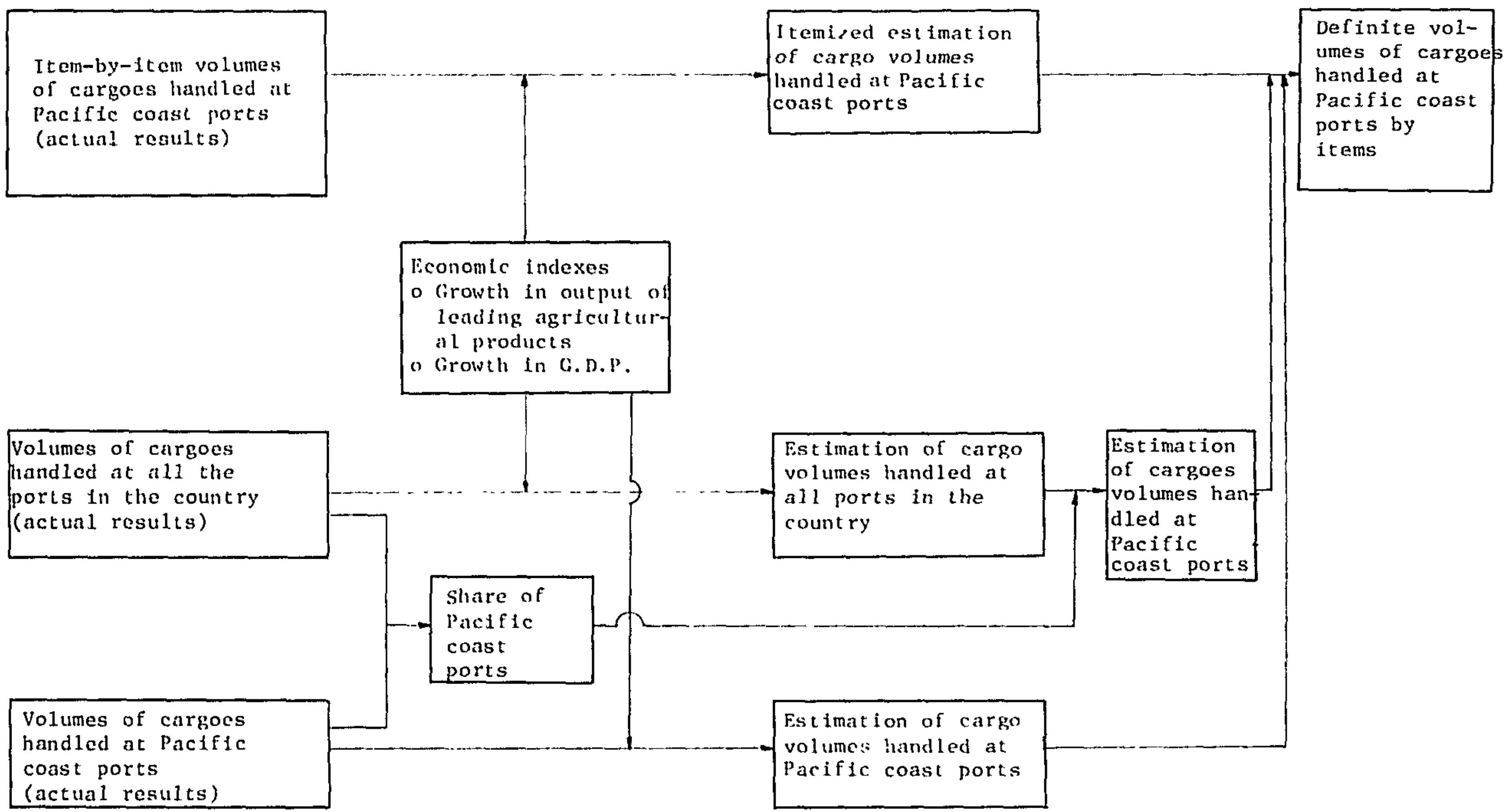
d) Of the export and import cargoes, crude oil is now handled at a sea berth near San José, and in view of the unlikelihood of handling oil at general ports also in the future, this should be excluded from estimation.

In consideration of the above points, the method of estimation shown in Fig. 3-1 has been adopted. In this method, volumes of cargoes handled at the ports on the Pacific coast are estimated by items on the basis of the anticipated expansion of the scale of economic activities and increase of agricultural production in the country. The result of estimation is then checked against the volume of cargoes distributed to the Pacific coast from the total future volume of cargoes handled at the all ports in the country or against the total volume of cargoes handled on the Pacific coast as estimated from past tendency. The final estimation is made on the basis of data obtained from the above procedure.

(2) Estimation of Cargo Volumes by Items

With respect to principal items handled in the various ports on the Pacific coast, exports are classified into five items, including coffee, cotton, cotton linter, seed (cotton seed and sesame seed) and other cargoes, while imports are classified into six items, including agricultural and fishery products, fertilizer, industrial raw materials, metal products, motorcars and other cargoes. Also, the annual growth rate (real) of GDP between 1973 and 1980 is estimated at 7 per cent. Estimates by principal items are given below.

Fig. 3.1 Flow chart for cargo volume estimation



Exports

Coffee

From the time series equation of output y=9,370 x -532,000 (r=0.982), the 1980 output would be y80=218,000 tons, the 1980 output/1973 output would be y80/y73=1.42 times.
The 1980 export volume against the 1973 export volume would be 15,000 tons x 1.42 = 21,000 tons.

Cotton

From the time series equation of output y=7,170 x 438,000 (r=0.768), the 1980 output would be y80=136,000 tons, and the correlative equation between output and exports would be y=0.648 x + 22.20 (r=0.794) where y = exports in 1000 tons and x = output in 1000 tons. Consequently, the 1980 exports would be y80=110,000 tons.

Cotton linter

The correlative equation of output and exports would be y=0.171 x -2.78 (r=0.886) where y=exports in 1000 tons and x=output in 1000 tons. Using the above 136,000 tons for 1980 output of cotton, the 1980 exports would be y80=21,000 tons.

Seed

From time series equation of output y=11,600 x -707,000 (r=0.750) the 1980 output would be y80=224,000 tons and the correlative equation between the output and exports would be y=0.883 x -86.62 (r=0.881) where y=exports in 1000 tons and x=output in 1000 tons.
Consequently, the 1980 exports would be y80=111,000 tons.

Other export cargoes

Assuming average annual growth ratio of GDP to be 7%, the 1980 export volume would be 11,000 tons.

Imports

Fertilizer

The time series equation obtained from the total output of coffee and cotton would be

y=16,500 x 970,000 (r=0.927).

The 1980 output would then be

y80=354,000 tons.

On the other hand correlative equation between fertilizer import volume and the total output of coffee and cotton would be y=0.336x + 1,174.21 (r=0.755),
where y=imports in tons and x=output in tons.
Consequently, the 1980 import volume would be 120,000 tons.

Assuming that the annual growth ratio of imports other than fertilizer, such as agricultural and fishery products, industrial materials, metal products, motorcars and others, would be the same as that of GDP, they would be respectively 16,000 tons, 41,000 tons, 60,000 tons, 9,000 tons and 37,000 tons.

As a result, cargoes handled in 1980 at the ports on Pacific coast would total 557,000 tons.

(3) Macroscopic Estimation

Let us first see about correlative equations between cargoes handled at the Pacific ports and GDP.

$$y \text{ tons} = 134.4x + 39,400 \qquad (r=0.773)$$

When the 1980 GDP of 3,509 million quetzals is substituted,

$y80$ = 511,000 tons are obtained.

The next would be the correlative equation between the volume of cargoes handled at all the ports of the country and GDP.

$$y \text{ tons} = 959.9x - 686,800 \qquad (r=0.983)$$

When the 1980 GDP of 3,509 million quetzals is substituted,

$y80$ = 2,681,000 tons are obtained.

The share of Pacific ports in the volume of cargoes handled against the whole country could be estimated 24.3% on the basis of actual result in 1973. Therefore,

$$2,681,000 \times 0.243 = 651,000 \text{ tons}$$

(4) From the foregoing results, as shown in Fig. 3.1 , the item-by-item estimation of the volumes of cargoes handled at the ports is appropriate in scale. The result is adopted as the demand for ports on the Pacific coast of Guatemala in 1980.

Table 3.1 Estimate of cargoes handled at Pacific ports in 1980

3-2 Necessity for New Port

(1) As stated in Chapter 2, San José and Champerico on the Pacific coast of Guatemala are provided with super-annuated wharves and other facilities, and in order to continue with the use of these ports, repairs almost to the new condition are urgently needed. Under the situation, clarification of the desired state of ports on the Pacific coast of Guatemala is required as early as possible.

(2) Also as stated in Chapter 2, the present state of things necessitates unloading of cargoes from the ship to the lighter in the open sea without any shelter and then unloading again on to the wharf. This method requires enormous time and cost in stevedoring; it is also accompanied with serious danger and results in unneeded cargo damages.

Table 3 - 1 Estimate of cargo volumes handled at Pacific ports in 1980

(Unit: 1,000 Tons)

	1973 Results	1980 Estimates
(Exports)		
Coffee	15	21
Cotton	77	110
Linter	13	21
Seed	59	111
Others	7	11
Sub-total	171	274
(Imports)		
Agricultural, Fishery products	10	16
Fertilizer	78	120
Industrial raw materials	26	41
Metal products	37	60
Motorcars	5	9
Others	23	37
Sub-total	179	283
Grand Total	350	557

Under such a method, handling of heavy cargoes or bulk cargoes is extremely difficult. For these reasons, ports where safe and efficient stevedoring can be done are extremely desired.

(3) While major economic activities distribution, especially agricultural production and population gravitate towards the Pacific region of Guatemala, no efficient ports are available in the region. For this reason, cargoes imported to and exported from this region had to be transported over long land to the Atlantic coast ports, Santo Tomas and Puerto Barrios. Much also has been dependent on the Port of Acajutla in the neighboring country. In the circumstances, correction of such physical distribution structure and construction of modern ports on the Pacific coast are conditions indispensable to the development of Guatemala.

(4) Meanwhile, as stated in 3-1, volumes of cargoes handled at the Pacific ports have shown growth of 6.8% subsequent to 1973, excluding imports of crude oil. The total cargo handled is estimated to reach 557,000 tons by 1980. However, as the capacity of each existing port on the Pacific coast is estimated to be no more than 130,000 tons at best because of natural conditions and cargo handling system available, it would be necessary, if things are left in the present state, to depend on the Port of Acajutla in the neighboring country for handling more than half the foreign trade. It would naturally give a heavy influence to the port activities of Acajutla. Furthermore, as the increase of cargoes handled at the ports is considered no less than 5% in the long-range view, the volume, even under conservative estimate, is likely to reach 1,500,000 tons by 2000. It, therefore, becomes very necessary to construct modern ports on the Pacific coast.

(5) While shrimps and other marine products are abundant in the coastal water along the Pacific coast of Guatemala, no safe ports are available for fishing boats to take shelter when the sea gets rough. In the circumstances, small-scale fishing operations are now continued, making inefficient and even risky use of ports, including Champerico. Construction of new ports with adequately consolidated facilities is necessary for making effective use of the abundant marine resources and for full-dress promotion of fisheries in Guatemala.

In consideration of the foregoing points, conclusion has been reached to the effect that construction of new modern port the long-range view, on the Pacific coast of Guatemala would be necessary.

3-3 Selection of Site for New Port

Any new port that will be constructed on the Pacific coast of Guatemala must play the leading role in the country's foreign trade for a long time. It also has the important role of promoting the development of the Pacific region. For these reasons, comprehensive study of the conditions, such as the natural conditions, transportation conditions and possibilities of regional development of the Pacific coast must be made in selecting the site of a new port.

(1) Studies Related to Port Location

For the new port, it is desirable to select a site where a large scale port can be developed for a long time and also to promote the intensive development of port there, without dividing the work into more than two locations. This is premised largely on the following reasons:

a) Formation of an international marine transportation network aims at linking few base ports with larger pipes. In this sense, it is not practical to locate more than two base ports along the pacific coast which extends for no more than 300 kilometers.

b) In order to make the port function as an attractive international trade center, it is necessary to promote intensive accumulation of high-order port functions.

c) Largely from natural conditions, ports to be constructed on the Pacific coast of Guatemala will require large initial investment for basic facilities. On the other hand, funds needed for subsequent expansion of the port capacity would be comparatively small. The scale merit of investment, therefore, can be taken advantage of.

d) The scale of demand is such that one port could serve adequately even under the long-range view. The estimated demand, however, does not include situations not anticipatable at this stage, such, for instance, as the need for larger-scale shipping facilities arising from discovery of some new mineral resources.

(2) Studies from Natural Conditions

While details of natural conditions about the Pacific coast of Guatemala will be given in Chapter 4, the following points are considered with respect to the site of new port:

a) The coast line of this region is a long sandy coast describing an gentle S-shaped curve from northwest to southeast. No inlets or bays sheltered from the outer sea are found here so that any site suitable for good natural port location is out of question. Also, while a number of rivers empty into the Pacific Ocean, they are all rapidly flowing rivers and offer no estuary of stabilized form and sustained depth. In the circumstances, development of a port making use of a river mouth is difficult.

b) No accurate observation data related to waves, which constitute the most basic sea conditions, are available but it has been found, after detailed studies, that the wind waves come more frequently from southeast but swells from southwest. No conspicuous difference is seen in these conditions for the entire coast line and these are not considered to become a potent factor in selecting the port site.

c) The topographical conditions differ between eastern and western parts of the coast line, with River Coyolate as the boundary line. The number of rivers is large in the western coast but it is small in the eastern coast. In the eastern coast, also, a natural canal approximately parallel to the coast line is formed, reflecting differences in the relative influence of rivers and the sea due to differences in slope of land and rainfall between the eastern and western parts of the coast. From such points, the eastern coast is considered more stabilized in the macroscopic coastal topography.

d) The predominant direction of drift sand on the Pacific coast of Guatemala is estimated to be from slightly east to westerly direction, but as the influence of the rivers is dominant as the source of drift sand, the drift sand at the estuaries of more forceful rivers appears to shift in the right and left directions in about equal amounts. As a consequence, the site of port construction should preferably be located far away from such forceful rivers as Samala, Nahualate, Coyolate, Achiguate and Maria Linda.

e) As a result of studies made as above, the site desirable for constructing new port as judged from natural conditions is the coast east of Iztapa or the Sipacate coast. The former is located just about midway between Esclavos and Maria Linda rivers, while the latter, between Achiguate and Coyolate rivers, which are very influential rivers. The distance between the river mouths, moreover, is more than 40 kilometers, the farthest from the rivers on the Pacific coast.

(3) Studies from Economic and Social Conditions

The following four sites should be investigated. Two are the coast east of Iztapa and the Sipacate coast, which have been chosen as result of studying natural conditions. The rest are San José and Champerico, which are existing ports and also have been mentioned as candidates in the past studies.

a) Accessibility to Cargo Originating and Consuming Areas

The location of the new port should preferably be easily accessible to the export cargo originating areas and import cargo consuming areas. As San José and Sipacate are located just about in the middle of the Pacific coast, they have advantage over the other two sites in this respect. Champerico is located too far west, while Iztapa is located too far east. San José has some advantage in accessibility to the capital of the country, but Sipacate is more easily accessible to agricultural export goods producing areas.

b) Transportation Facilities

While the new port should be able to make use of existing transportation facilities to the full in the early stages, it should also be accessible to future transportation systems of the land in the long-range view. The three localities other than the coast east of Iztapa have direct access to the two-lane paved highway, which can be utilized without trouble for the time being. San José and Champarico also have access to the railway, but it is of superannuated narrow-gauge railway which can hardly be considered as a marked advantage in cargo shipping.

c) Utilization of Land at Construction Site

As the new port is to be developed successively and is ultimately to give rise in the future to an industrial area and a large-scale port zone that includes an urban area, the site selected should be such that the land utilizing situation and its trend will not compete against the development of the new port over a long period of time. San José and Champerico already have existing urban areas around them. In the case of San José, in particular, competition in the utilization of land is liable to arise, since a villa zone is formed around the city and development as a resort around the natural canal is in progress. At Sipacate, on the other hand, a vast state-owned and unused land and a farming area spread along the littoral area.

d) Acquisition of Land for Port Facilities

The difficulty or ease of acquiring land for the project greatly affects smooth construction and completion date of the new port. Land around San José is mostly owned by private persons and even now it is used in all sorts of ways. At Sipacate, the government land extends from the coast line to the hinterland for about 1.5 kilometers. This area has the best advantage in acquiring the land for constructing the new port.

e) Formation of Port City

The position of the new port should also be considered from the standpoint of the formation of a city around it. On the point of making use of the existing city San José and Champerico have the advantage, but no high-order integration is conceivable in the existing cities on the Pacific coast. New development appears to be the only means.

(4) Conclusion

Judging from the results of considerations from various viewpoints, the conclusion is that the Sipacate coast is the site optimally suited to construction of a new port as an international trade port on the Pacific coast of Guatemala. In the long-range view, therefore, port functions on the Pacific coast should be concentrated in Sipacate. Of the existing ports, San José, which is close to the new port, will be completely absorbed, and the area should aim at development as a resort since some development has already been accomplished. The Port of Champerico, on the other hand, should preferably be given an auxiliary part to aid the new port as the transit point for exporting and importing cargoes related to agriculture in the western coast, till such time as the new port begins to function with full stability.

CHAPTER 4. NATURAL CONDITIONS ON THE PACIFIC COAST OF GUATEMALA

Chapter 4. Natural Conditions on the Pacific Coast of Guatemala

4-1 Topographical and Geological Conditions

Guatemala borders on El Salvador and Honduras in the southeast and on Mexico in the north. It is divided into the Pacific and Atlantic regions by the Sierra Madre, some peaks of which rise 3,000 to 4,000 meters. The topography and geological conditions of both the two regions differ markedly, but here the topography and geological conditions of the Pacific coast of Guatemala will be looked into from the standpoint of the port construction project. Fig.-4.1 represents a rough description of the geological conditions and topography of the Pacific coast as taken from (Ref. 401). It shows volcanoes, rivers and chronological geological formations. In the figure, the upper part shows part of the Sierra Madre. Here a number of volcanoes are distributed, including active volcanoes like Fuego and Pacaya and others that are dead or dormant. The coast line extending from the mountain skirts to the seashore for 30 to 50 kilometers is occupied by plains of Quarternary alluvial soil, and large numbers of rivers of all sizes that rise in the Sierra Madre Mountains are found. Regionally viewed, medium and small rivers with large numbers of tributaries are concentrated in the western part, including the area around Champerico. On the eastern part including San José and Sipacate, on the other hand, so many rivers are not distributed but these are relatively bigger and longer. Although the middle and upper reaches of these rivers are generally rapid in flow, the slope of the river bed in the plains is quite gentle. Especially in the central and eastern parts, a number of meandering rivers are seen. These rivers, however, turn into muddy rapids during the rainy season lasting from May to October, and they carry down large volumes of mud and sand. The Achiguate River, which borders on the active volcano Fuego along the upper reaches, in particular, empties its muddy water containing volcanic substances like volcanic ashes and lapilli into the Pacific Ocean throughout the year.

The 160 kilometers of the Pacific coast forms a S-shaped monotonous coast line with little indentations. Such a monotonous coast line is maintained on the basis of balance between the continuous supply of sediments to the sea through rivers and the erosion of seacoast. But the topography of the coast line near the river mouth undergoes specially marked change, because the influences of the rivers and the sea notably change between the rainy and dry seasons. Conspicuous difference in the topography near the river mouth is seen between the eastern and western portions of the Pacific coast. Such characteristics will be detailed in 4-5.

Most parts of the Sierra Madre and the mountain skirts closer to the coast line, as shown in Fig.-4.1, are covered with volcanic Tertiary or Quarternary rocks, pumice or their detritus. These are considered to have been deposited on the granite bedrocks of the Cretaceous period. Volcanic activities in Guatemala during the Tertiary period must have been notably different from those of other areas in

Central and South America. These are considered completely continental, because there are no traces of submarine lava and interbeded marine sediments. The active volcanic belt found along the Pacific coasts from Mexico to El Salvador must have grown on the rock beds of the Tertiary period, and formed the Quarternary volcanic rock belt by the eruptions and lava of these volcanoes (Ref. 402)

A continuous zone of igneous rocks is seen in the region of Tertiary rocks shown by vertical lines in Fig.-4.1. This zone consists mostly of andesite, but also contains rhyodacitic tuffs, ignimbrites, lavas with besalt, or volcanic sediments. The ratios of these components differ between the eastern and western areas, and in the eastern part of the Pacific coast of Guatemala, the ratio of rhyolite and basalt is high. Generally speaking, igneous rocks formed in the Tertiary period are firmly welded and are considered good in quality. The rock bed zone formed in the Quarternary period shown with dotted lines in Fig.-4.1 contains lava of later formation, deposits caused by the lava flow and tuff. The quality of rocks here is likely to be comparatively brittle. The pumice belt formed in the Quarternary period consists of volcanic deposits with pumice as the main ingredient.

The lower layers of most parts of the Pacific coast of Guatemala seem to contain plutonic rocks formed prior to the volcanic activities of the Tertiary period, but since the volcanic rocks of tertiary or Quarternary period are predominant, exposure of plutonic rocks made up largely of granite is seen only in limited parts, as shown in Fig.-4.1. Besides, plutonic bouldes are common in the detritus found in the Naranjo river and so forth, but the sources of these rocks have not been clarified by geological surveys undertaken to date.

From the foregoing geological conditions of the Pacific coast of Guatemala, procurement of rocks for the port construction project needs to be made at areas where plutonic rocks are exposed or at least at areas where igneous rocks formed in the Tertiary period are found.

4-2 Climatic and Meteorological Conditions

4-2-1 Climatic Conditions

According to Köppen's climatic zones, the Pacific coast of Guatemala comes under the tropical savannah climate, the Caribbean coast comes under the tropical jungle climate and the central highlands come under the temperate summer rain climate.

The temperature differs according to elevation, and the temperature slope in Guatemala based on the Thornswaite's classification of climate is 1°C for every 176 meters. The mean temperature on the Pacific coast is 25 to 30°C, which means the region is quite hot. The temperature variation is from 25 to 34%, the lowest being 20°C and the highest being 35°C or higher (Ref. 405).

Roughly speaking, the seasons divide into the rainy season covering from May to October and the dry season from November to April of the following year. The characteristics of precipation differ in various areas. The rainy season for the tableland of the Pacific coast lasts for about 120 days and the average annual rainfall is less than 2,000 mm. Rainfall in the highland of the Sierra Madre often reaches 4,000 mm, while in some localities of the country, it sometimes reaches 6,000 mm (Ref. 405).

Wind that blows from north-northeasterly direction towards south-southwesterly direction is predominant. This arises from the normal characteristics of Trade Wind, and while different wind directions are observed in some localities, these may be considered as local phenomena arising from some exceptional topographical conditions. On the Pacific coast which completely opens towards the sea, variations that may be called as land wind and sea wind are observed.

Meteorological observations in Guatemala are largely undertaken at the National Observatory of the Ministry of Agriculture. Table-4.1 shows monthly average data for 1971 on the meteorological elements as obtained at the San José Observatory (Ref. 407). Table-4.2 shows data on wind characteristics at the watershed on the Pacific coast (Ref. 408). In the former, the total annual rainfall is 423 mm, indicating that rainfall along the coast line is not so heavy. Fig.-4.2 represents the wind rose based on data obtained at the San José Observatory between 1969 and 1973 (Ref. 409).

Abnormal weather conditions are generally infrequent in Guatemala, but chubascos develops often during May and November, and also the effect of tropical storms and hurricanes, which will be described later, is sometimes felt. Chubascos is the name given to a violent local squall accompanied by thunder storm; it develops when the equatorial doldrums shift to the north. This season coincides with the rainy season, and gust of wind accompanied by thunder storm is said to blow fiercely from the west or southwest, but some records say that such wind always blows from the east in San José. The wind continues to blow for about 1.5 hours at a time, and reports from ships show change of wind velocity from 5 knots to 65 knots in only 10 minutes. It is pointed out that ships at anchor need special care as the devastating wind rises suddenly (Ref. 425).

Weather map that includes Guatemala is issued once a day in El Salvador, the neighbor of Guatemala, by cooperation of the United States (Ref. 410). In Guatemala, too, such a map is being prepared by the Direccion General de Aeronautica Civil from the standpoint of airport control (Ref. 411), but it is not adequate as marine weather map for utilization in estimating waves.

4-2-2 Tropical Storms

Hurricanes that sweep along the North Atlantic coasts, including the Caribbean Sea and the Gulf of Mexico, are wellknown. Meanwhile, tropical storms frequently develop over the Northeastern Pacific coast including Central America and Mexico. In the references 412) and 413) general characteristics of tropical storms that occur over the Northeastern Pacific coast are described in the following manner:

(1) These develop from the latter part of May to November, but the frequency reaches the peak in September. The number of occurrences in other months is few.

(2) The track is approximately parallel to the coast line, and this trend is especially conspicuous with those of the mid season. Storms that occur early or later in the season are frequently deflected towards north or northeast.

(3) The travelling speed of the storm is normally 5 to 15 knots, and the average duration is 4 to 5 days.

(4) The average scale is somewhat smaller than those occurring over the Atlantic or Northwest Pacific coast, with maximum wind velocity ranging from 100 to 110 knots.

Table-4.3 presents monthly occurrences in each of the recent seven years taken from well-repleted observations using weather satellite. The average frequency per year includes hurricane 6.7 times and tropical storm 8.6 times for a total of 15.3 times. In such recent data, greater frequency of occurrence is observed for July, August and September.

With respect to localities of generation, largest numbers arise off the Pacific coasts of Central America and southern Mexico. Sometimes, those that have occurred over the Caribbean Sea travel across the land and reach the Pacific coast. The early stage of occurrence is no more than a tropical depression, but it develops into a tropical storm or hurricane intensity during its progress. Damages in the past have been greater in the Mexican west coast of 100° west longitude where hurricanes often sweep over. It may be said that fully developed hurricanes rarely sweep over the sea off the Guatemala coast.

Figs.-4.3 and 4.4 show tracks taken by tropical storms that developed between May and July 1970 and between August and November 1971 (Ref. 416, 417). Recent hurricanes that seem to have affected Guatemala markedly are Hurricane Francesca of 1970 and Hurricane Olivia of 1971, both of which are shown in the figures. Olivia, in particular, proved to be the largest class hurricane developing over the sea in question. Its central pressure was 990 mb to 980 mb at off the Pacific coast of Guatemala and reached 948 mb during its peak development, when it swept over the sea off the coast of central Mexico. The distance from the center to the point of greatest wind velocity may be taken as 20 to 25 nautical miles.

4-3 Tides, Abnormal Tide Levels and Currents

4-3-1 Datum Plane of Sea Level and Depth

The datum plane of land elevations in Guatemala is the mean sea level at the Pacific coast. This is known in the country as the datum nacional de nivelacion. The datum plane, the so-called chart datum level (C.D.L.), for the tide level and the depth in the chart is somewhat different from that of Japan and is the mean low water springs (M.L.W.S.).

For practical purposes the tide characteristics along the Pacific coast of Guatemala can be deemed identical. For this reason, the tide level chart shown in Fig.-4.5 is presently established as tide variation characteristics along the Pacific coast (Ref. 420). According to the chart, the mean low water springs is 0.93 m below the mean sea level. In order to avoid confusion, this will be used also as the working datum level in this report, and the tide level, depth and the crown height of port structures will be based on it. The standard sea level defined as the level equivalent to the sum of amplitude of the major four tidal components below the mean sea level used in Japan and others, as will be dealt with later, would become 1.02 m below the mean sea level and 0.09 m below MLWS when calculated from the harmonic constants for the Port of San José.

4-3-2 Tide Observation, Harmonic Constant and Tide Table

Tide observations are undertaken by IGN (Instituto Geográfico Nacional) since 1950 at the Port of San José and since 1963 at the Port of Champerico. The observation is made with a tide gauge recording for one month; its paper feeding speed is 1 inch per hour and the recording paper for one day is of about 61 cm length. Tide observation is also undertaken at the Port of Santo Tomas on the Atlantic coast. Data obtained therefrom are sent to the U. S. Coast and Geodetic Survey.

At San José, the American agency undertakes harmonic analysis on the basis of actually observed data for 365 days. The harmonic constants of various tidal components derived from the analysis are as shown in Table-4.4 (Ref.421). The amplitudes of the major four tidal components M_2, S_2, K_1 and O_1 are expressed respectively as H_m, H_s, H_k and H_o, and when various non-harmonic constants are obtained from the values given in Table-4.4 as follows:

Spring range: $2(H_m + H_s) = 1.77$ m
Neap range: $2(H_m - H_s) = 1.17$ m
Mean range: $= 2H_m = 1.45$ m
Mean high water interval:

$$\frac{K}{28.984} = \text{2hrs. 7 min.}$$

The sum of amplitudes of the major four tidal components =
$H_m + H_s + H_K + H_o = 1.02$ m.

Tide forecasts are possible using the harmonic constants given in Table-4.4, but actually La Union Port of El Salvador is used as the reference port to make estimates by deeming the tide level of the Pacific coast of Guatemala as identical. The occurrence time and the level of high tide and low tide are charted in the yearly tide table, which is published by IGN for practical use (Ref. 420).

4-3-3 Anomalous Sea Level

In general principal causes of anomalously high sea level are storm tide caused by hurricane or tsunamis accompanying undersea earthquake. Both have the characteristic of rising higher towards the end of the bay and the like. As the coast line of the Pacific side of Guatemala is extremely monotonous, the effect of tsunamis on the coast is not considered conspicuous, even though a seismic zone does exist off the Pacific coast. Neither has there been any case observed of storm tide caused by a developed hurricane. It may be said that these are not the source of much concern.

Occurrence of anomalous sea level can be grasped through long-range investigation of the maximum and minimum sea levels. In this connection the maximum and minimum sea levels have been checked for each month and each year between 1963 and 1973 at San José and between 1970 and 1973 at Champerico. Table-4.5 gives the result for each year (Ref. 423). In general the sea level in tide observation is made as the value based on the datum level at the observatory (O.D.L.). In the table values based on C.D.L. are those converted from O.D.L. according to (Ref. 424). In the comparison of the maximum and minimum sea levels at the two ports for the same year on the basis of C.D.L., both levels at Champerico are higher. In particular, the minimum sea level of the year is found to be higher than the mean low water springs. This is clearly unnatural, leaving some questions in the method of taking the datum. However, leaving this as it is, two or three statistical characteristics of the high sea level based on O.D.L. obtained at San José will be gone into.

Let us begin with the trend in the variation of monthly maximum sea level. Fig.-4.6 shows the maximum and the average values taken from ten monthly highest data from 1963 through 1972. However, nine data only were used for May, since the data for May 1965 are absent in the original data.

Distribution of the highest tide in each month of the ten years is observed to be highly correlated with the distribution of the average value, excepting June. The general trend of monthly highest tide may be properly judged on the basis of changes in the average values. It is noticed in the result that January and February show low values while September and October show high values. However, as the difference is maximum 0.15^m or so, monthly variations in the highest tide may be taken as being far from conspicuous.

Let us next look into the probability of the high sea level occurrence. As monthly and annual highest tide levels are available as data, tide levels with return period of one year, i.e., tide levels that are likely to occur once a year, are scrutinized on the basis of monthly data, and tide levels with return period of 10 years, i.e., tide levels that are likely to occur once in 10 years, are scrutinized on the basis of the annual highest tide data. Regarding the probability distribution, the former will be based on the logarithmic normal probability distribution since it concerns with the trend of the whole data, and the latter will be based on the double exponential distribution as it concerns with extremely large values. Figs.-4.7 and 4.8 present respective distributions. The probability tide level that returns once a year as based on the optimum straight line shown in Fig.-4.7 is 2.85 m above ODL, while probability tide levels that occur once in 10 years, once in 50 years and once in 100 years based on the optimum curve given in Fig.-4.8 respectively are 3.04 m, 3.20 m and 3.27 m above ODL. In order to convert these values to those above CDL, subtraction of appropriate differences of datum levels from them will do the trick. If the difference at the Port of San José Tide Observatory is provisionally assumed as 0.44 m, the probability tide levels that occur once a year and once in 50 years mentioned above will be 2.4 m and 2.8 m above CDL. From the result, it has been confirmed that on the Pacific ocast of Guatemala, increase in the highest tide that may be expected along with increase in the return period is not so conspicuous.

4-3-4 Ocean Current and Tide Currents

The ocean current along the Pacific coast of Guatemala is the deflected equatorial counter current and flows northward. As some description of the current along the near shore is available in connection with the ports of Champerico and San José, it will be introduced hereunder (Ref. 425).

Current in the Port of Champerico: During the dry season the current generally flows in the east-southeasterly direction at a velocity of about 1 knot. The velocity increases above this figure spring tide. The east-southeasterly current often continues for three to four days, followed often by west-northwesterly current for about the same period. From June to August west-northwesterly current of more than 1/2 knot velocity becomes predominant.

Current in the Port of San José: During the dry season southeasteary current of about 1 knot velocity is the general situation, but the current frequently alternates for three to four day periods with the west-northwesterly flow.

4-4 Waves

4-4-1 Basic Policy of Design Wave Determination

The general principle of determining design wave used for the examination of breakwater stability consists of selecting the highest known wave or wave with appropriate return period on the basis of data obtained in the following manner: Data derived from wave observations over a period of considerable length or data derived from wave hindcasting with the aid of meteorological data over a considerable period of time. The accuracy of hindcasted data should be confirmed by actually observed wave data over a comparatively long time and, if necessary, they should be modified so as to get a good accordance with the observed data.

In the case of the Pacific coast of Guatemala, however, the only data available are tabulations of the results of observations made on ocean navigating ships; no data derived from reliable wave observation made near the shore that can be used for above purpose are available. At the present stage, therefore, design wave will have to be determined by grasping the gist of characteristics of deep water waves on the basis of existing data related to the Pacific coast of Guatemala and then making wave forecasting for the highest-class hurricanes that arise in the area.

4-4-2 Characteristics of Deep Water Waves Based on Existing Data

(1) On-board Observation Data

As compilations of data obtained as a result of observations onboard ships navigating the seas bordering on the Pacific coast, some like references 426) and 427) are available as publications. These are compilations of results of observations in the seas covering considerably wide areas and are not necessarily appropriate for obtaining wave data close to the shore where a port is to be constructed. As data compiled by the Corps of Engineer, U. S. Army , are available, on the seas limited to the Pacific coast of Guatemala (Ref. 431), an outline of the wave conditions in the area will be grasped on the basis of these data. These were contained in the report of feasibility survey related to construction of a port on the Pacific coast of Guatemala submitted by the Corps of Engineer in 1963. The data are limited to areas bounded by 90° to 92° west longitude and 13° to 14° north latitude for one, and by 91° to 93° west longitude and 14° to 15° north latitude for the other. In this sense, the data may be considered as indicating the characteristics of deep water waves along the Pacific coast comparatively well. The wave data used in this survey were those of the Hydrographic Office of the U. S. Navy, but nothing definite is indicated as the Period during which the data were taken.

The original data indicate average frequencies of wind waves and swells by wave directions and by wave height classes for each month and each years. Fig.-4.9 is a graphic presentation of the frequency of occurrence by different directions on the basis of average annual figures. From these data, characteristics of the wind waves may be summarized as follows:

1) West is predominant with respect to all wind waves.

2) East is predominant with respect to waves with height of more than 1 meter.

3) The highest waves have been observed in the southwest, the wave height being more than 6 meters.

4) If the wave directions are limited to southeastern, southern and southwestern directions, waves of southeastern and southwestern direction occur most frequently, and the southeastern direction is predominant in waves of more than 1 meter.

Similarly with respect to swells, the characteristics may by summarized as follows:

1) The occurrence frequency of swells is greater in the order of southwestern, southern and southeastern directions, but no conspicuous difference exists.

2) Predominance in swells of more than 2 meters in the height is noticed in the southwestern direction, followed by southern direction.

3) While swells of more than 4 meters have also been observed in all directions, the frequency is greater in the westerly direction.

Fig. 4.9 shows general directions of the coast line at San José, Sipacate and Champerico. Directions of deep water waves that reach these coasts, of course, are limited to southerly waves. If this is taken into account and attention is paid only to comparative high waves, the characteristics of deep water waves can be summarized as follows: wind waves occure more frequently in the easterly direction, while swells are higher in the southerly direction.

Wave data compiled by the National Climatic Center of the U. S. Department of Commerce based on recent observation results are also obtained (Ref. 428).

(2) Some Investigations of Swells

One of the features of waves hitting to the Pacific coast not only of Guatemala but also of all Central America is the existence of swells almost at all times. As James has studied such swells (Ref. 432), it will be introduced below.

James assumed the cause of swells of 12 to 20 sec. in the period that reach the Port of Acajutla in El Salvador to be storms that arise in the southern hemisphere. Accordingly, he selected seven severe weather conditions between 1948 and 1969, made wave hindcasting and obtained the expected values shown in Table 4.6. The figures in the right-hand column of the table represent waves that reach the Port of Acajutla as obtained by taking into account the decay of the swells in the course of propagation from the generating area and shoaling coefficient.

Such swells should naturally hit the Pacific coast of Guatemala. For instance, the wave of 19 to 20 sec. in the period that occurs at the probability of once in 20 years results in 2.3 to 2.8 m in the deep water wave height with the shoaling coefficient of 1.3.

Also, at the time of survey undertaken for a port construction project of the Republic of Coasta Rica, an interesting point that the Trade Wind blowing into the tropical convergence zone is the cause of swells was brought up (Ref. 433).

4-4-3 Determination of Design Wave

(1) Deep Water Wave

Characteristics of waves along the offshore areas of the Pacific coast of Guatemala have been examined on the basis of available data. While data compiling results of observations from on-board ships are highly effective in the grasp of wave conditions in the sea, they are not necessarily appropriate for obtaining wave conditions near the coast where a port is to be constructed. In the circumstances, the following will be considered as design wave usable for immediate purpose.

As already stated in 4-4-2, consideration of southeasterly waves and southwesterly swells as deep water wave condition of design wave appears to be necessary. It appears appropriate to think that higher wind waves of southeasterly direction are caused by tropical storms or hurricanes. Consequently implementation of wave hindcasting against such abnormal weather conditions is desirable, but no sufficient marine weather observation data have been made available. In the circumstances, design wave considered most appropriate under the present situation will be established on the basis of wave forecasting for the hurricane of the largest conceivable scale and of James' investigation for swells.

The hypothesized hurricane is 980 mb in center pressure and the distance from the center to the point where the maximum wind speed develops is 40 kilometers. The track is identical with Hurricane Olivia. For calculations the Wilson method which takes into account the variable wind field for wave development in the generating area and the Bretschneider method for the decay of swell have been used. The result of calculations is roughly as follows with respect, for instance, to the deep water area of Sipacate:

SE wave : $H_{1/3}$ = 4.0 m, $T_{1/3}$ = 9.0 sec.
S wave : $H_{1/3}$ = 2.0 m, $T_{1/3}$ = 12.5 sec.
SW wave : $H_{1/3}$ = 1.0 m, $T_{1/3}$ = 11.0 sec.

Viewed from the forecasted location and the track of the hurricane, it is natural that SE wave should be the highest. Such characteristics in different directions differ little over the entire Pacific coast of Guatemala.

For swells of southwesterly direction, meanwhile, waves occurring once in 20 to 50 years have been adopted on the basis of studies made by James, and the following as conditions for design deep water waves has been selected as reasonable conditions at present stage.

Design deep water wave: (off Sipacate coast)
SE wave: $H_{1/3}$ = 4.0 m, $T_{1/3}$ = 9.0 sec.
SW wave: $H_{1/3}$ = 3.0 m, $T_{1/3}$ = 20.0 sec.

(2) Design Wave at Breakwater Construction Site

Deep water waves cited above are likely to reach the breakwater construction site while changing in wave height and wave direction under the influence of changes in depth. The transformation of waves during their propagation from deep water to shalow water are obtained in consideration of refraction and shoaling, and the transformed wave height after variation is given by the following equation.

$$H_s = K_s \cdot K_r \cdot H_o$$

where H_s= wave height after being influence by depth variations, H_o= deep water wave height, K_s= shoaling coefficient and K_r = refraction coefficient.

The refraction coefficient and the wave direction after refraction are obtained by preparing refraction diagram. Fig. 4.10 is an example of orthogonals obtained with the aid of electronic computer for wave of 12.5 sec. in the period and of southern direction at the deep water. The distribution of sea depth is based on the chart (S=1/713,000) for the Pacific Ocean bordering on Central America prepared by the U. S. Naval Oceanographic Office. It is the general practice to obtain refraction coefficients and incoming wave directions for respective conditions from such results. In the case of the Pacific coast of Guatemala, however, it may be rather easier to envisage a model coast of parallel straight isobath in order to undertake examination by using the result of analytical treatment of refraction at such a coast, because the coast line is comparatively simple and the accuracy of the chart is not great.

Fig. 4.11 shows the wave directions and refraction coefficients, at the depths of 12 m, 10 m and 5 m, for the waves of 9 sec. and 20 sec. in the period and the incident angle of 45° to the normal of the coast line at deep sea, using such analytical results. It is clearly evident that as the waves propagate closer to the coast line, the wave direction changes to right angle to the coast line and the refraction coefficient decreases. Such a trend is more conspicuous with waves of longer period.

When the wave height and direction of the design wave cited in (1) at the depth of 10 meters are obtained simply on the basis of the result of such refraction and shoaling coefficient, the result is Table 4.7. In other words, a wave of SE direction, 126 m in the wave length and 4.0 m in the wave height at the deep water is transformed into a wave of the direction angle of 153° expressed in clockwise direction from the north, 82 m in the wave length and 3.4 m in the wave hight at the depth of 10 m. And the swell of SE direction, 624 m in the wave length and 3.0 m in the wave height is transformed into a wave of 193° in the wave direction, 195 m in the wave length and 3.3 m in the wave height.

However, such wave transformation represent an extremely simplified case, and if the accuracy of deep water wave estimations is taken into consideration, it appears appropriate under the present situation to consider the waves shown in Table 4.8 as the design wave near the breakwater construction site.

4-4-4 Wave Conditions at Normal Times

In the proper arrangement of breakwater and other port facilities, consideration must be given not only to abnormal waves like the design waves but also to the characteristics of waves at normal times. In particular, as the existence of swells is observed almost at all times along the Pacific coast of Guatemala, consideration relative to these is required.

It is, of course, possible to grasp waves in normal times on the basis of 6-4-2 (1), but here the result of observing the highest sea level and the lowest sea level related to one wave used for checking the tide observation records at San José and Champerico piers will be employed as the clue. However, as the work is not undertaken for wave observation, the data would not be adequate for dealing with waves, but they may be effective for grasping the situation very roughly.

The observation consists of daily reading the maximum and minimum levels of one wave from the movable staff mounted on the post erected near the tip of the pier (Ref. 434). The difference is deemed a single wave height in the continuous wave train, and while as to which one wave is observed from among the wave train seems to follow the random sampling as a rule, a rather high wave seems to be selected at San Jose and a rather low wave seems to be selected at Champerico. The trend is clearly evident when the collected observation results are compared. Even if the statistical characteristics in actual wave train is pursued by adding probability consideration to observation data having such a trend, it would be meaningless without clear and definite criterion for observations. Consequently, average results will be pursued here on the basis of data available at San José where somewhat higher wave appears to have been observed.

Observations are undertaken in San José at a spot about 9 meters in depth. Average for the whole, average for the maximum values of the month and average for maximum value for the year obtained from the results of observations for four years between 1970 and 1973 are shown in the Table 4.10. Observation was supposed to be made once a day, but days of non-observation total 317 in four years. While the question as to how results should be interpreted is posed, it is not unnatural to consider them as significant wave height that occur daily, once a month or once a year, judging from wave data of various kinds and from personal observations and oral informations obtained during field explorations. Also, since swells are considered predominant in waves of normal times, it may be considered adequate to suppose that the wave period is about 12 sec. and the wave direction, near Sipacate coast, is south to south-southwest for the examination of calmness in the harbour.

Such observations of maximum and minimum sea levels as being made at the San José pier serve as visual wave observations when they are made continuosly, and this is to be implemented by the Guatemala upon recommendation of this survey party. When the results become available, the characteristics of waves in normal times are likely to be grasped in greater accuracy.

4-5 Coastal Topography and Littoral Drift

4-5-1 Problems Caused by Littoral Drift and Surveys of the Past

In general questions that must be taken into consideration in constructing a port along the coast where littoral drift exists are possible shoaling of the naviagation channel and the harbour basin and the effect on the nearby coast. Such problems arise from shifting of materials constituting the beach under the action of waves and currents. From the engineering viewpoint, the alongshore drift which is a component of littoral drift moving parallel to the shore line is important. The practical nature of alongshore drift is to be determined by the direction and the rate of littoral transport, but it is not so simple to decide as the dynamic variations of external forces and shore configuration are involved. For instance, the direction of littoral drift varies temporally since the waves and currents constantly change. However, under long-range view, such as in seasonal or annual unit, the existence of the predominant direction of littoral drift peculiar to the coast is found. The predominant direction of alongshore drift is generally determined by investigating the following items:

1) Wave energy components in the shore direction.

2) Changes in the granular composition and mineral composition of bed materials along the shore line.

3) Shore configuration and granular composition of the bottom materials around existing structures like the breakwater, jetty and offshore breakwater.

4) Topography, near the cape and river mouth.

Estimation of the rate of littoral transport is made by the use of an empirical equation related to the wave energy components in the direction of the shore line, but accurate estimate is extremely difficult even when wave data are available.

As stated already in 4-4, no wave observation data are available for the Pacific coast of Guatemala except for visual observation data on deep water waves made on-board navigating vessels. The coast, also, is naturally montonous so that existing structures that offer any effective means of judging the predominant direction of alongshore drift may be considered nil. At San José and Champerico, pile type piers project out at right angle to the coast line, but these can hardly be considered an effective means since they are of highly permeable structure.

Two investigations have already been made of alongshore drift on the Pacific coast of Guatemala. The first was undertaken by the Corps of Engineer which submitted its report in 1963 (Ref. 435). The report states that from the frequency of occurrence frequency of deep water waves by directions, which has been introduced in 4-4, the predominant direction of alongshore drift is from west towards east throughout the coast of Guagemala, though there are seasonal variations. Later, in 1972, Professor J. W. Johnson of the University of California submitted his report (Ref. 436). This report states that largely from the dynamic states of the river mouth, the predominant direction of alongshore drift is from east to west over the entire coast.

The two reports thus brought out conclusions diametrically opposed to each other, but since the predominant direction involves highly delicate elements, the two may be considered to have been sound at the respective stage. In order to undertake accurate examination of the predominant direction from wave data, energy in the shore direction must be obtained while taking the wave refraction close to the shore into account, but when the accuracy of wave data available for use is considered, further analysis may be meaningless. Therefore, macroscopic grasp largely of the shore topography on the basis of the result of such valuable studies of the past will be made and the characteristics of the drift along the Pacific coast of Guatemala will be summarized as data littoral drift along the Pacific coast of Guatemala will be summarized as data useful to selecting the site of port construction as well to the selected site.

4-5-2 Rivers and River Mouths

(1) Rivers.

The Pacific coast of Guatemala forms a monotonous coast line slightly curved in S-shape, and the entire shore area is a sandy beach. A large number of rivers that originate in the Sierra Madre drain into the Pacific Ocean. And as has already been stated in 4-1, the tableland of the Pacific coast itself appears to have developed as a result of erosion of highland by these rivers and their washing down of mud and sand therefrom. Consequently the rivers exert strong influence on the drifts at the coastal areas of this country, and these can be deemed as playing the controlling part as supply sources of littoral drift.

Figure 4.12 shows the distribution of river courses in the watershed of the Pacific coast together with the average annual rainfall(Ref. 437). The watershed of the Pacific coast is further divided into 18 river basins and the area of each basin is also shown in the figure. Rivers have developed in dentritic shape with trunks and branches, and the higher density of rivers is clearly observed for the area west of Coyolate River.

The Sierra Madre that form the background of the tableland on the Pacific coast are sloped from west towards east, and rainfall is more abundant towards the higher western part. It is, therefore, imaginable that the rivers in the western part exhibit more turbulent character. This is evident also in the coastal topography. On the western side, most rivers either drain into the sea at right angle to the shore line or form inlet-like estuaries. The rivers on the eastern side, on the other hand, form spontaneous waterway known as Canal de Chiquimulilla almost in parallel with the shore line from near Sipacate to Barra del Jiote close to the El Salvador border. Such topographical differences are considered as reflecting the relative powers of the sea and the rivers on the coast line, and the power of the rivers in the western part are considered slightly superior to those of the sea. A river on the eastern side that should be noted, however, is Achiguate, the upper reaches of which borders on the active volcano Fuego. For, the volcanic activities in recent years have been dumping much mud and sand into the river so that formation, as will be described later, of a delta at the mouth is observed.

As has already been stated in 4-2, the year in Guatemala divides in into the rainy and dry seasons, and naturally rainfall is greater between May and October, and the flow in the rivers increases at the same time. Rainfall is especially abundant in August, September and October,but it is much less between January and April. During the rainy season, the rivers turn into muddy streams, and at the river mouths muddy water spreads out into the sea in semicircular form. This can conspicuously be observed from the air. Most of the rivers are natural unimproved rivers, and floods frequently develop in the middle and lower reaches, washing bridges away and otherwise damaging the basins. The river courses are also mostly unstable, making it difficult to construct roads parallel to the coast line. It is particularly difficult on the western coast. Under the circumstances, macroscopic grasp of the topography near the shores leads to a conclusion that stability is co paratively higher in the easterly coast.

(2) River Mouths

According to aerial photographs (S=1/20,000) taken in April 1974, a total of 23 outlets are found along the Pacific coast line of Guatemala. Of this total, those on the western side, including Coyolate River, total 17, while only 6 are found on the eastern side. This well reflects the difference in the density of rivers. The river mounths are highly unstable both in positions and configurations. In particular, because of differences in the discharge between the rainy and dry seasons, many of the river mouths are closed up during the dry season but open up again when water levels rise during the rainy season. Good examples are the mouth of Acomé River that drains into the sea on the Sipacate coast and that of Achiguate River in the past.

As stated in 4-5-1, the configuration of the river mouth offers an effective means for judging the predominant direction of alongshore drift. Actually, however, formation of the shape of a river mouth is by no means simple, since influences of the littoral drift, waves, tidal prism, river flow and supply of materials by the river are involved. If seasonal variations are found in such factors, careful consideration becomes necessary, and it is difficult to obtain clear assessment criterion. In general, the sand spit at the mouth of a river grows towards downstream from the drift, and the shifting of the outlet coincides with the drift direction. Study of the river mouth topography and its changes on the basis of the aerial photographs leads to more cases of concluding the predominant direction of alongshore drift to be largely from east towards west as mentioned in Prof. Johnson's report.

As a conspicuous example of shift of the river mouth towards west, that of Maria Linda River may be cited. According to the result of survey by the Highway Bureau, shift of 1,150 meters westward in 1965 and that of 1,985 meters in 1967, with the position seen in 1946 taken as the criterion, are reported in the (Ref. 436). As of April 1974, according to the aerial photograph, the river mouth that was closed up once has reopened during the flood season towards Iztapa and this has further shifted westward. Fig.-4.13 represents changes that have taken place in the position of the mouth of Acomé River that drains into the sea at the Sipacate coast as studied from aerial photographs taken in the past. However, this does not show continuous changes in the position of the river mouth, since closing up during the dry season is definitely evident and there have been cases of opening it up artificially. In the figure, however, no closing up is evident between September 1973 and April 1974 and westward shift is recongnized here also.

(3) Delta Formation at River Mouth

With the development of table land on the Pacific coast, the trend towards advance of the coast line due to deposition of transported materials by rivers has slowed down, but formations of delta are observed at a number of river mouths. The delta at the mouth of Samalá River is the most distinguished. Formation of deltas is observed also at the mouths of Achiguate, Coyolate and Nahualate rivers. In configuration these deltas have approximately symmetrical shape to the vertex, showing no marked development in any one direction.

Indication of changes in the shoreline on the basis of aerial photographs taken in March 1967 and in April 1974 as an example of such temporal variations of the delta at the Achiguate River mouth results in Fig. 4.14. The growth of the delta at the mouth of Achiguate River in recent years has been notable, and a maximum advance of 200-meters in shoreline during about 7 years is observed. The increased area might be approximated to an isosceles triangle of 6,000 meter base and 200-meter vertical distance from the base to the vertex. If the thickness of the expanded area is assumed as 7 meters, the volume would be 4.2 x $10^6 m^3$, corresponding to an annual rate of 0.6 x $10^6 m^3$. Although figures are not presented, changed at the Samalá, Nahualate and Coyolate rivers in the past 7 years have not been so conspicuous. Such a result is an indication of the increased power of Achiguate River in recent years, reflecting variations in the river course and the vigorous activities of the volcano Fuego along the upper reaches of the river. The scope of direct effect exerted by conditions like the shore line variations due to growth of a delta may, in the order of about half a century, be taken as being 5 to 10 kilometers to the both sides.

4-5-3 Seabed Configuration

The distribution of depths along the Pacific coast of Guatemala has already been given in Fig. 4.10. While this is based on an old chart (Ref. 443), it is quite interesting as, for example, it shows the 10-fathom equidepth line projecting towards the sea off the mouths of Samalá, Nahualate, Coyolate and Achiguate rivers, thus indicating the influence of mud and sand washed out from the river mouths. Detailed sounding survey near the river mouth serves as a potent means of determining the predominant direction of alongshore drift, but the accuracy of the present data may be inadequate.

Another characteristic of the distribution of the equidepth line is comparative sharp deepening near the eastern shores of San josé. Fig. 4.15 shows a cross-section of the seabed, as taken from the same chart, of the area on the line extended at right angle to the coast line near Champerico, Sipacate and San José. While this is an extremely macroscopic indication of the seabed, the mean slope down to the depth of 50 meters is approximately the same for Champerico and Sipacate at 1/500 but that for San José is 1/260. The slope of continental shelf is formed at 40 to 70km from the shore line, and this extends to the Central American trench at a slope of about 1/30. Fig. 4.16 shows the average configuration seabed near the shores, as taken from the sounding maps. For instance, the distance from the shore line to the depth of ten meters is 1,400 meters at Champerico, 600 meters at Sipacate and about 300 meters at San José.

4-5-4 The Bottom Materials of Shore

While the entire shore line of the Pacific coast of Guatemala is constituted with sandy beach, differences in the granular composition of bottom materials are observed at different sectors. For example, the median diameters of sand sampled at the foreshore of the coast at San José, Sipacate and Champerico were found respectively to be 0.7mm, 0.45mm and 0.23mm. The difference in size was evident even under visual observation. The sand at these places is blackish, indicating rather high iron sand content. Incidentally an analysis of sand sampled at the Sipacate shore for heavy mineral content results in Fig. 4.17.

With regard to the bottom materials of the shore line, preliminary grading analysis and specific gravity analysis have been undertaken by the government agency of Guatemala over about 60 kilometers of shore area from Tecojate to San José, with Sipacate located in the middle, on the basis of the recommendation of the preliminary survey team (Ref. 444).

Fig. 4.18 shows the results of these analysis. In order to discuss the predominant direction of drift from these results, the data are still inadequate with respect to the scope of sampling points and density of such points. As full-dress survey of the shore bottom materials has been proposed by the present survey team, the result obtained is likely to serve as a suitable means of clarifying the characteristics of littoral drift.

Survey has also been undertaken at the Sipacate coast on the texture of the seabed bottom materials (Ref. 445). The result is shown in Fig. 4.19. The specific gravity is approximately 2.8, with slight diminishing trend seen in the offshore direction. The median diameter decreases from 0.3mm at the shoreline to about 0.1mm at the water depth of 5m, and then slightly diminishes in the offshore direction. Such a trend in the distribution of median diameters is apt to appear where waves and currents are not outstandingly severe.

4-5-5 Conclusions

In the foregoing coastal and shore topography and characteristics of littoral drift have been described on the basis of past data and those obtained by present survey. Conclusions that can be reached at the present stage may be summarized as below.

1) The tableland on the Pacific coast is considered to have been formed by erosion and deposition effects of the rivers from the Sierra Madre that form the background. In the process the river courses must have undergone frequent changes and they are still unstable.

2) With the Coyolate River as the demarcation line, the topography near the shore is different between the western and eastern sectors. In other words, the density of rivers is higher in the west, natural channel approximately parallel to the shore line are formed in the eastern sector, reflecting differences in the relative powers of the rivers and the sea due to land slope and rainfall. From such viewpoint, macroscopic topography can be said to be more stable towards the east.

3) Formation of delta is presently observed at the mouths of Samalá, Nahualate, Coyolate and Achiguate rivers. Particularly in recent years the growth of the delta at the mouth of Achiguate River is conspicuous on account of the activities of volcano Fuego along its upper reaches. As a result, change in the shore line has affected up to about five kilometers on both sides of the river mouth.

4) The predominant direction of alongshore drift on the Pacific coast of Guatemala is estimated to be from east to slightly westward, mainly from the configuration and the shift of the river mouths. However, since the influence of the rivers is dominant as supply sources of littoral drift, the sand seem to shift about equally on both sides near the mouths of rivers with greater powers. Consequently, the port construction site should preferably be as far away from such rivers as possible.

5) In seabed topography, the western coast is of gradually sloping, but the area around Iztapa on the eastern coast is of the sharply deepening type. For instance, the distance from the shore line to the depth of 10 meters is 1,400 meters at Champerico, 600 meters at Sipacate and 300 meters at San José.

6) From the foregoing, the most desirable sites for port construction probably are the east coast of Iztapa and the Sipacate coast, which is positioned at about the middle point between the Coyolate and Achiguate rivers.

4-6 Earthquakes

Earthquake observations have been undertaken in Guatemala since about 30 years ago by the Observatorio Nacional. Fig.-4.20 shows the frequency distribution of earthquakes as observed in the part 30 years for Guatemala and the surrounding regions. (Ref. 446) Various points in the figure represent center of epicenters, and the frequency of earthquake occurrence in the areas around the epicenters is classified into three stages. The areas hatched are parts of Guatemala where earthquakes occur most frequently. According to the figure, the most frequent earthquake regions are distributed around the coast lines of the departments of Retalhuleu, Suchitepequez and Escuintla on the Pacific coast of Guatemala. Fig.-4.21 represents distribution of epicenters classified by magnitudes as prepared from the list of earthquakes of more than 5.0 on the Richter Scale that occurred between 1900 and 1972. (Ref. 447) With regard to earthquakes of above 7 in magnitude, the epicenters and the depths of hypocenters and the magnitudes have been given in Table-4.10.

Earthquakes that caused greatest damages in Guatemala since 1900 were those that occurred successively from 1917 to 1918. Serious damages were inflicted on most of the buildings and houses in the City of Guatemala. (Ref. 448-a) The magnitude of this earthquake was no higher than 6 3/8 but the maximum acceleration in the city is estimated to have reached 250 gal.

No scientific records of earthquakes in Guatemala prior to 1900 are available. However, earthquakes that have occurred since 1530 are recorded, including the conditions and damages sustained, and preserved in the National Observatory (Ref. 448-b) The record indicates at least 10 earthquakes of considerable violence since 1530. Besides the 1917 earthquake, those of 1773 and 1874 are known to have caused great damages.

However, it is only when densely populated areas are found near the epicenter that occurrences of great earthquakes are known from records of damages. Leading cities in Guatemala are located on higher regions where elevation ranges from 800 meters to 1,500 meters and where climatic conditions are good. These regions are 40 to 50 kilometers inland from the Pacific coast where the port is to be constructed. On the sparsely populated Pacific coast, such records of earthquakes are hard to come by. However, the epicenters of earthquakes that have occurred since 1900 are concentrated in the Pacific coast. This is an indication of the need for taking earthquakes into consideration in constructing a new port on the Pacific coast of Guatemala.

In case earthquake resistant designs for the new port is to be undertaken on the basis of the seismic coefficient method, it would be necessary to determine an appropriate design seismic coefficient. This should include magnitudes of earthquakes and frequency of earthquake occurrence, subsoil conditions and the importance of structures, but at the same time it is necessary and effective to consider actual results used in other structures. Adoption of earthquake resistant design in Guatemala is comparatively recent, but the most advanced method on earthquake resistant design is being adopted for long bridges and high-rise buildings. In the case of bridges, the Highway Bureau has adopted 0.08 to 0.10 horizontal seismic coefficient for small and medium scale highway bridges since 1955. While a large-scale highway bridge is now under construction in the City of Guatemala, the dynamic design method stipulating earthquakes of 1917 scale has been adopted for this bridge design. Although no specification peculiar to Guatemala on earthquake resistant design has been established for buildings, the California Building Code has been adopted by deeming the earthquakes in Guatemala to be similar in scale to those of California. With regard to port structures, small-scale piers are only found in Champerico and San José on the Pacific coast. Although no earthquake effects were considered initially for these piers, and an earthquake of the magnitude of 6.5 or so occurred after construction of the piers, no record of marked damage is found. This probably is attributable to the fact that structures like piers are originally resistive against earthquakes. Modern port structures are found in Acajutla in the neighboring country of El Salvador. This port is constructed on a rocky coast and its foundation subsoil is very hard. Even there, horizontal seismic coefficient of 0.12 has been adopted for the cellar bulkheads (Ref. 449).

The Pacific coast of Guatemala belongs to the frequent earthquake area, and there is strong possiblity of experiencing earthquakes of considerable intensity. Also the alluvium is far more made up than around the Port of Acajutla. For this reason, construction of a port on any site along the Pacific coast requires to adopt a higher value as design seismic coefficient than for the Port of Acajutla. In fact, it will be recommeded to adopt the seismic coefficient of about 0.15.

4-7 Soils

As stated in 4-1 the subsoil of the Pacific coast of Guatemala is composed of Qurternary alluvium. From the topographical conditions of the Pacific coast, the geological conditions on the whole are likely to be similar for the entire coast. However, it would be necessary to have proper knowledge of the variations in the localized soil conditions in order to judge whether the subsoil conditions are suitable for port construction or not.

With respect to soil survey of individual points on the Pacific coast of Guatemala, data (Ref. 450) arising from survey of Champerico and San José areas conducted by the U.·S. Corps of Engineer have been made available. However, as the boring ended in checking the geological textures and rough grading down to the depth of about 15 meters, information on soil strength like the standard penetration resistance is not available. According to the data, principal deposits down to about 15 meters below the surface consist of gray to blackish sands of medium or fine grading., and in some places deposits of organic soil 1 to 2 meters thick are found. In the case of Champerico, there is a definite record that such principal deposits were of volcanic nature. While no special mention of the area around San José is made, the soils are very likely to be of volcanic deposits, judging from the color of deposits and the topographical conditions of the hinterland.

Regarding the soil conditions of Sipacate located between Champerico and San José, the result of survey at the five locations recommended by the preliminary survey group has been made available. Boring has also been undertaken at the shore line while the present survey group was in Guatemala. Now boring at additional three locations is in progress. Fig.-4.22 shows the topography and boring locations near Sipacate. The eastern side of the Sipacate Village presents a topography typical of the Pacific coast of Guatemala, and the natural channels are notably formed, on both sides of which mangrove forests grow up. Behind the land side spread salt marshes and across the flat hill spreads swamps. Taking into account such topographical features, borings were scheduled to be conducted at 9 locations, two of which were on the west of Sipacate Village, and seven of which were on the east of Sipacate Village. Boring data up to No. 6 have been made available up to preparation of this report.

At Sipacate, geological textures and standard penetration resistance (N value) at each boring location have been investigated down to 30 meters from the ground surface. Also, physical tests (grain size analysis and specific gravity test) were conducted on samples taken by split samplers. Table-4.11 shows the test results on the grain size analysis and specific gravity at four points. The specific gravity of sandy soil is rather higher than the general level; this arises from the iron sand content. This kind of soil containing iron sand is ditributed not only around Sipacate but also throughout the Pacific coast.

From the results of soil investigation at Sipacate, soil profiles along the lines approximately perpendicular to the coast line may be drawn as shown in Fig.-4.23 and 4.24. It will be seen that the main deposits on the west side of Sipacate Village consist of grey sands of fine to medium grading underlying the organic soils of 1 to 2 meters thick. The deposit is generally very hard and is considered to be well cemented. On the west side of Sipacate, the top soil layer down to 1 to 2 meters consists of silt or sand containing organic matters. The N value of this layer is less than 10. Below this layer sand deposits of fine to medium grading are found and further down below GL-20 m is found deposits of volcanic sands containg pumice.

It must be noted that the soft soil layer (N value of 2 to 10) sandwiched between relatively hard sand deposits exsits beneath the hill bordering the swamp. But this soft layer disappears at the middle section of the hill. Excluding the area bordering the swamp, the soil deposits consist generally of hard sandy soils with N value of more than 40. While this is expected to serve as an adequate supporting layer, it has the possibility of posing some problems in the construction work. At the salt marshes and mangrove areas, the upper layer is slightly lower in N value than the hill (N=20 - 30), but the value tends to increase with depth, and the N value becomes more than 30 below M.S.L -10. However, the top layer (1 - 2 m thick), as stated before, consists of organic soil with low N value of 0 - 10. For this reason, careful consideration should be taken into for both designing and construction of structures. Also, in case when foundations for structures are to be set up in these areas, adequate processing of the surface deposits liable to be carried down by the Acome river should be taken into account.

Soil conditions are likely to be changeable in the direction approximately perpendicular to the coast line because of considerable difference in topography. In the direction approximately parallel to the coast line, however, soil conditions may have no marked change, judging from less difference in topography. Since no data have been made available on this matter at this stage, confirmation is needed by checking boring data of No. 8 and 9 in Fig.-4.22.

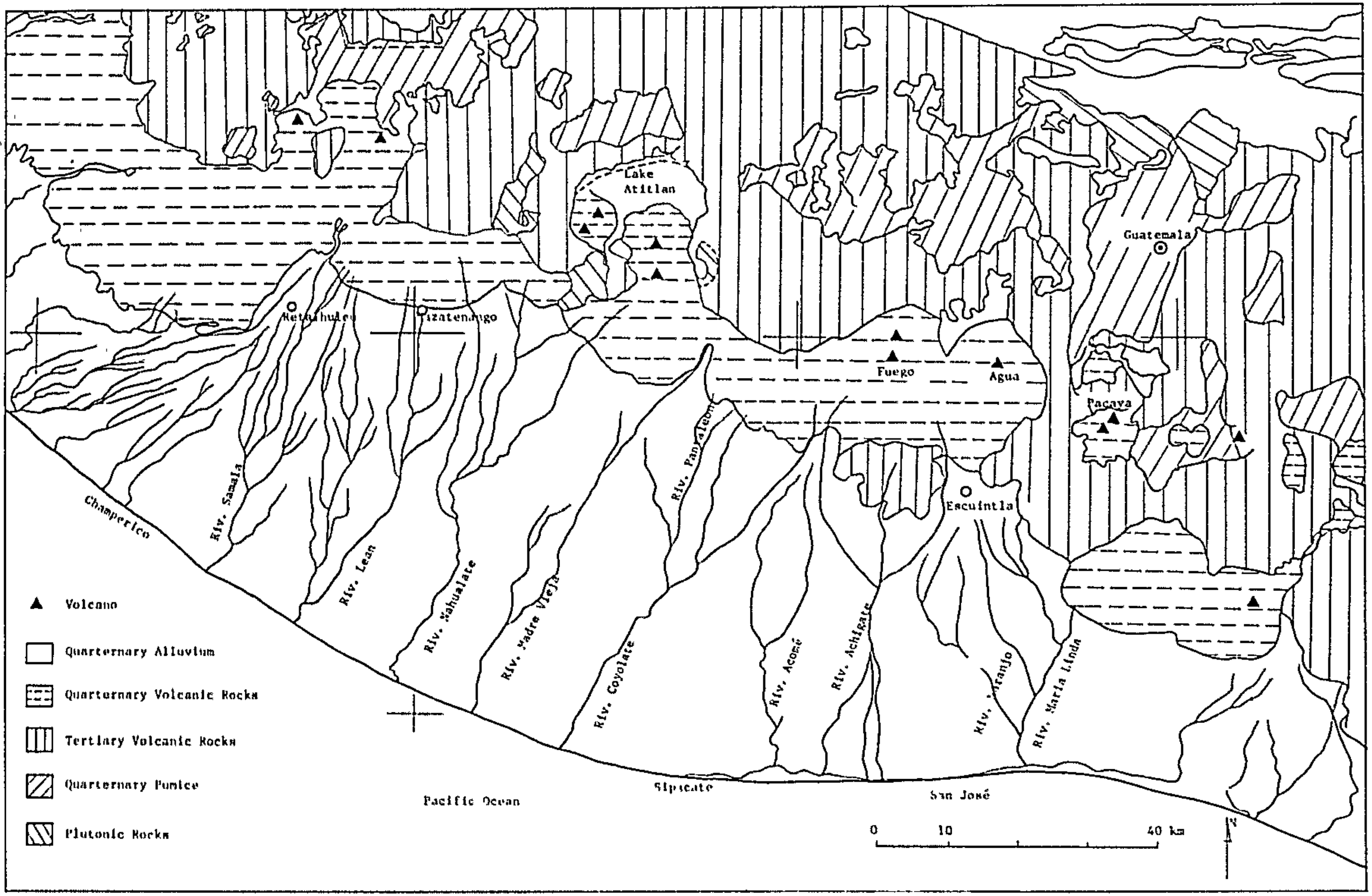


Fig.-4.1 Geological Map at Pacific Ocean Side of Guatemala

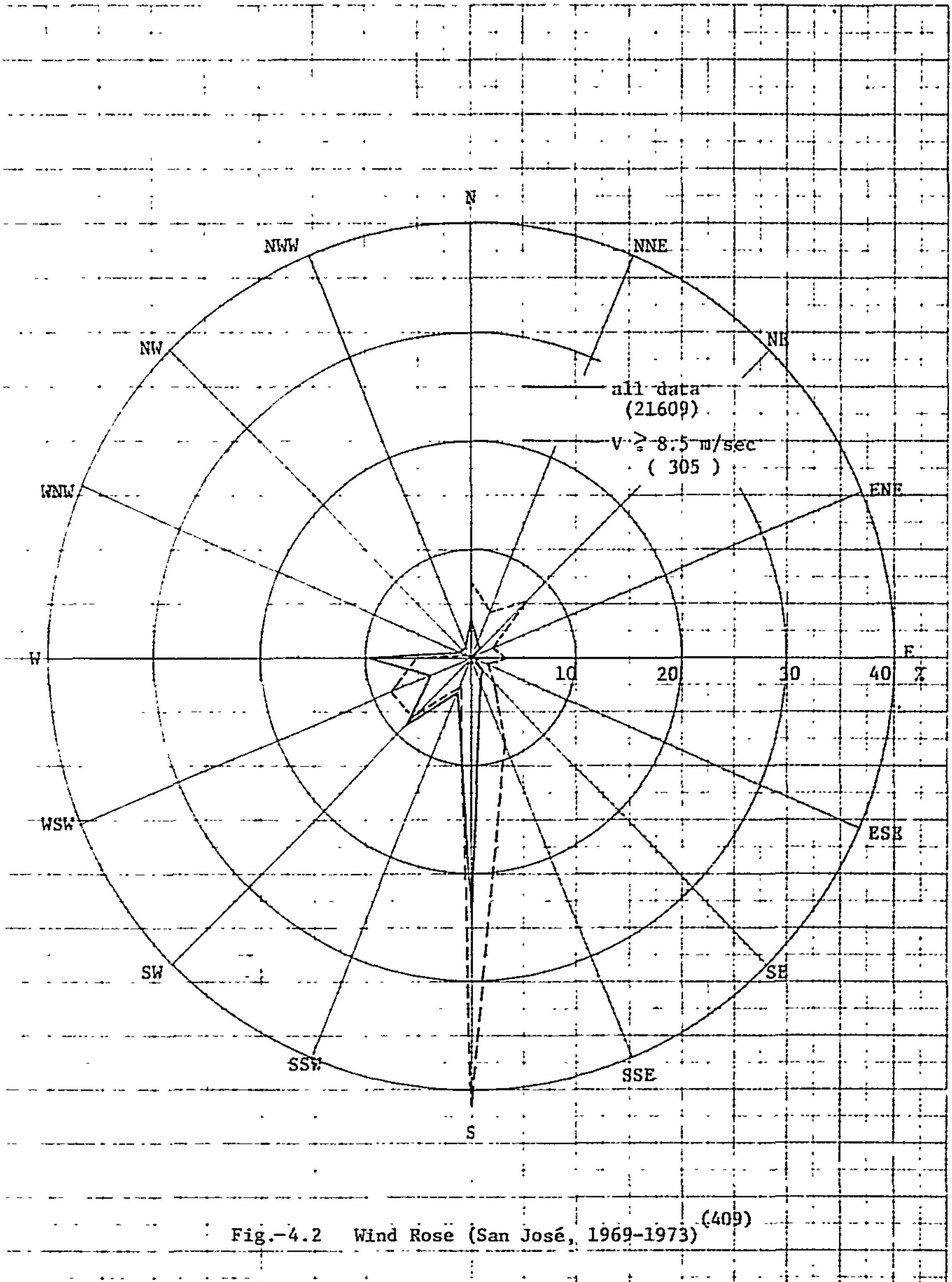


Fig.-4.2 Wind Rose (San José, 1969-1973)(409)

Table - 4.1 Mean monthly data for meteorological elements at San José meteorological observatory (1971)

Month	Wind		Atmospheric pressure (mm)	Temper- ature (°C)	Hu- midity (%)	Rain- fall (mm)
	Wind derection	Wind velocity (m/sec)				
1	SE	1.0	758.9	27.2	63	0.0
2	SE	1.0	758.4	27.0	63	1.0
3	SE	1.6	758.4	28.0	62	6.4
4	S	1.6	758.3	28.8	57	2.2
5	S	1.0	757.9	28.9	71	46.0
6	S	1.0	758.7	27.9	74	58.9
7	S	1.0	758.0	28.2	71	46.2
8	S	1.0	758.5	27.6	75	117.1
9	S	1.0	757.7	27.2	78	68.1
10	S	1.0	757.8	27.6	76	57.0
11	S	1.0	758.2	27.5	72	20.0
12	S	1.0	758.1	27.4	66	0.0

Table - 4.2 Wind over the watershed zone of Pacific coast (Retalhuleu, Suchitepequez, Escuintla)

Month	1	2	3	4	5	6	7	8	9	10	11	12
Predominant wind direction	NNE	NNE/SSW	NNE	NNE	NNE	NNE	NNE	NNE	NNE	NNE/SSW	NNE	NNE
Mean velocity of predominant wind (m/sec)	6.3	5.6	4.9	4.7	3.3	3.5	4.3	4.2	4.4	6.4	6.1	6.3
Maximum possible wind velocity (average) (m/sec)	12.5	11.1	13.9	9.7	9.7	12.5	12.5	13.9	15.3	18.0	20.8	20.8

Table-4.3 Frequency tropical storm occurring over northeastern Pacific

[1966 ~ 1972]

Year	May		June		July		Aug.		Sept.		Oct.		Nov.		Total		
	Hu	TS	Hu	TS	Hu	TS	Hu	TS	Hu	TS	Hu	TS	Hu	TS	Hu	TS	Combined
1966			1				4		2	4		2			7	6	13
1967			1	2		4	2	2	1	2	2	1			6	11	17
1968				1		4	3	5	2	1	1	2			6	13	19
1969					1	2	1	1	1	3	1				4	6	10
1970	1			3	1	5	1	3		1	1	1		1	4	14	18
1971	1		1		5	2	2	2	2		1	1		1	12	6	18
1972	1					1	6		1	1		1		1	8	4	12
7-y Total	3		3	6	7	18	19	13	9	12	6	7		3	47	60	107
										Annual average					6.7	8.6	15.3

Hu: Hurricane

TS: Tropical Storm

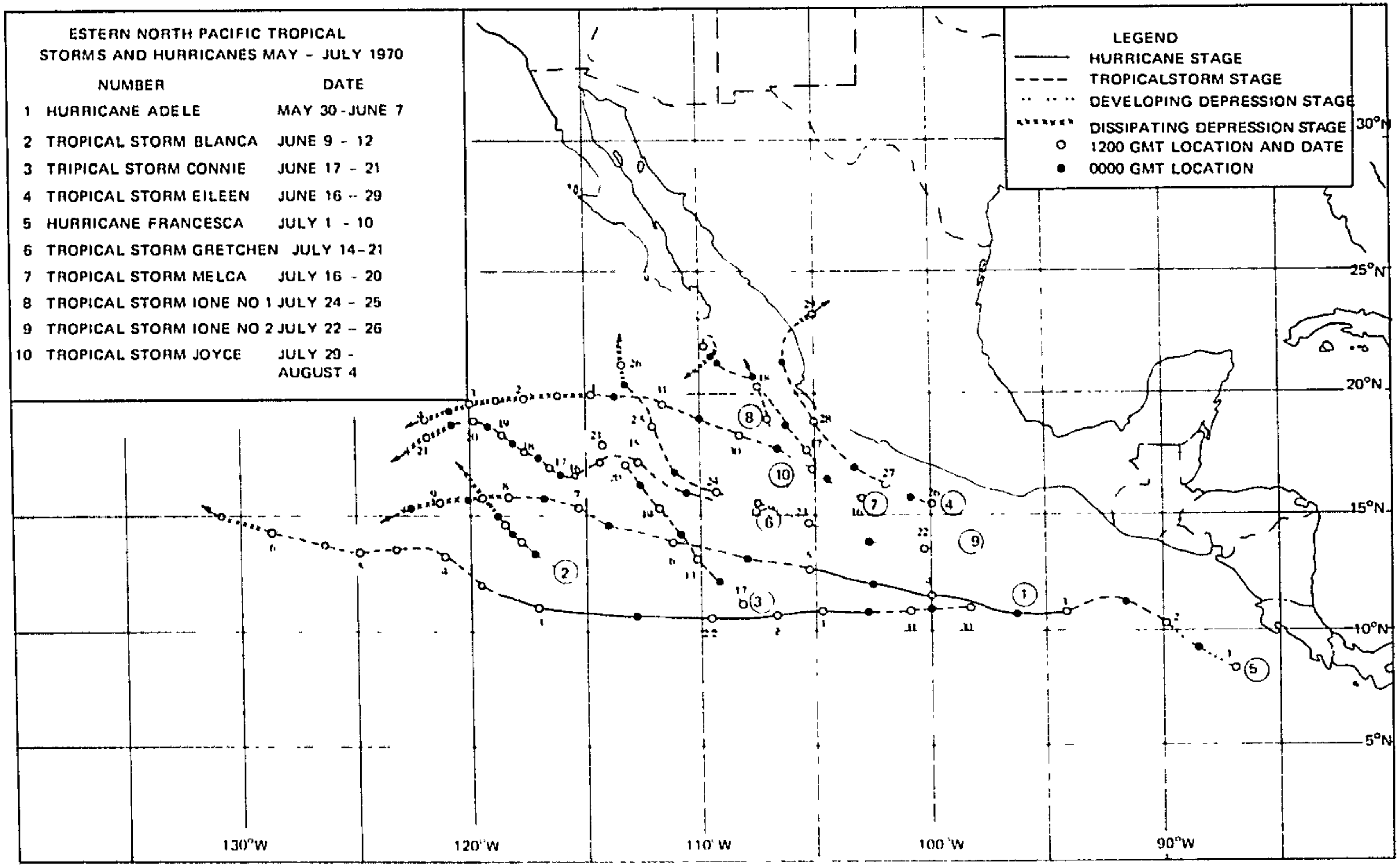


Fig. 4.3 Eastern North Pacific Tropical Storms and Hurricanes druing May - July, 1970 (417)

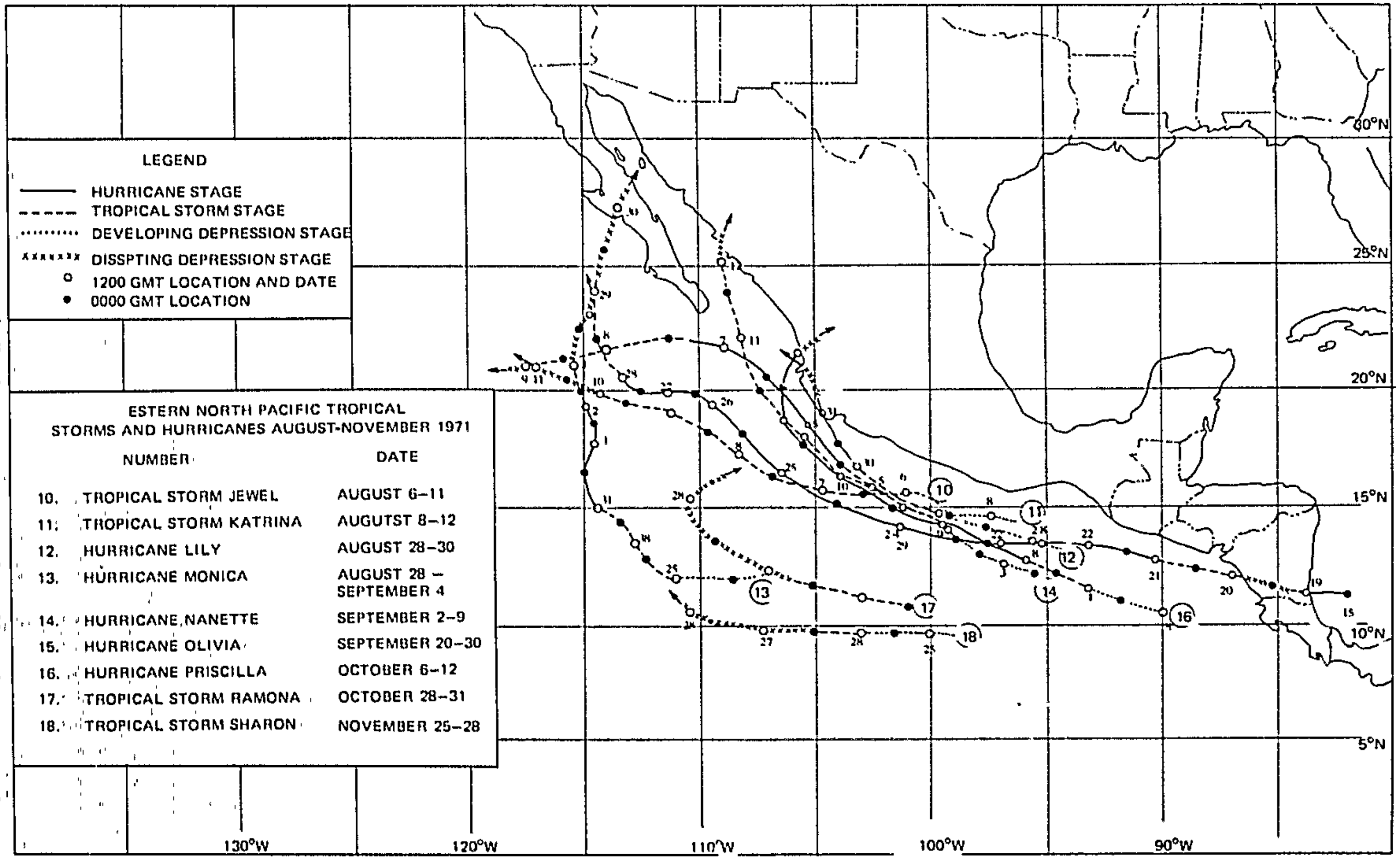


Fig.-4.4 Eastern North Pacific Tropical Storms and Hurricanes during August - November, 1971 416)

Table - 4.4 Harmonic constant of San José Port

(Lat. 13°55'0 N , Long. 90°49'8 W)

Tidal constituents	H (cm)	κ (°)	Tidal constituents	H (cm)	κ (°)	Tidal constituents	H (cm)	κ (°)
M_2	72.51	61.2	2	0.37	219.0	$(2SM)_2$	0.12	127.6
S_2	14.11	133.2	S_1	0.76	69.3	M_3	0.15	181.4
N_2	15.15	27.3	M_1	0.30	53.1	L_3	0.55	159.8
K_1	9.63	6.8	J_1	0.73	15.6	$(2MK)_2$	0.09	24.9
M_4	0.21	330.7	Mm	0.91	338.7	K_2	3.32	125.7
O_1	5.52	34.5	Ssa	3.32	241.6	M_8	0.03	172.6
M_4	0.15	180.6	Sa	3.60	178.6	$(MS)_4$	0.09	217.1
$(MK)_3$	0.06	271.0	MSf	0.40	313.2			
S_1	0.09	345.2	Mf	1.04	35.4			
$(MN)_1$	0.03	301.0	1	0.12	9.7			
2	2.44	23.0	Q_1	1.31	38.4			
S_8	0.03	299.7	T_2	0.82	156.0			
2	2.47	359.9	R_2	0.21	59.8			
$(2N)_2$	1.83	357.5	$(2Q)_1$	0.21	54.2			
$(OO)_1$	0.67	11.0	P_1	3.14	5.5			

Table-4.5 Annual highest and lowest sea level at port of San José and at port of Champerico

Highest tide		Lowest tide		Date			
O.D.L. (m)	C.D.L. (m)	O.D.L. (m)	C.D.L. (m)	year	month	day	time
Puerto de San José (Δh = 0.44m)							
2.93	2.49			1963	Nov.	3	03.29
		0.34	-0.10		Nov.	1	20.24
2.76	2.32			1964	May	14	17.00
		0.21	-0.22		Jun.	10	21.21
2.80	2.37			1965	Jul.	30	16.30
		0.17	-0.27		Apr.	14	07.00
2.80	2.37			1966	Jan.	9	04.00
		0.17	-0.27		Apr.	7	22.48
2.77	2.34			1967	Aug.	12	07.18
		0.17	-0.27		Apr.	26	23.00
2.80	2.37			1968	Sep.	26	05.18
		0.30	-0.13		Feb.	16	10.24
		0.30	-0.13		Mar.	17	11.00
		0.30	-0.13		May	14	22.30
3.03	2.60			1969	Jun.	2	16.00
		0.44	-0.11		Mar.	19	09.30
2.85	2.41			1970	Oct.	17	04.00
		0.34	-0.10		Mar.	10	23.30
2.96	2.52			1971	Oct.	7	04.30
		0.24	-0.19		Feb.	27	10.12
2.96	2.52			1972	Sep.	26	04.30
		0.33	-0.11		Apr.	16	23.00
2.80	2.37			1973	Aug.	2	05.18
		0.34	-0.10		Jul.	3	23.18
Puerto de Champerico (Δh = 0.76m)							
3.29	2.53			1970	Oct.	17	04.00
		0.96	0.20		Mar.	10	10.54
3.66	2.90			1971	Jun.	15	07.00
		1.04	0.28		Apr.	26	22.24
3.55	2.79			1972	Sep.	26	04.30
		1.19	0.43		Apr.	15	22.30
3.23	2.47			1973	Jul.	2	16.00
		0.91	0.15		Jul.	8	15.18

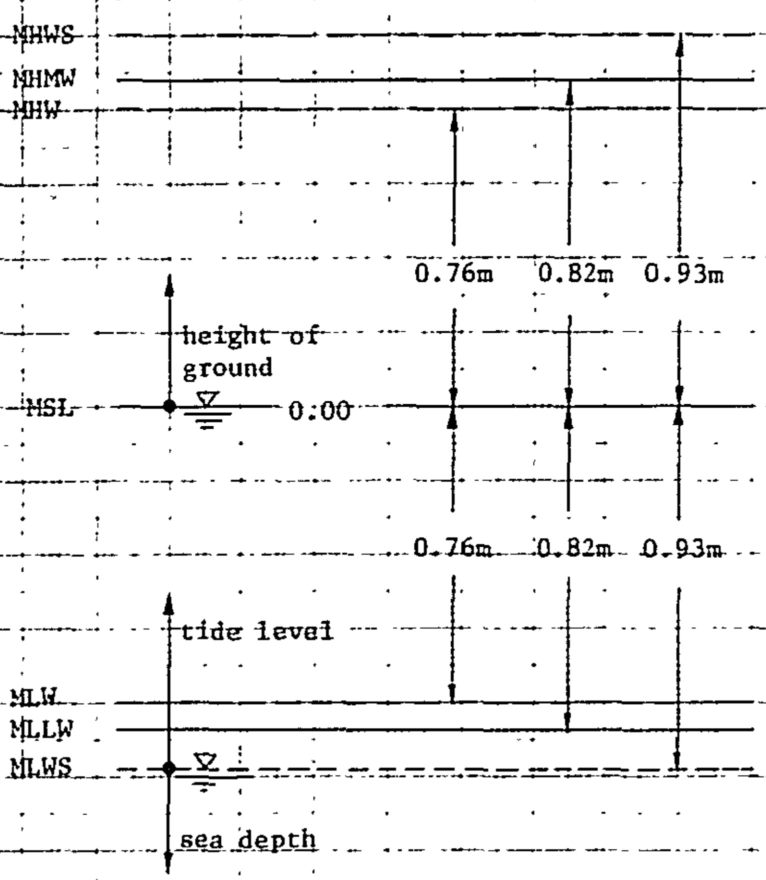


Fig.-4.5 Tide Level at Pacific Coast

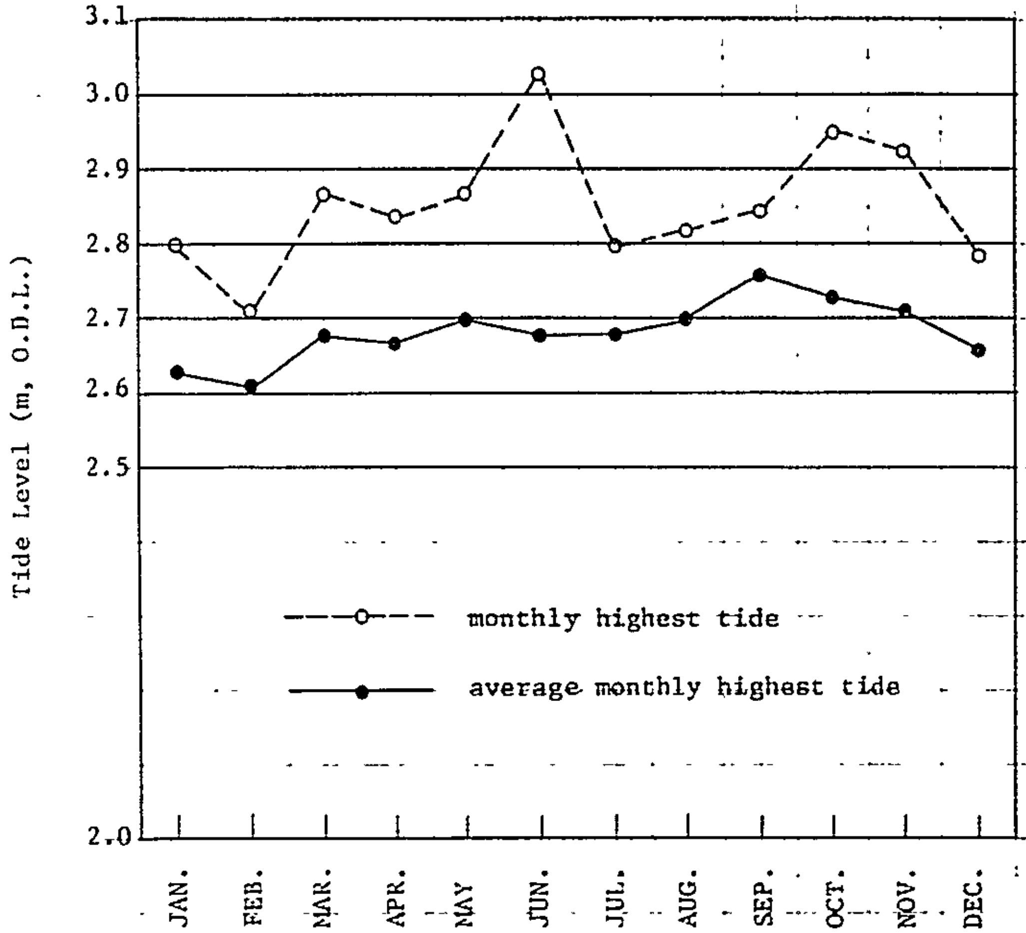


Fig.-4.6 Monthly Highest Tide Level at Pto. San José (1963 - 1972)

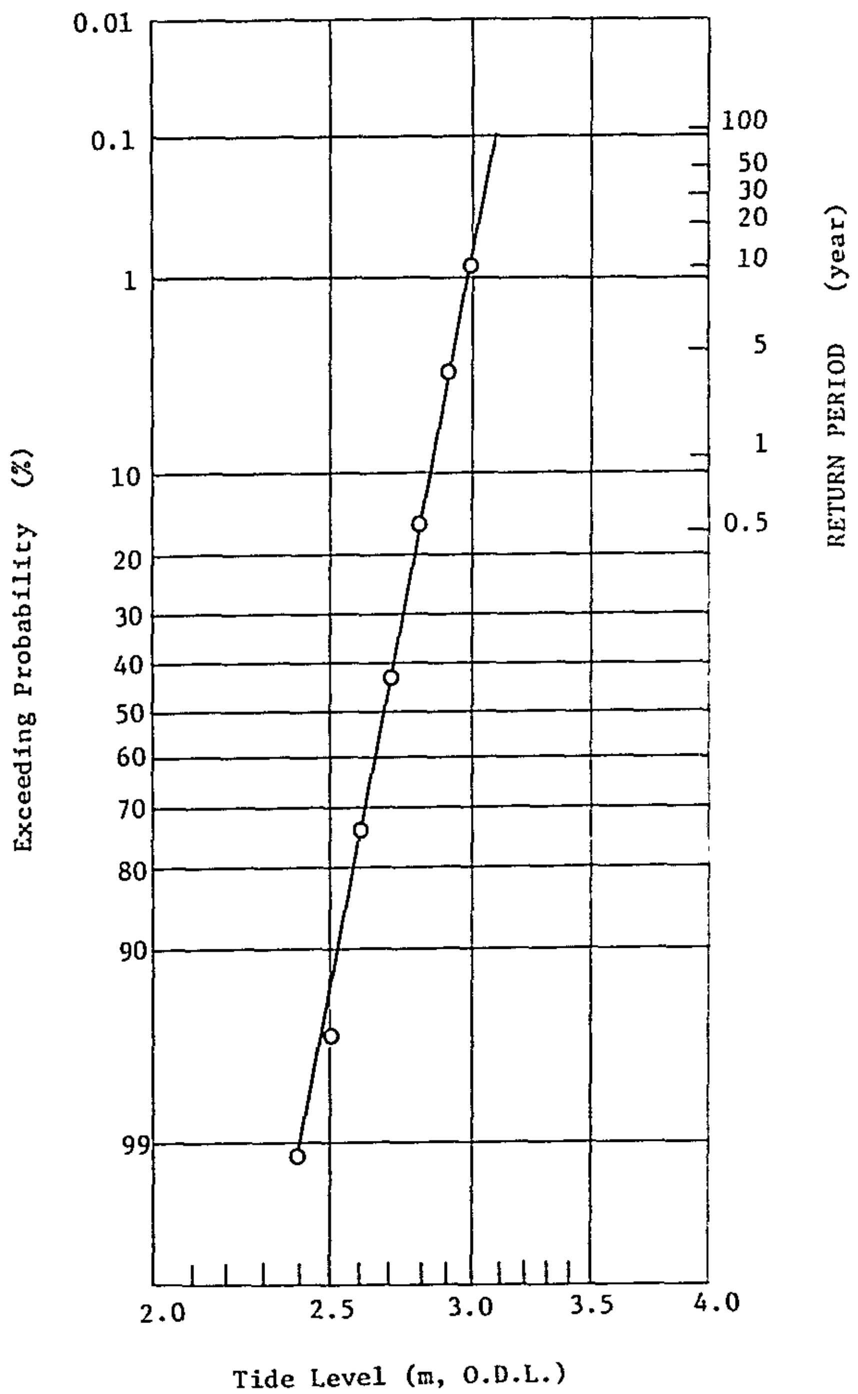


Fig.-4.7 Occurrence Probability of High Tide at Pto. San José based on Monthly Highest Tide Data

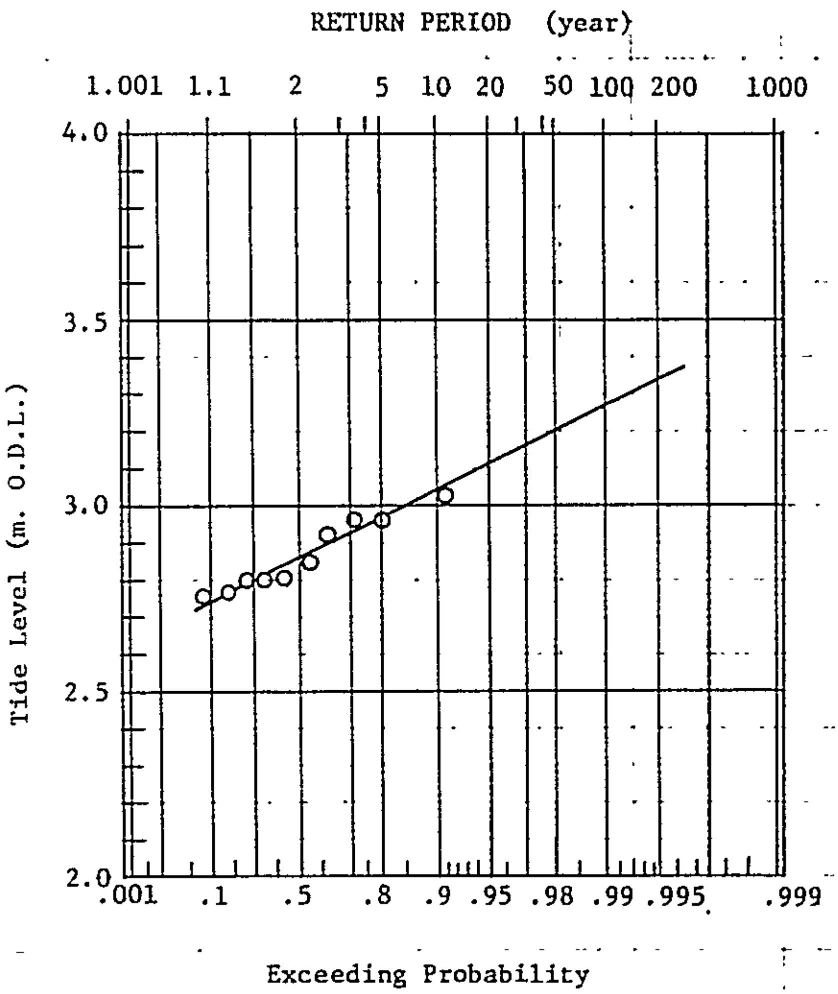
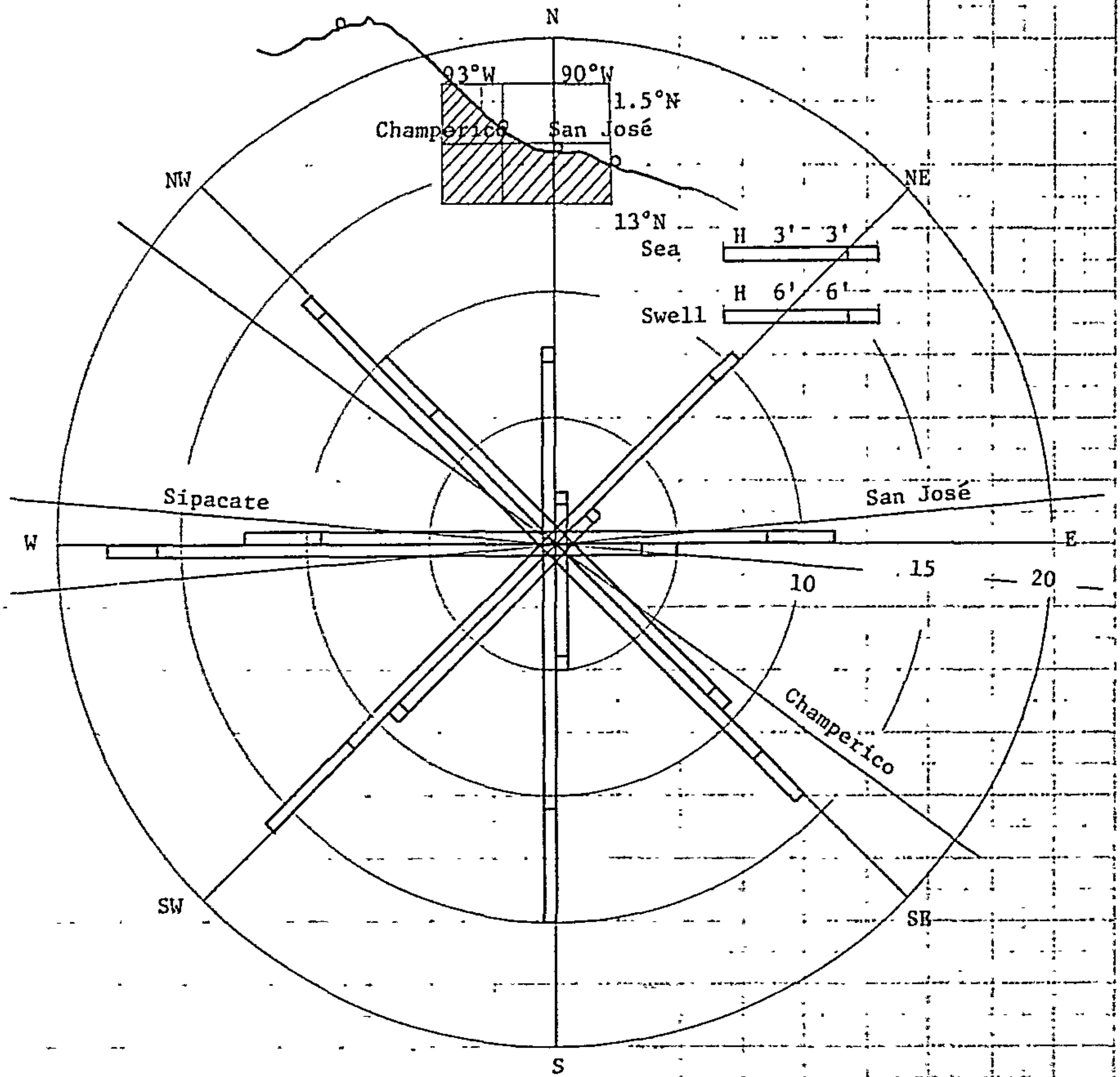


Fig.-4.8 Occurrence Probability of Hight Tide at Pto. San José, based on Yearly Highest Tide Data

Table - 4.6 Expected value of waves due to storms occurring in Southern Hemisphere

Return period (year)	Generating region		Acajutla	
	Ho (m)	To (sec)	Hs (m)	Ts (sec)
20	14.3	17	3.0 ~ 3.7	19 ~ 21
50	15.5	18	3.7 ~ 4.3	21 ~ 23
100	16.4	19	4.3 ~ 4.9	23 ~ 25

Fig.-4.9 Directional Frequency of Sea Wave and Swell in the Offshore of Guatemalan Pacific Coast, based on the Data by Corps of Engineers



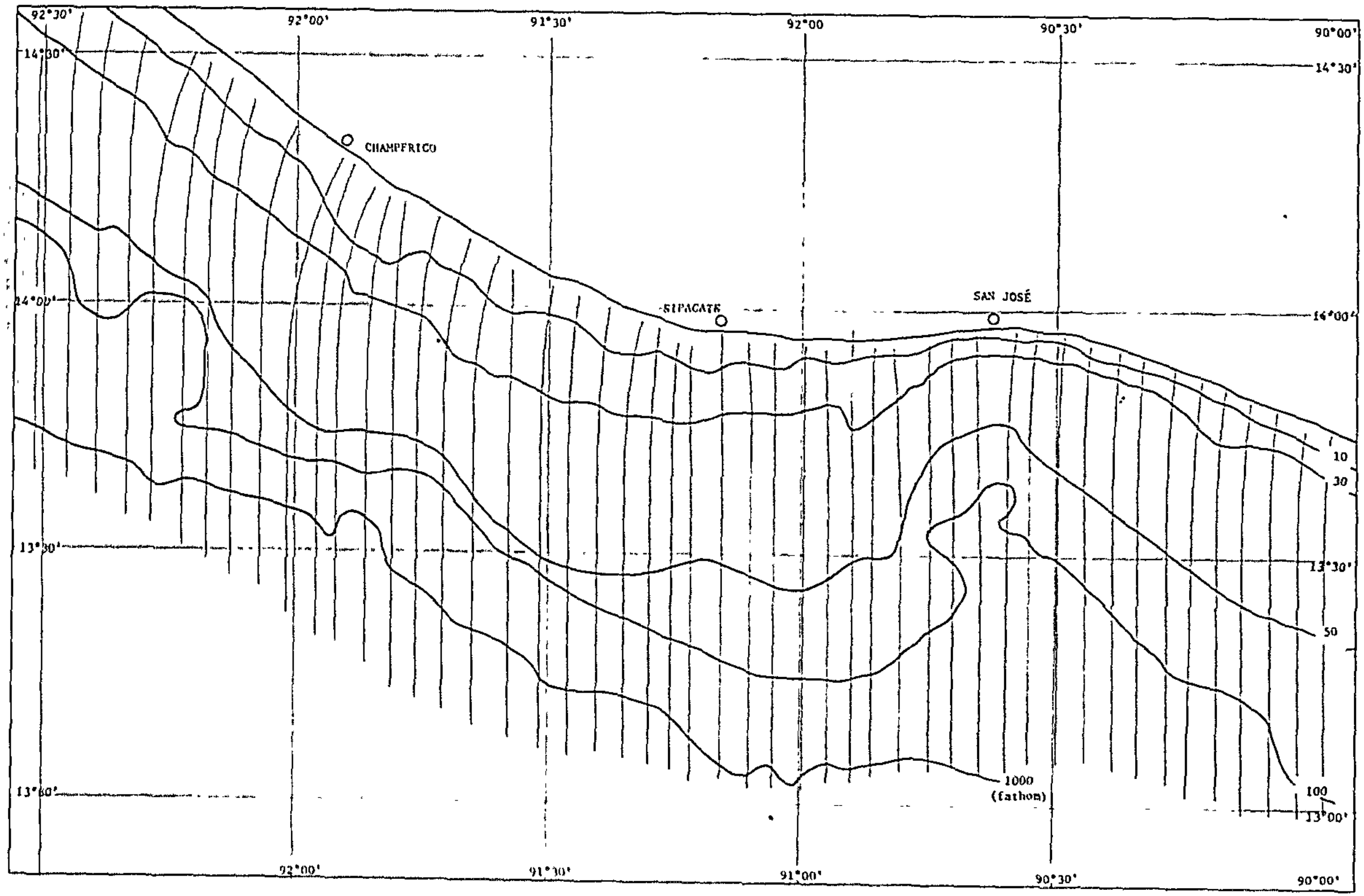


Fig.-4.10 Wave Refraction at the Guatemalan Pacific Coast

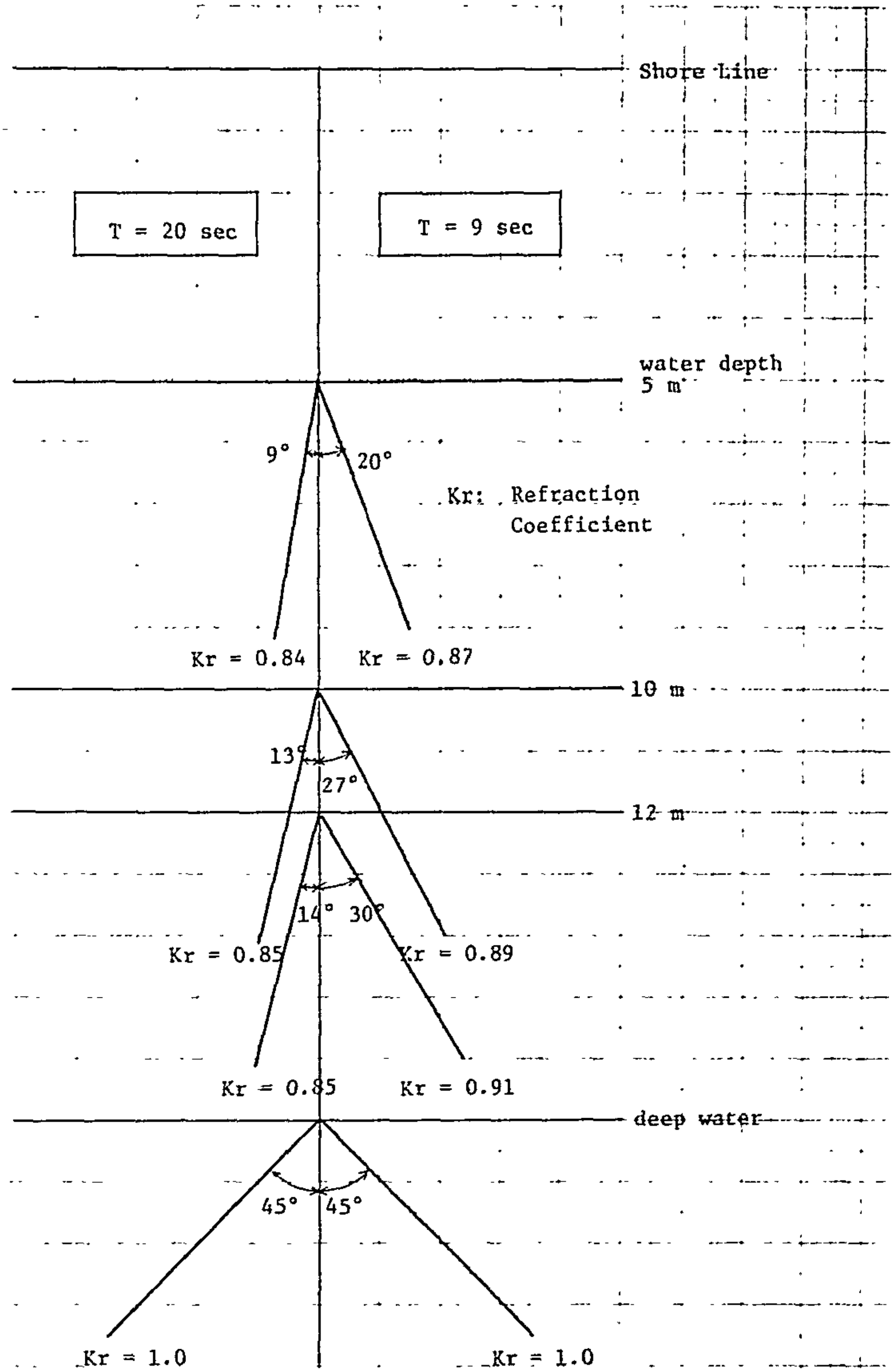


Fig.-4.11 Wave Refraction on the Sea Bottom with Parallel Linear Isobath

Table-4.7 Post-refraction waves at 10-meterdepth

deepwater wave				wave at water depth of 10m				
direction	period (sec)	length (m)	height (m)	Kr	Ks	direction*	length (m)	height (m)
SE	9	126	4.0	0.89	0.96	153°	82	3.4
SW	20	624	3.0	0.85	1.29	193°	195	3.3

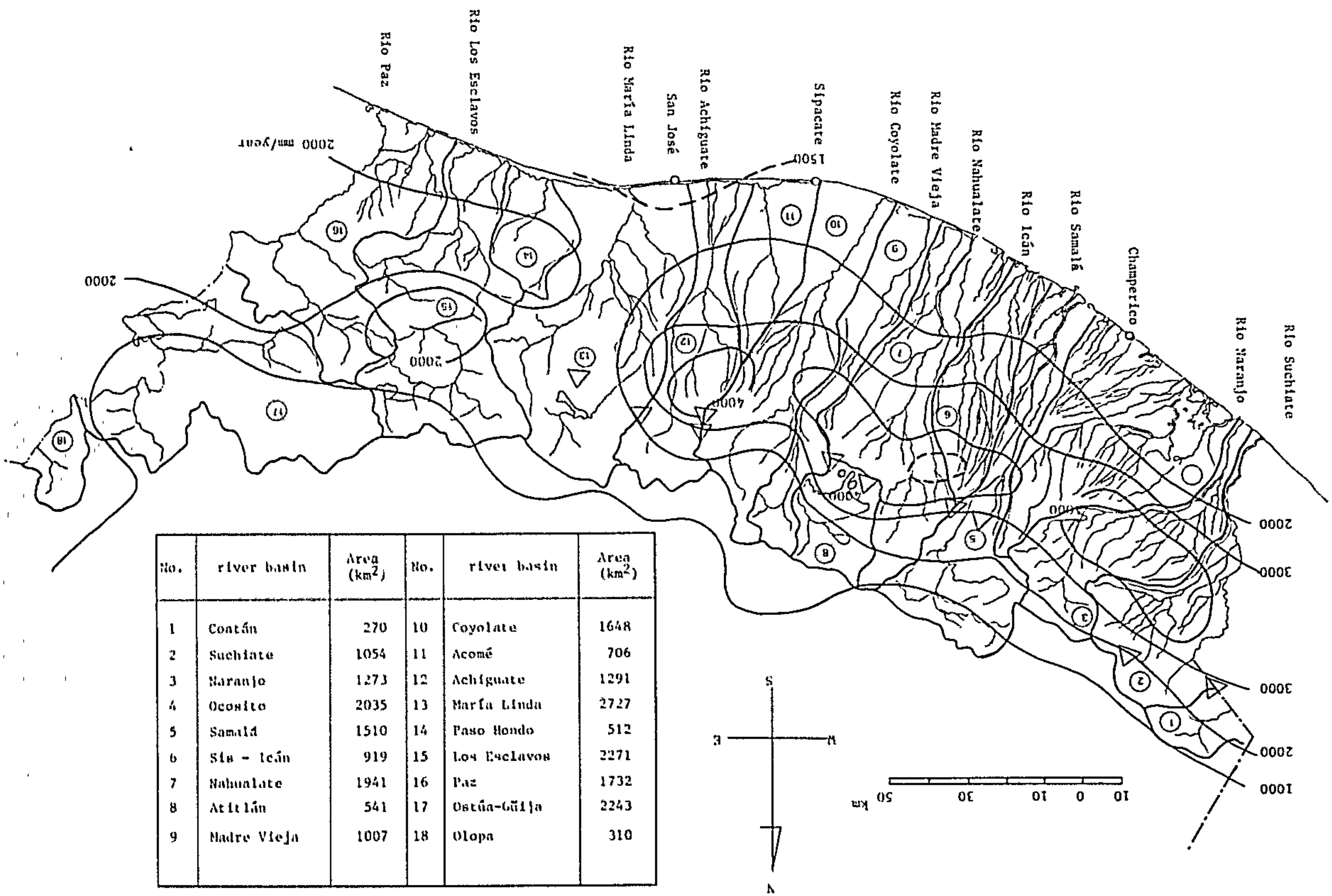
* Angle measured in clockwise from the north

Table-4.8 Design significant wave near breakwater construction site

wave direction	wave period (sec)	wave height (m)
150° ± 15°	9	4.0
190° ± 15°	20	3.5

Table-4.9 Mean value of the result of visual observations of wave heights of one single wave at San José pier

average of all data	average of monthly highest	average of yearly highest
1.0	1.7	2.3



No.	river basin	Area (km^2)	No.	river basin	Area (km^2)
1	Contán	270	10	Coyolate	1648
2	Suchiate	1054	11	Acomé	706
3	Naranjo	1273	12	Achiguate	1291
4	Ocosito	2035	13	María Linda	2727
5	Samalá	1510	14	Paso Hondo	512
6	Sís - Icán	919	15	Los Esclavos	2271
7	Nahualate	1941	16	Paz	1732
8	Atitlán	541	17	Ostúa-Güija	2243
9	Madre Vieja	1007	18	Olopa	310

Fig.-4.12 Rivers and Precipitation in the watershed of Pacific Ocean Side

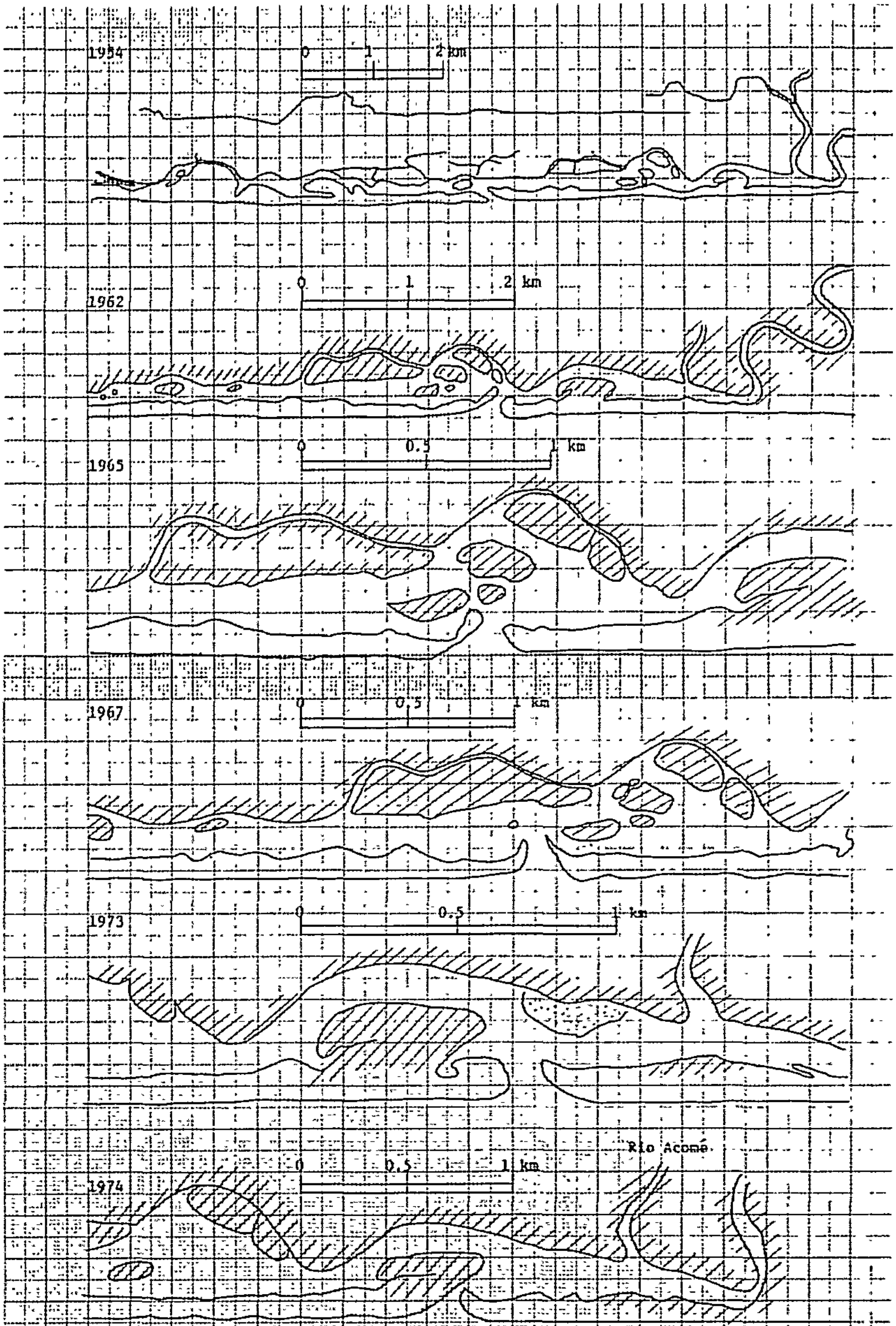


Fig.-4.13 Changes of River Mouth of Rio. Acomé

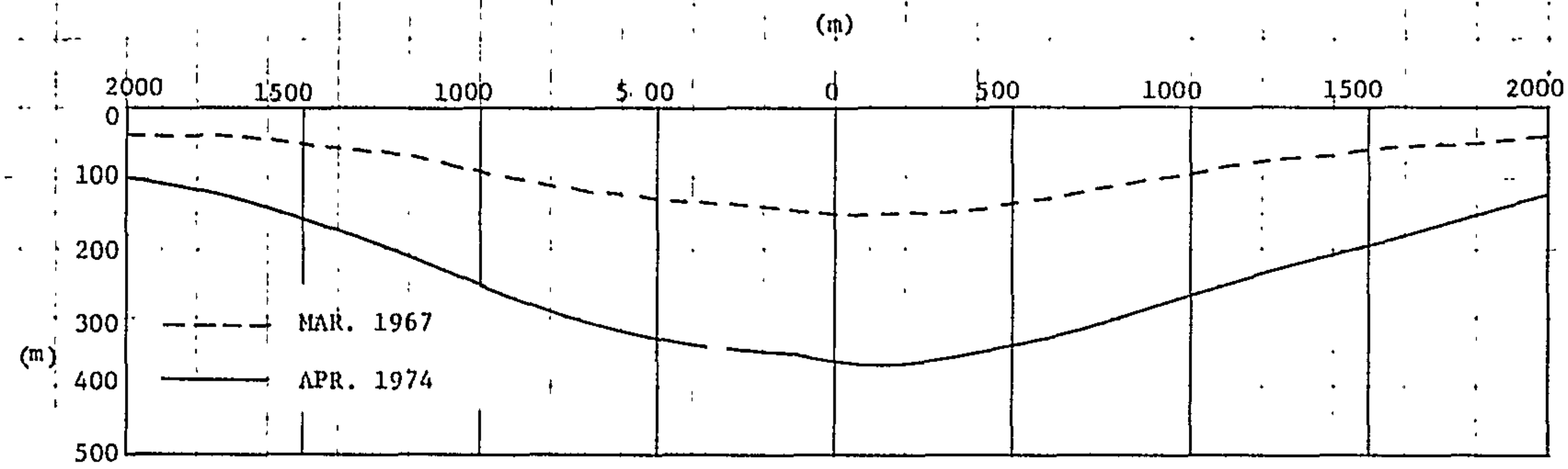


Fig. 4.14 Delta at River Mouth of Rio Achiguate

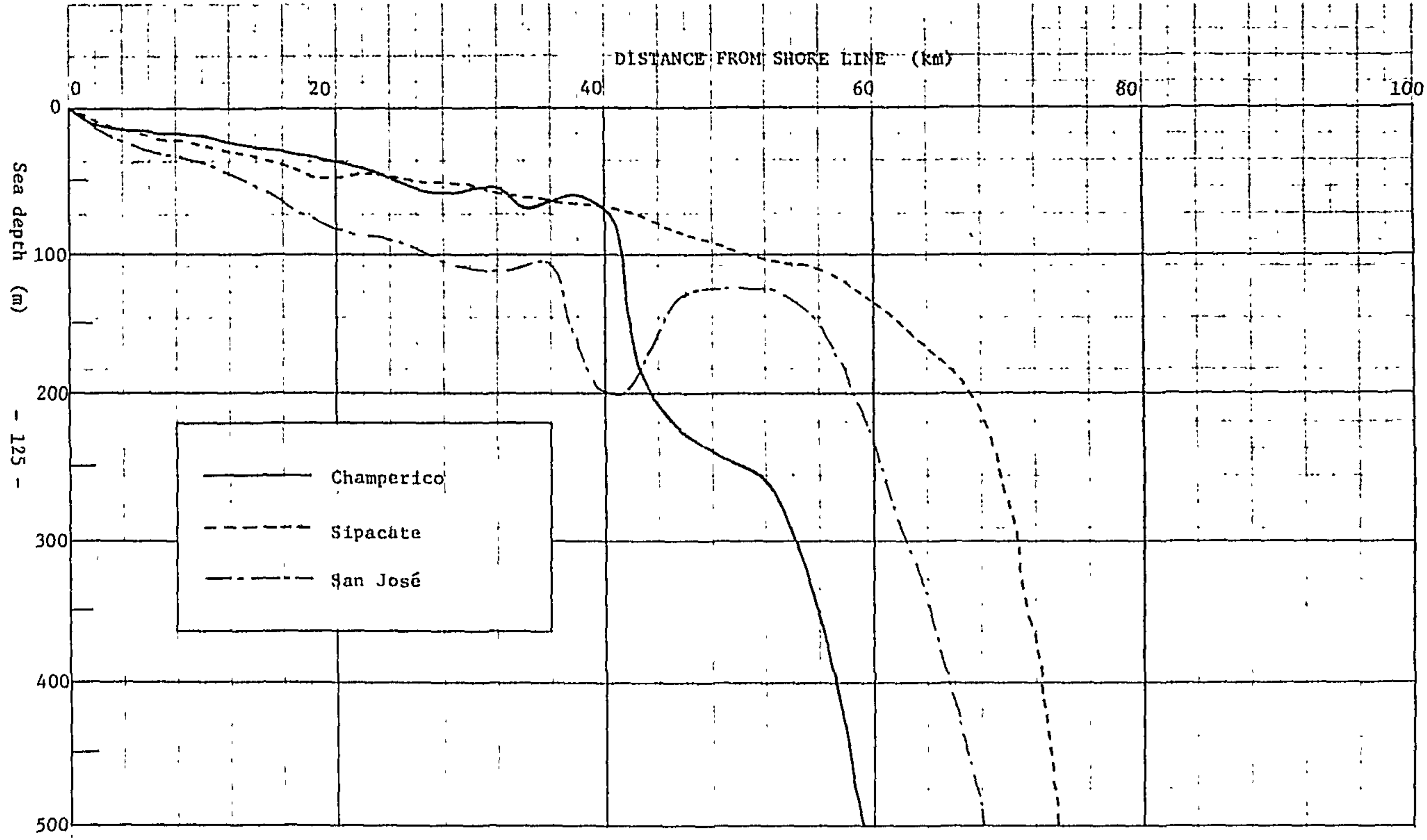


Fig. 4.15 Macroscopic configration of Sea Bottom

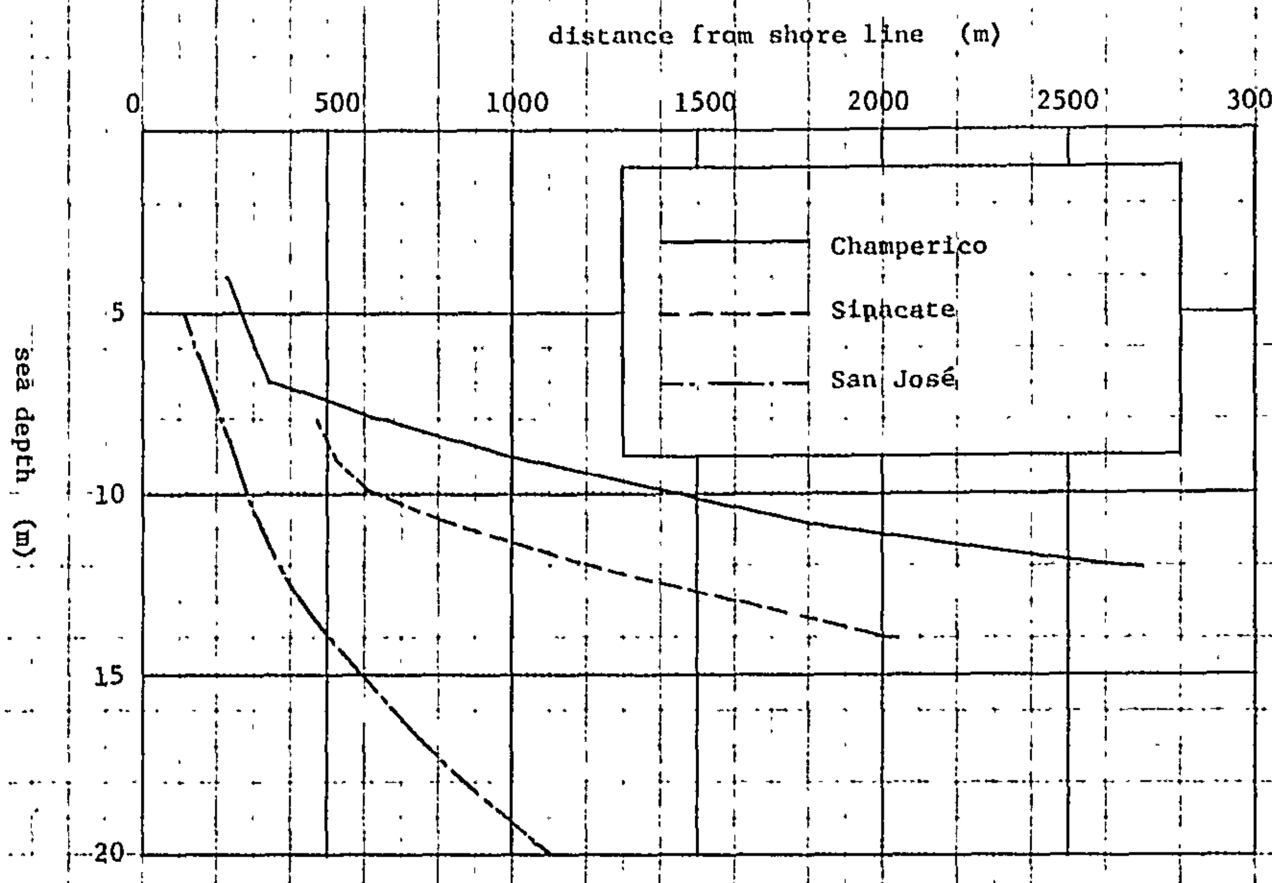


Fig.-4.16 Configration of Sea Bottom near Coast

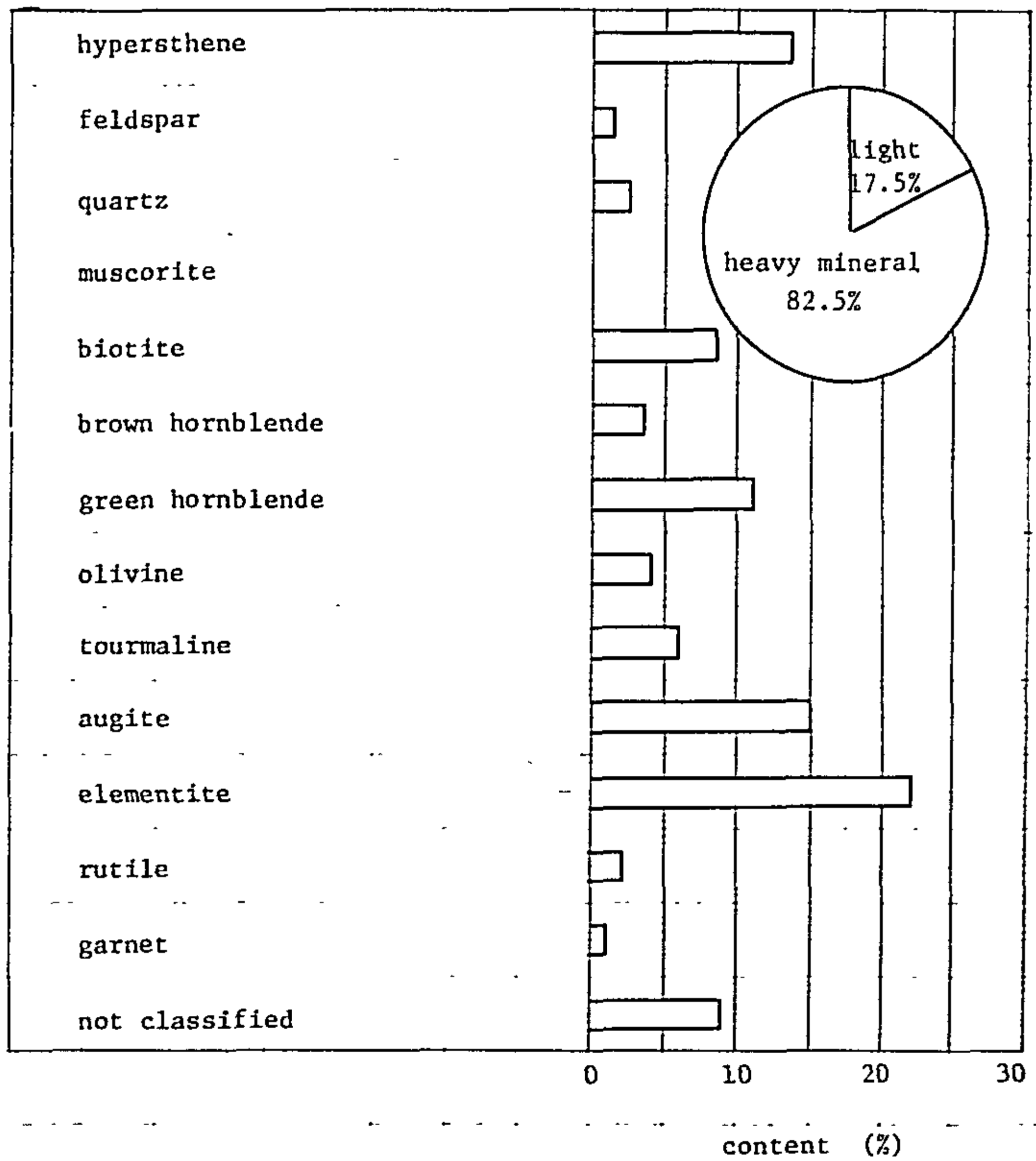


Fig.-4.17 Contents of Heavy Minerals

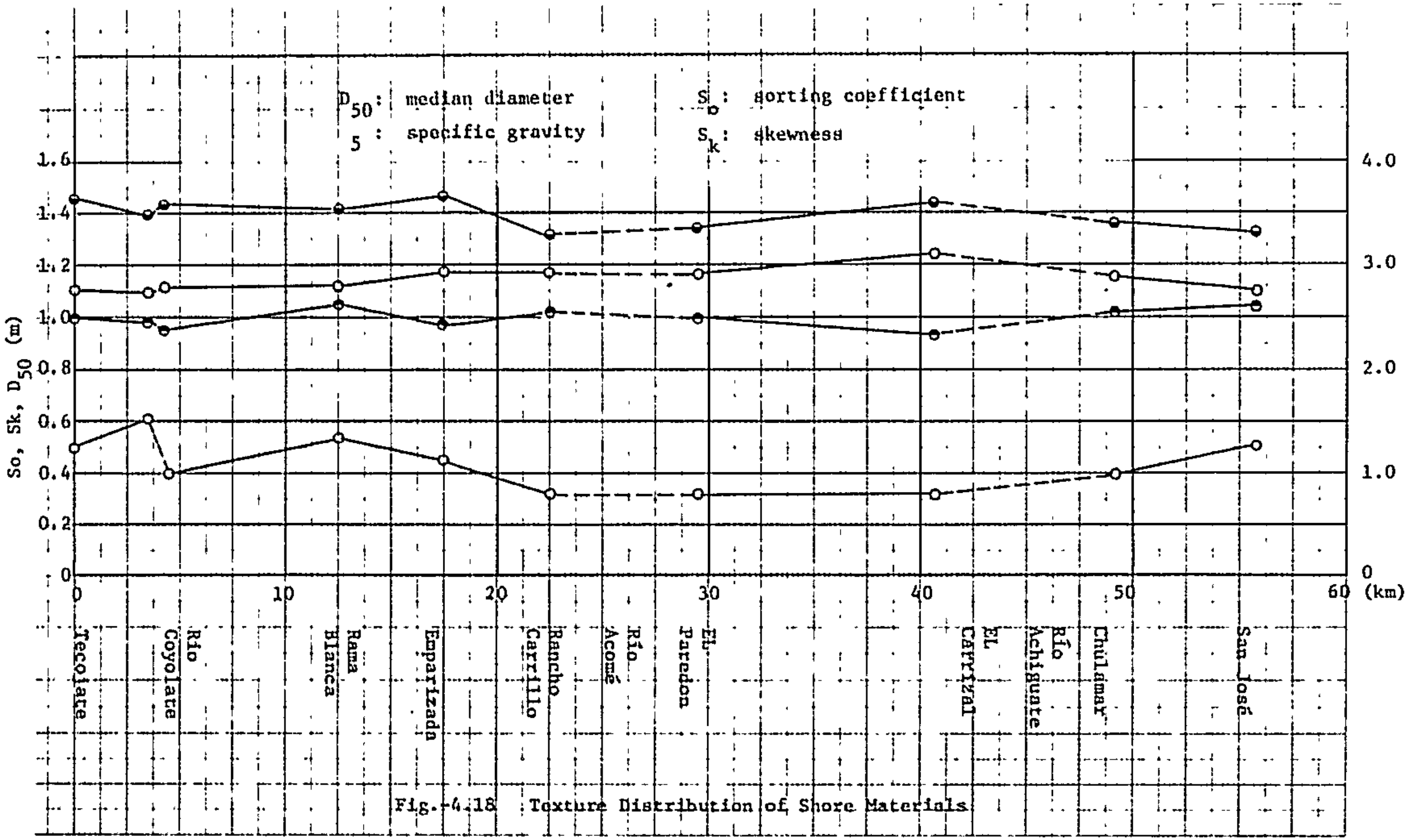


Fig. 4.18 Texture Distribution of Shore Materials

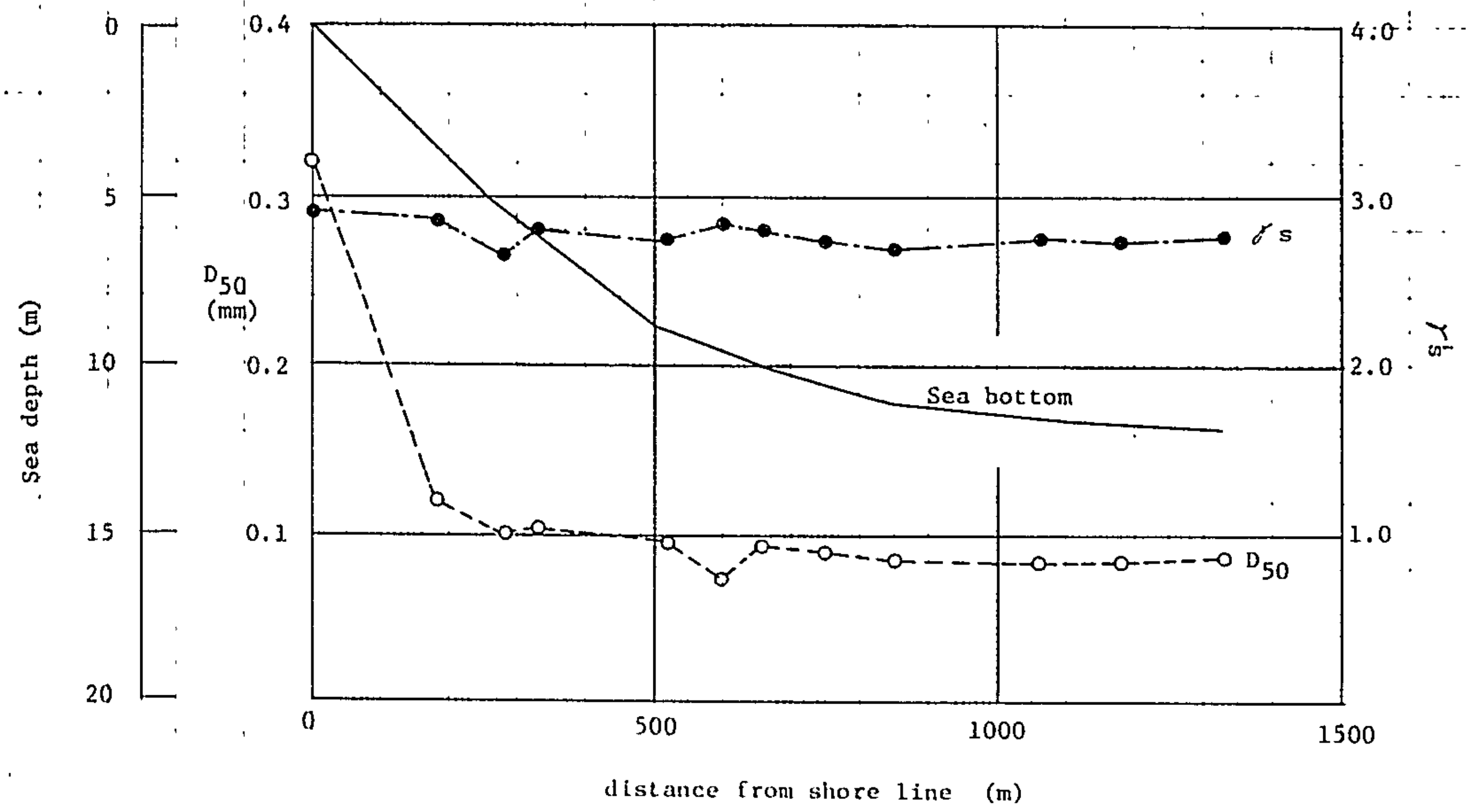


Fig.-4.19 Texture Distribution of Sea Bottom Materials at Sipacate Coast

Table-4.10 Earthquakes of magnitude 7 or above (since 1900)

Year	Location Lat. Long	Depth Km	Magnitude (Richter)
1902	13.50N - 91.0W	25	7.73
1914	17.00N - 92.0W	150	7.23
1915	14.00N - 89.0W	80	7.48
1921	15.00N - 91.0W	120	7.23
1942	13.50N - 91.0W	0	7.73
1953	13.80N - 91.8W	0	7.14

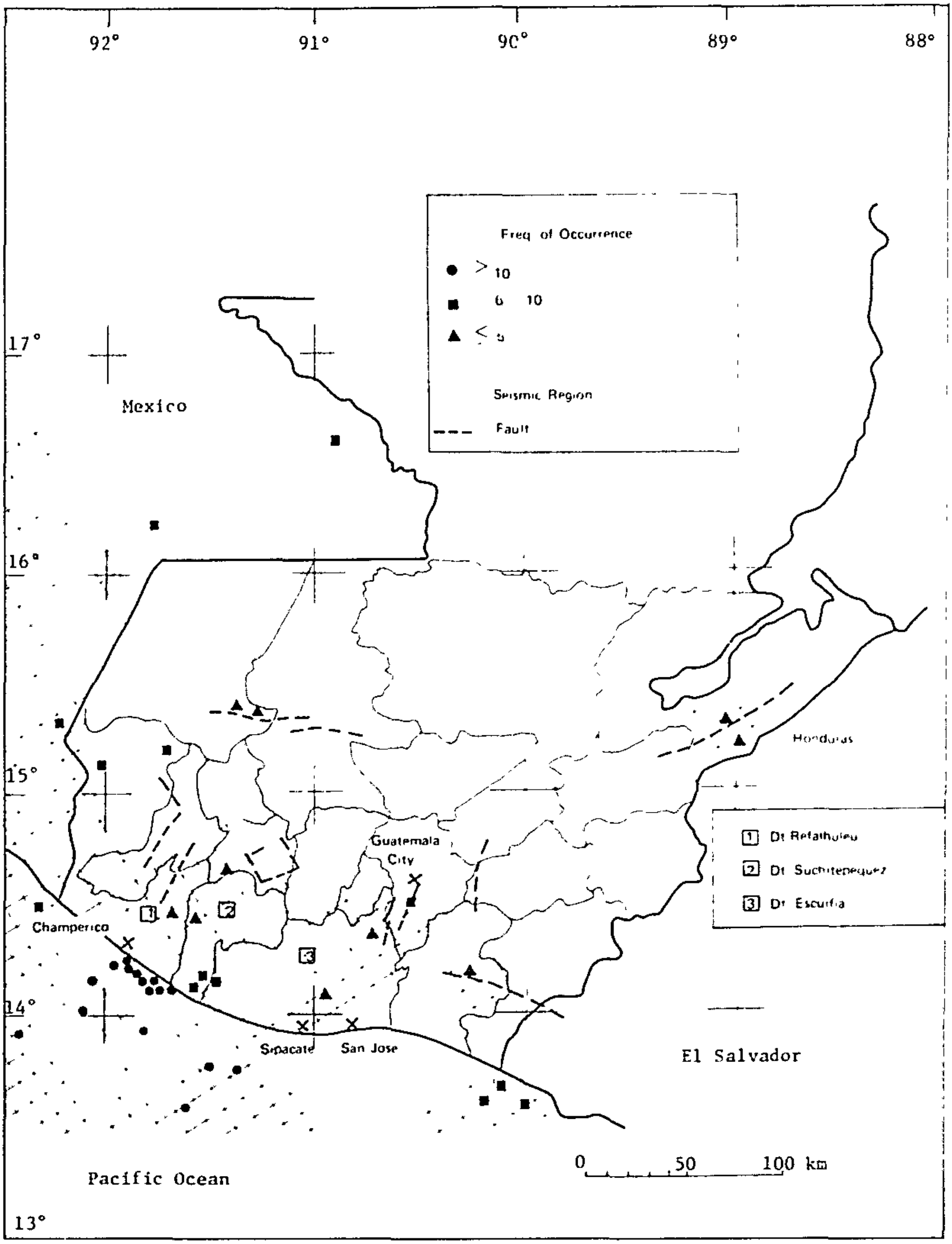


Fig. 4.20 Distribution of Epicenters Classified by Frequency
(Based on past 30 years' statistics)

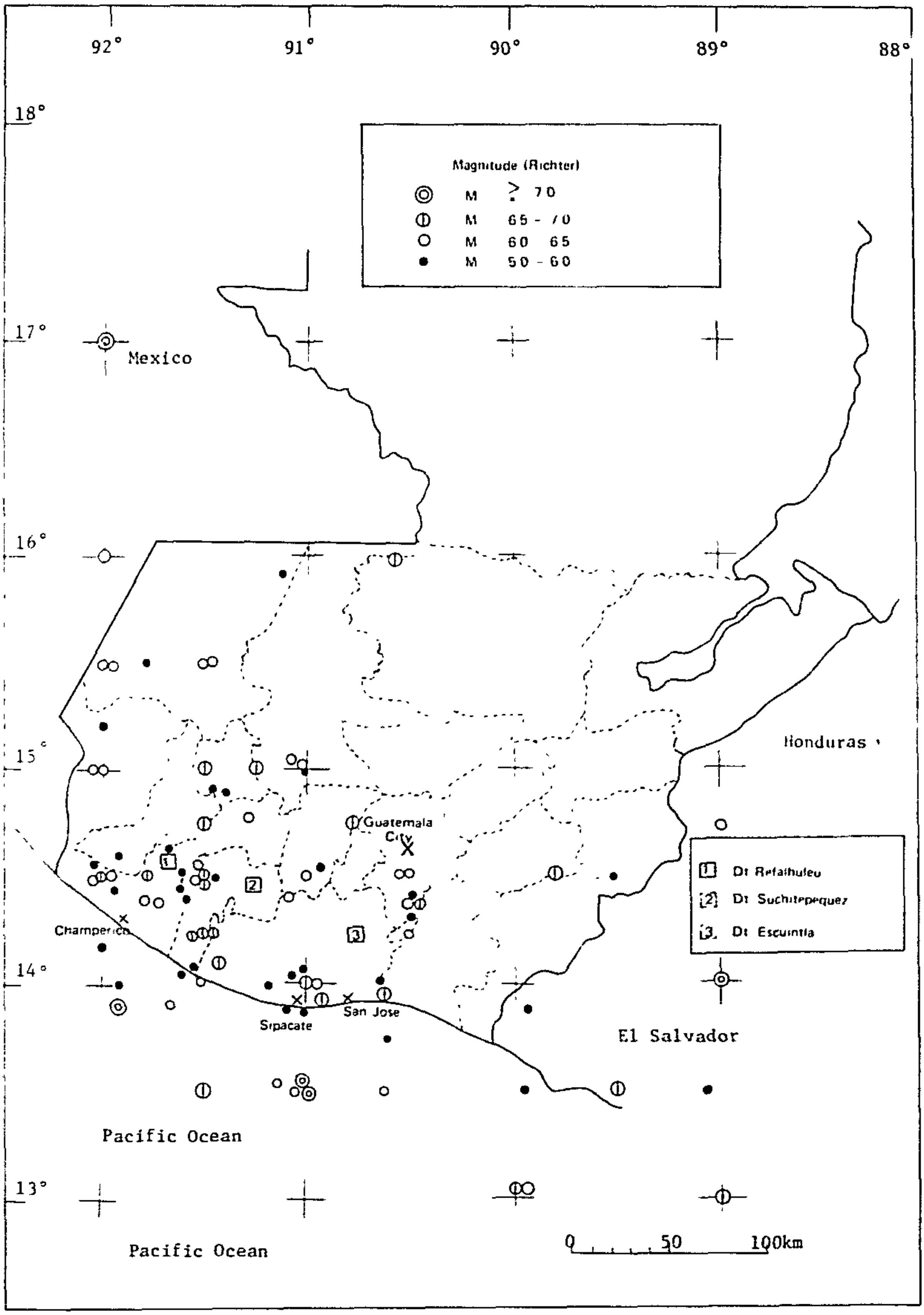


Fig.-4.21 Distribution of Epicenters Classified of magnitude
(Since 1900 year)

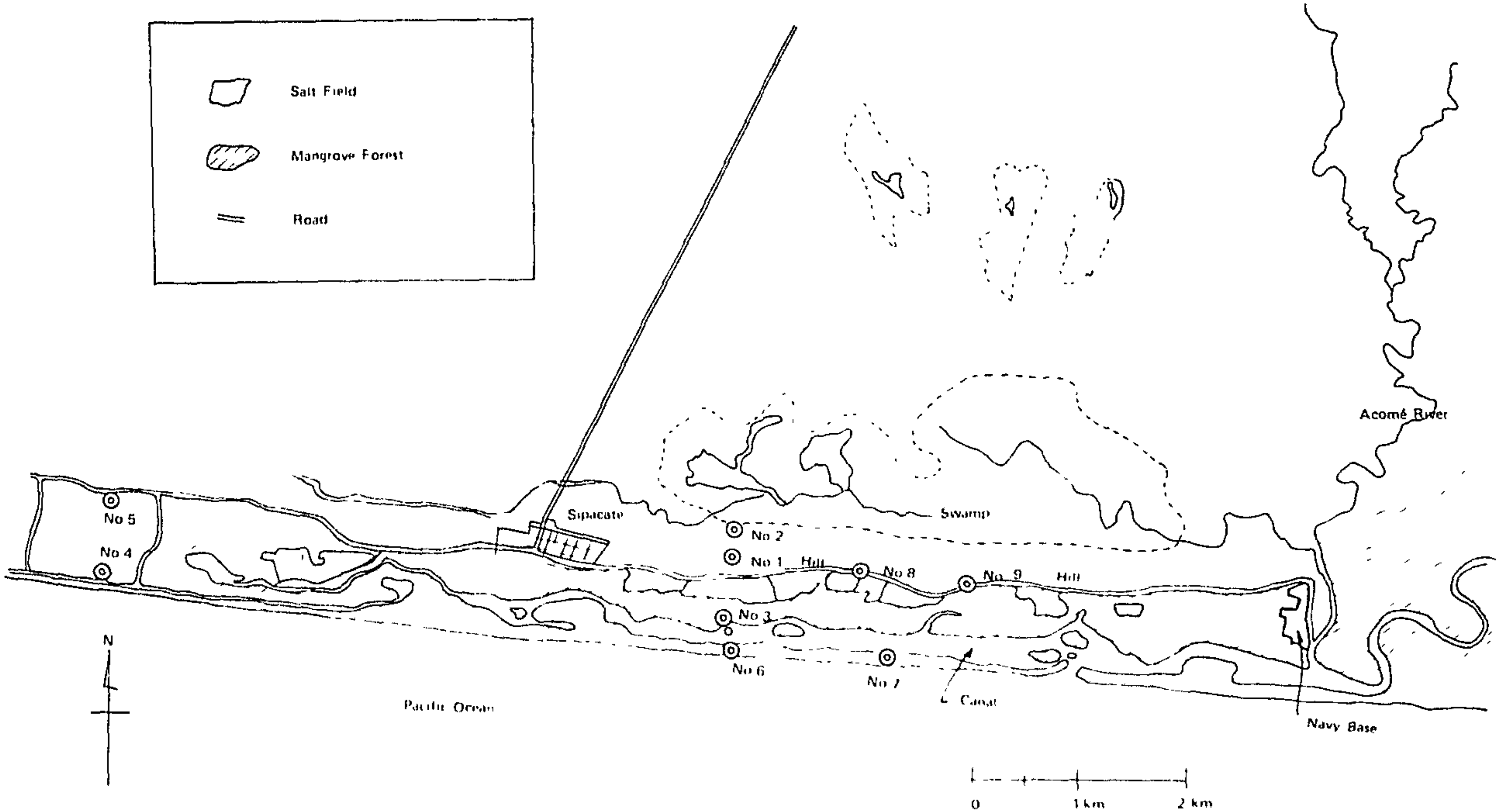


Fig. 4.[illegible] Locations of Boring Performance

Table-4.11 Results of physical test on Sipacate Soils

Specimen		Grain Size Distribution			D_{10}	D_{30}	D_{60}	Gs
No.	Depth (m)	less 0.074mm	0.074mm ~0.42mm	0.42mm ~2.0mm	mm	mm	mm	
1-1	0 - 1.22	20.1	47.1	32.8	-	0.18	0.38	2.64
2	1.22 - 1.83	4.6	67.1	28.3	0.16	0.25	0.35	2.90
3	1.83 - 6.10	1.2	52.4	46.4	0.24	0.31	0.45	2.83
4	6.10 - 9.75	9.8	43.5	46.7	0.11	0.27	0.48	2.88
5	9.75 -13.63	22.2	34.3	41.5	-	0.20	0.45	2.88
6	12.63 -28.04	7.3	47.5	43.2	0.094	0.23	0.45	2.84
2-1	0.61 - 1.22	35.2	21.3	39.5	-	0.05	0.55	2.63
2	2.44 - 3.05	13.0	20.5	61.5	0.05	0.39	0.75	2.70
3	3.66	1.1	25.6	71.3	0.43	0.62	0.97	2.66
4	10.97 -12.19	79.0	21.0	0.0	-	-	-	2.08
5	14.02 -17.07	56.2	21.2	8.6	-	-	0.10	2.37
6	24.38	6.9	51.7	39.4	0.11	0.23	0.43	2.46
7	24.38 -28.65	22.4	74.2	3.4	0.05	0.089	0.17	-
3-1	0 - 0.60	1.5	84.5	14.0	0.14	0.21	0.29	2.96
2	0.60 - 3.00	8.0	67.6	25.4	0.10	0.24	0.33	2.87
3	3.00 - 4.20	10.9	69.3	18.6	0.074	0.165	0.26	2.92
4	4.20 -10.20	1.6	34.5	59.6	0.22	0.36	0.54	2.76
5	10.20 -28.80	4.0	90.4	5.1	0.08	0.11	0.165	2.83
6	28.80 -31.80	11.3	84.7	4.0	0.07	0.11	0.23	2.60
6-1	1.50 - 2.10	5.9	32.2	55.7	0.12	0.37	0.58	2.84
2	7.80 - 8.40	2.2	25.1	61.9	0.25	0.47	0.88	2.86
3	18.00 -18.60	9.0	22.5	29.2	0.076	0.37	2.00	2.73
4	19.50 -20.10	34.6	58.7	3.4	-	0.072	0.11	2.75
5	26.40 -27.00	43.0	46.6	8.1	-	-	0.11	2.42
6	30.00 -30.60	19.4	43.7	23.0	0.05	0.12	0.36	2.27

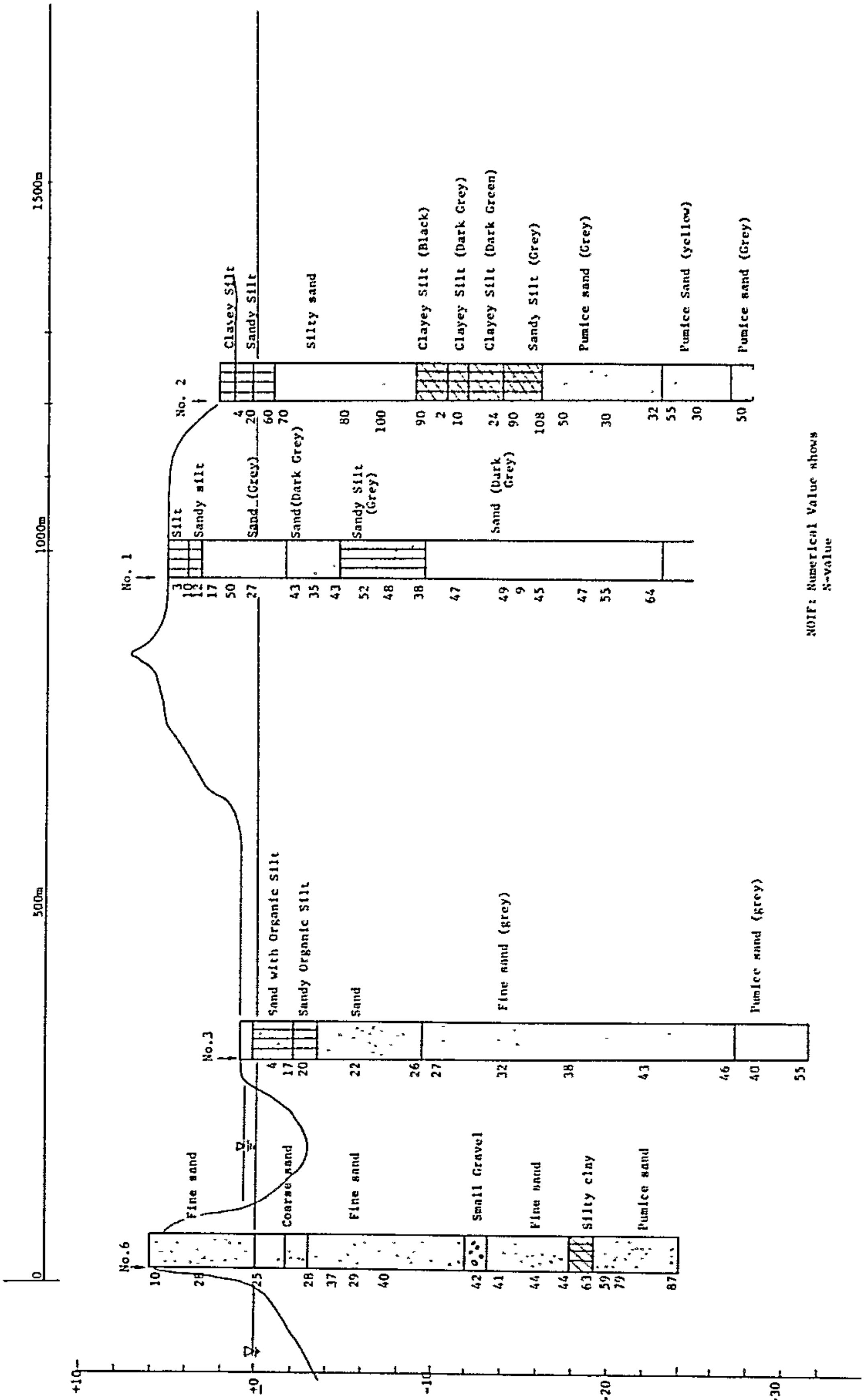
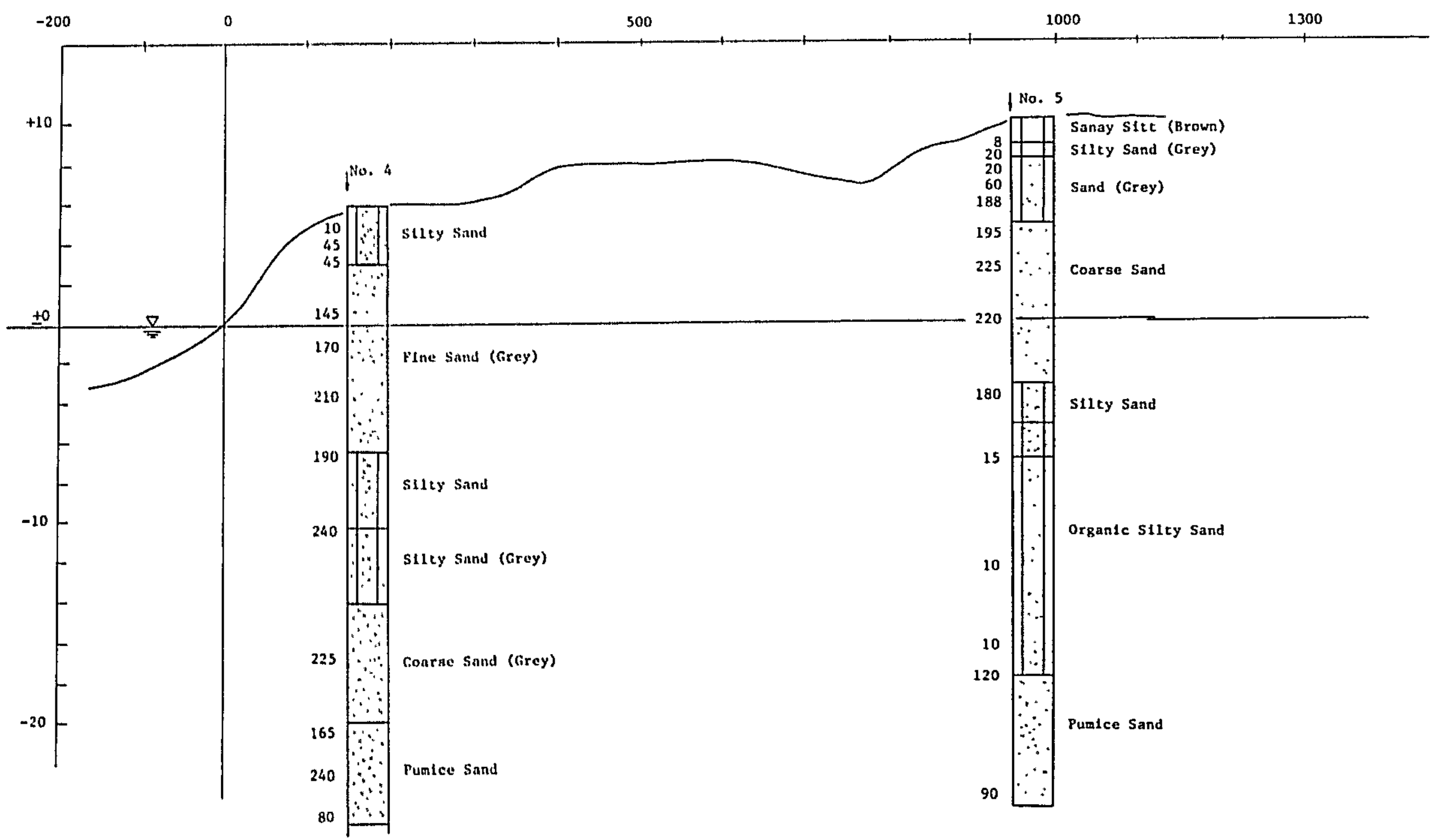


Fig.-4.23 Soil Profile



Note: Numerical Value shows N-value

Fig.-4.24 Soil Profile

CHAPTER 5. BASIC PLANS FOR NEW PORT

Chapter 5. Basic Plans for New Port

5-1 Location of New Port

Advantages of constructing the new port around Sipacate have been presented in Chapter 3. The new port, in consideration of the following points, will be located at about the middle point between the Sipacate Village and the Pacific Naval Base of Guatemala. For details reference should be made to the drawings of layout plan at the end of this report.

(1) Stability of Coast Line

As stated in the Chapter 4. on natural conditions, construction of a new port on the sandy coast like Sipacate causes disruption of the balance of the coast line and ultimately the erosion of the sand dunes or the destruction of the canals. In the circumstances, the site of port construction was selected in consideration of the changes in the coast line that have taken place in the past several years. For instance, the site should be located where changes in the coast line are slight. Where inhabitants living on the sand dunes are found, the sand dunes may be considered stable. The site should be as far away from the outlet of flood water from the canal. The site has not been the canal outlet in recent times. And the site selected has met the above conditions. Also, in consideration of the fact that rivers are important sources of drifts, priority was given to sites located as far away from the rivers as possible. While the site is immersed under water several times during the rainy season, flow of flood water into the harbor should be prevented as far as possible. In this sense, too, the site should be as far away from the canal outlet cut by the flood water.

(2) Workability

Port construction requires much dredging, except when the type of port consisting of a piled pier that juts out into the sea is built. Also, as a -10- meter quay is built and the cargo handling equipment are set up on it, adequate bearing capacity is necessary. According to the result of soil exploration, the area west of Sipacate consists of exceedingly hard strata and is unsuitable for dredging.
For this reason, plans will be made with the eastern side of the Sipacate Village as the port construction site, since reasonable bearing capacity can be expected and dredging is comparatively easy.

Disposal of large quantities of dredged up dirt is not much of concern under this plan, since there is a lowland behind the site, where the dirt can be discarded without trouble. The site, therefore, has an advantage over others in this respect also.

(3) Problem of Land Utilization

As the new port construction requires a vast tract of land, ease of land acquisition is an advantage. Further, as development of a large port city around the port is envisaged for the future, adequate room for future development is necessary.

As the state-owned land extends for about 1.5km from the coast line to the hinterland at the selected site, acquisition of land would be easy, and the room for future growth would be sufficient when the low marshland behind is included. The mooring basin can be created without much trouble by dredging the mangrove area, which is a marshland of plus-minus zero meter in elevation and has no utility value.

Of some importance in connection with land utilization around the Sipacate Village are the salt farms operated on the land leased from the government. In the area west of Sipacate, high yield salt production is in progress under improved techniques, but on the eastern side most farms are being run under the old techniques, and losses arising from discontinuation of salt farming are not considered so great. In this sense, too, the selected site is considered appropriate.

(4) Relation to Other Projects

That the new port and related facility construction plans do not come into conflict with other projects is an important factor. One of such other projects is the Chiquimulilla Canal project. The present port project, therefore, will be carried out at a site feasible to making adequate use of the functions of the canal for purposes of the port, while securing sufficient canal utilization possibilities. The site, moreover, has been selected so as not to come into conflict with the Naval Base located to the east of the project site.

5-2 Type of New Port

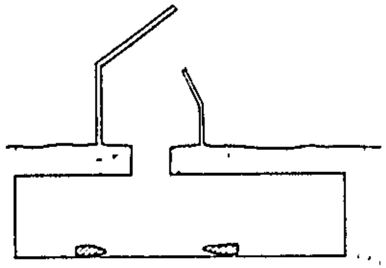
As the type of the new port suitable for Sipacate, the artificially excavated port type, sheltered type by breakwaters, Acajutla type or the piled pier type is conceivable. The type drawing and features are as shown in Fig.-5.1. Table-5.1, meanwhile presents results of study made of the case of applying each of these types to the Sipacate project from the aspects of construction work, safety, utility and maintenance and administration.

When comparison of the types is made on the basis of Table-5.1, the piled pier or the Acajutla type offers advantage in the period of construction and construction cost. However, if the question of safety, of long-range maintenance and administration and the need for the new port to fit the port and harbor requirements of 21st century Guatemala, which are the most important factors, are considered, the artificially excavated port type would offer the greatest advantage.

The type of the new port, therefore, will be the artificially excavated port type.

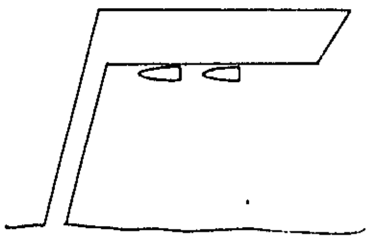
Fig.-5.1 Types of New Port

[A] Artificially excavated port type



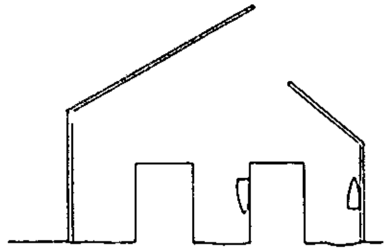
1. The mooring basin and the quay walls are secured by dredging landward.
2. Breakwater will be designed not only for protecting the mooring basin in the harbor but also for securing calm waters outside the port for navigation and for preventing shoaling of the navigating channels.
3. The scale of breakwater will be smaller as compared with the sheltered type by breakwaters.

[B] Acajutla type



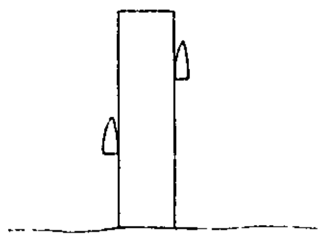
1. This type is employed at port Acajutla.
2. The wharf and its base perform the function of breakwater.
3. The armor is of unidirectional type.
4. The part sheltered by the wharf itself is the only place where the wharf can be used in safety.
5. The base of the wharf and the wharf are of the steel cellular construction so as to shut the waves off completely.
6. As the distance from the landing to the storage facilities is long, handling charges are large.

[C] Sheltered type by breakwaters



1. In most cases, it is planned from the existing shore line towards the sea side.
2. Investment in breakwater is big.
3. Reclamation is needed in many cases.
4. Compared with the type [A], the distance from the sheltered area of breakwater to the quay is shorter.

[D] Piled pier type



1. This is the type used at Champerico and San José.
2. Shielding is completely absent.
3. Quay is formed with the pier.

Table-5.1 Comparison of 4 Types

Item	Artificially excavated port type	Sheltered type by breakwaters	Acajutla type	piled pier type
Construction aspect				
Construction period	Long	Long	Short	Medium
Breakwater	Medium scale	Maximum scale	Not needed, but the wharf and its base serve as breakwater	Not needed
Dredging work volume	Maximum	Large	Large	Medium
Relative difficulty of work	Mooring facility is easy as sheet piles are land driven but base work of breakwater hard	Breakwater base work difficult. Mooring facility construction will be over-water work	Base work difficult	Comparatively easy
Construction cost	Initial investment big	Initial investment big	Medium	Comparatively small as length actually usable is short, it is uneconomical
Future expansion	Easy	Determined by breakwater arrangement	Construction of new pier necessary	Construction of new pier necessary
Safety aspect				
Calmness of mooring basin	Very calm	Calm	Safe against unidirectional waves	Risky against effect of all waves
Ship maneuverability	Adequate space available for stopping distance makes ships safety	Short break water makes basin narrow, risky.	Risky till shielded area is reached	Risky as effect of swells is unavoidable
Utilization of canal	Safe	Safe	(risky)	(risky)
Utilization aspect	Convenient. Little handling needed from distributing area to storage area. Cargo damage by sea water splash inconsequential. Annual work turnover greatest	Convenient. Handling distance short. Annual work turnover big	A little inconvenient. Handling range long Damage to cargo big. Annual work turnover medium	Inconvenient. Handling range long. Damage to cargo big. Annual work turnover small. In many cases stevedoring not possible
Maintenance and administration aspect				
Shoaling by drift	Gradual shoaling at port entrance	Gradual shoaling at port entrance	Shoaling marked	Little
Maintenance of port facilities	Easy	Easy	Damage by splash big (same for cargo)	Damage by splash marked (same for cargo)

5-3 Functions and Scale of New Port

In the harbor plans for the new port, positioning thereof as the main port on the Pacific coast of Guatemala in the future through full utilization of its advantageous location and natural features will be kept in mind. However, when the present situation of ports and harbors on the Pacific coast and the physical distribution system of Guatemala are considered, step-by-step changes, rather than quick changes, are anticipated. In the circumstances, the harbor project will be planned in several periods. In other words, the first-stage project will be undertaken between 1975 and 1980. In this period fusion of the functions of the existing ports and those of the new port will be promoted. It will, therefore, be a transition period during which the functions of the existing ports will be transferred to the new port.

Upon completion of the first-stage project, the San José Port, in view of the existing facilities, will be abandoned by next stages. And by 1980 all the export and import cargoes between Guatemala and the west coasts of North and South America, Asia and Oceania will be handled at the new port and Champerico. The volume of cargoes will be 557,000 tons, of which the new port will take care of 427,000 tons and Champerico, 130,000 tons. The second stage project will cover from 1980 to 2000. During this period, facilities of the existing port will become practically unusable, and the effect of the construction of the new port will have permeated gradually. Approximately from 1,500,000 to 2,000,000 tons of cargoes that should be handled on the Pacific coast will all be handled at the new port in the year of 2000.

The new port will thus give priority to handling import and export cargoes that pass through the Pacific coast of Guatemala, but the following functions are also expected:

(1) Modernization and function integration of ports and harbors on the Pacific coast.

(2) As the gateway into Guatemala and ultimately to Central America on the Pacific coast, the new port will become the center of physical distribution system.

(3) Regional development of the Pacific coast, which has fallen behind the central highland region, will be promoted through the port development. For instance:

   a) construction of modern city that will serve as nucleus on the Pacific coast;

   b) modernization and promotion of Guatemalan industries through construction of a free port and induction of various industries;

   c) promotion of fisheries through fishing port construction;

   d) promotion of agriculture through export and import of cargoes related to agriculture.

(4) Together with Iztapa and San José, the new port area will form a seaside recreation center.

(5) Make the base of the Pacific coast envisaging container transportation among three countries, so called "Land Bridge".

5-4 Fundamental Philosophy of Port Construction Program

The port construction program for the immediate future will be focused primarily on the first-stage project between 1975 and 1980, and plans will be made on the basis of the following policies.

(1) Calm mooring basin will be secured for the sake of safety, thus assuring safety of navigation, mooring and stevedoring.

(2) Poor efficiency arising from lighter cargo loading and unloading now in practice will be done away with and efficient and stable utilization of the port will be promoted by minimizing the effect of weather conditions and marine phenomenon.

(3) Cargo-working equipment and facilities capable of handing not only general cargoes but also bulk and heavy cargoes will be provided.

(4) Storage facilities for different cargoes will be repleted to do away with cargo damages in the waterfront areas, while at the same time promoting smooth distribution of concentrated agricultural products by storing.

(5) Smooth and safe linkage of the port area and its hinterland will be promoted by consolidating port traffic facilities. However, no railway will be included in the first-stage project; it will be planned in line with the progress of the land bridge concept of container transportation envisaged in the second and subsequent stages.

(6) An industrial area will be created behind the port area to promote development of modern industries.

(7) Centralization of fishing operations scattered over the Pacific coast will be promoted and induction of modern fishing port facilities will be expedited in order to promote increased fisheries production and efficient utilization of marine resources.

(8) For the port area and the areas behind it, effective utilization of natural mangrove forests will be promoted. Also new green belts will be inducted so as to assure preservation of the environment of the port area.

(9) Utilization of land behind the port area will be planned with adequate margin so as to be able to fit future development.

CHAPTER 6. FACILITY PLAN

Chapter 6. Facility Plan

Facility plans will be made as hereunder presented on the basis of the existing state of ports and harbors described in Chapter 2, port requirements cited in Chapter 3, considerations given to natural conditions presented in Chapter 4 and of the fundamental philosophy set forth in Chapter 5.

In this case, as stated in 5-4 of Chapter 5, the new port must be such as to be capable of adequately meeting future development. For this reason, what may be considered the master plan covering up to 2000 will be drafted (see Chapter 14), and the port facility plans for the project ending in 1980 will be drafted as a first step in the total planning.

6-1 Breakwater Plan

6-1-1 Scale

West breakwater	1,000 m
East breakwater	430 m
Shore Protection Facility (Groin 3 x 150 m)	450 m

6-1-2 Arrangement

As stated in Chapter 4, a number of problems still remain as the wave characteristics and littoral drift have not yet been fully clarified. In this circumstances, it is difficult to draft plans for the scale and arrangement of breakwater. As the present plans have been drawn up from the following viewpoints through full utilization of data now available, may need for partial modification of the plans on the basis of new information on natural conditions may arise in the future.

(1) As the predominant direction of littoral drift is thought to be from east to west, the east breakwater will be considered the main breakwater, and the form of sheltering the west breakwater will be followed. The set of breakwater will be arranged so as to prevent shoaling of the port entrance. For this purpose, the tip of the west breakwater on the sea side will extend to the position deeper than the depth (-10 m) of the planned channel and the breaker depth in order to maintain the depth of the planned channel.

(2) The main direction of the waves at the tip of the breakwater on the sea side is 150 degrees to 210 degrees from the north in the clockwise direction. The waves in the direction of 150 to 170 degrees are mostly wind waves of high amplitudes.

The east breakwater, therefore, will be positioned so as to completely shelter the mooring basin and the channel. In this case, the diffraction coefficient of the wave is taken below 0.2.

Incoming waves from the 170 degree direction are largely swells. The significant period of the swell is about 12 seconds. Regarding the significant amplitude, according to actual measurements taken at San José for four years between 1970 and 1973, it averaged as follows:

H 1/3 =	1.0 m	daily average
	1.7 m	average for the month's highest waves
	2.3 m	average for the year's highest waves

It will be difficult for the east breakwater and the west breakwater to shelter the port completely from these swells, because the port entrance can not help to be established in the path of the main direction thereof. The waves of the 210-degree direction come straight towards the channel and the mooring basin of the outer port. According to visual observations, however, most swells come at right angle to the shoreline. In consideration of the case of the greatest danger, therefore, the breakwater will be arranged in such a way as to make the mooring basin calm against the swells from the direction of 190 degrees. In other words, planning was made so that the diffraction coefficient of the waves of the swells from the direction of 190 degrees will be 0.5 and 0.15 or less at the sea side of the sand bar and the front of the quay wall respectively.

By this means, the wave height in front of the quay wall is likely to be limited to less than 0.3 meter for more than 90 per cent of the year. However, as this breakwater arrangement is limited to the minimum in consideration for economy, the breakwater will have to be extended to broaden the sheltered area in case the channel and the mooring basin should be expanded in the future.

(3) The starting point of the breakwater from the shore line will be planned perpendicular to the shore line in consideration of the problems of construction method and in order that the waves reflected from the breakwaters will not erode the coast line.

The point at which the breakwater is bent will be deeper than breaker depth, which is from -5 to -7 meters. The bending angle will be planned in such a way that the waves reflected from the breakwater will not disturb the port entrance.

(4) Loss of balance in the littoral drift through construction of the breakwater is conceivable. As the predominant direction of drift is thought to be from east to west in the case of the new port, the beach behind the west breakwater is probably eroded. In order to prevent such erosion, three groins, each 150 meters in extension, will be built perpendicular to the coast line.

6-2 Channel and Mooring Basin

6-2-1 Scale

-10 m channel and mooring basin (channel width: 120m)	380,000 m^2
-4 m mooring basin	71,000 m^2

6-2-2 Arrangement

(1) Channel and mooring basin are designed for 15,000 DWT class ships. The size of ships is as follows.

Ship length (L)	163 m
Ship breadth (B)	21.8 m
Depth (D)	12.2 m
Draft at full load (Df)	9.0 m
unloaded (Db)	2.8 m
Hatch width	9.8 m
Hatch coaming height	1.4 m

(2) Channel Breadth, etc.

While the channel breadth has been cited as 120 meters, this is not wide enough for the 15,000 DWT vessels to pass each other. This is not likely to pose problems in the immediate future as the first-stage project estimates port scale of about -10 meter quay with three berths, but when the number of berths increases together with the number of vessels in the future, the channel will have to be expanded in breadth so as to accommodate at least vessels length (L).

The turning basin has also been limited to the minimum standard of 1.5 x L, but this is the minimum space needed to turn the ship's head with the aid of two tugboats. This necessitates assignment of two tugboats at the new port.

6-3 Mooring Facility

6-3-1 Scale

-10.0 m quay wall	3 berths	555 m
-4.0 m quay wall		350 m

(for -4.0 m quay wall refer to Chapter 7 where fishing port project is treated)

6-3-2 Arrangement

Planning will be made for 15,000 DWT class vessels. In order to handle the cargoes, 427,000 tons, as estimated in Chapter 3, -10 m quay wall is designed 3 berths. Each berth will be capable of handling about 150,000 tons cargoes a year. Of the planned 3 berths, a crane will be provided for one berth.

6-4 Cargo Handling Equipment, Cargo Transit Shed, Warehouse and Tugboat

6-4-1 Cargo Handling Equipment

(1) Cargo Handing Equipment and Cargo Handling Method

With regard to loading and unloading of general cargoes, the derrick crane on-board will be used. For heavy and bulky cargoes the crane on the quay will be used. However, the crane is to be set up only at one of the three berths, and heavy cargoes will be handled at this berth. Cargo handling work at the quay and in the transit shed will depend on fork lifts.

(2) Crane on the Quay

1) Type: Rope trolley typed bridge crane

As crane suitable for the wharf where heavy cargoes are handled, the bridge crane or the level luffing crane is thinkable. The bridge crane travels horizontally, while the level luffing crane repeats rotation and luffing frequently as it works the cargoes.

The level luffing crane is nimble and capable of small turns in handling the cargoes, but the need for making a turn at each cycle of work makes it inconvenient for handling long sized cargoes. If containers are to be handled, the bridge crane would be more desirable. Bridge cranes are available as the man trolley system and the rope trolley system, but the rope trolley type is smaller and requires less installation cost. For this reason, the rope trolly typed bridge crane will be adopted.

2) Number of unit: 1

Greater portion of cargoes will be handled with the ship's derrick crane, and cargoes requiring use of quay crane are likely to be small in volume. For this reason, rails will be laid only for one berth and the crane installed will also be for one berth only. If the volume of cargoes increases, additional crane can be considered in future.

3) Load lifting capacity: 40 tons

When the ISO1A type 40-foot container (30.5 tons) is considered, the spreader weight will be 9.5 tons, though it depends on the type, so the lifting capacity of 40 tons would be appropriate (30.5 + 9.5 tons).

The rated capacity may be changed a little by means of Changing Spreader, but cargoes weighing more than 30 tons are very rare case.

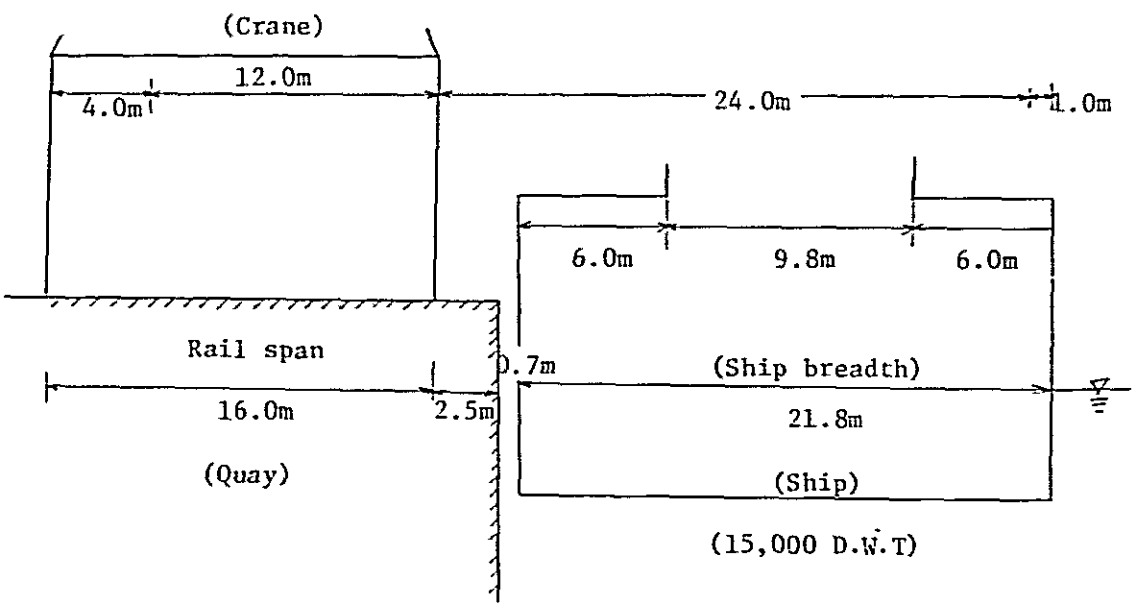
4) Rail span: 16.0m

It is capable to make 3 carrier lanes in the 16.0m span.

5) Effective range of bridge: 14.5m

As ISO1A type container measuring 40 feet is the target, the range of the bridge has been set at 14.50 meters.

6) Outreach (from the face line of quay): 21.5m

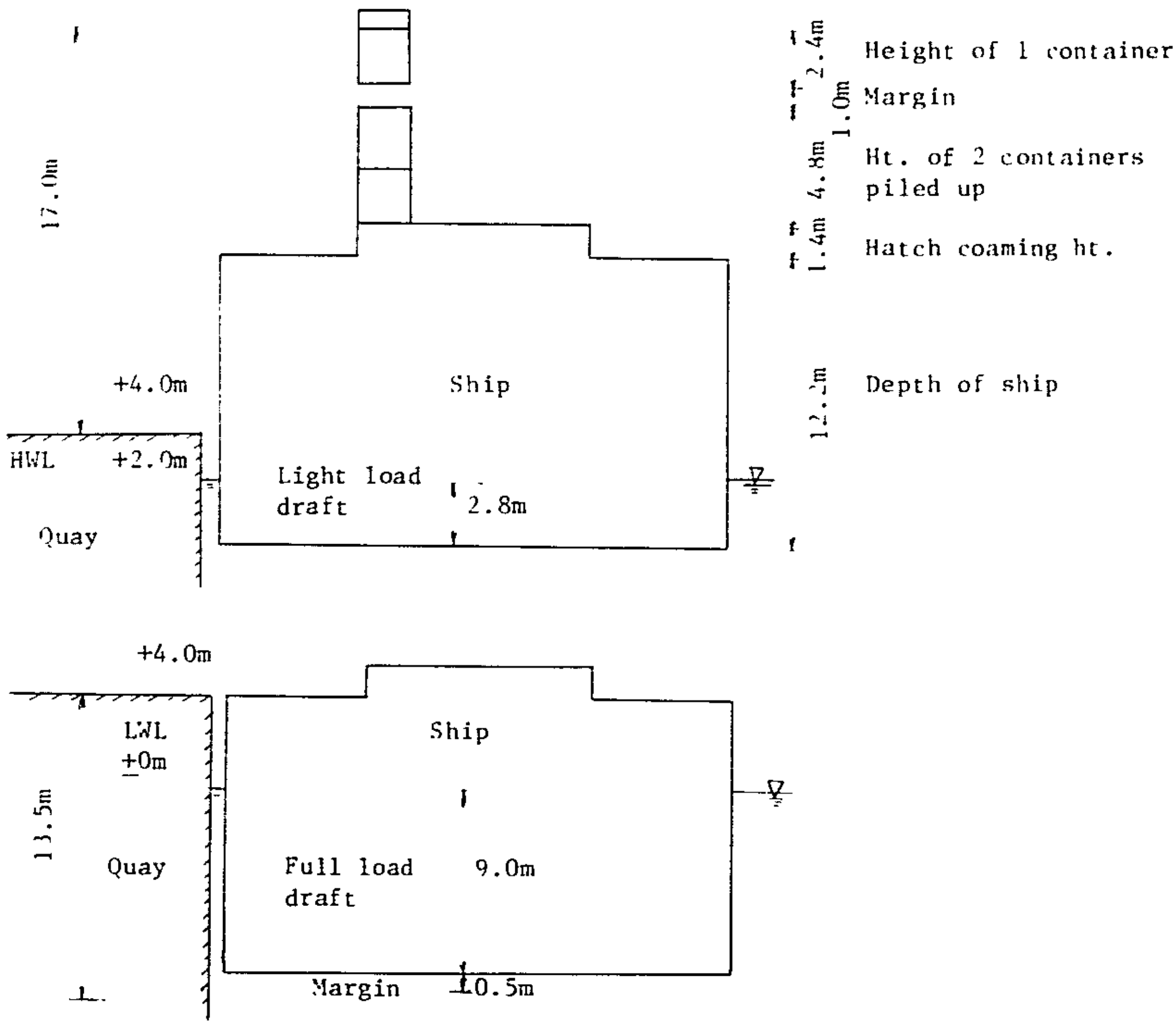


As the transit shed is provided directly behind the crane, lateral travel is halted at the point 4 meters this side of the land side rails, and no backreach is provided. If the center of the hook reaches to 1 meter this side of the ship side, cargoes loaded close to the ship side can be adequately handled. Specifications, therefore, will be:

Total lateral range:	36.0m
Outreach (from the face line of quay):	21.5m
Outreach (from sea side rail):	24.0m
Backreach (from sea side rail):	12.0m

7) Lifting ranges:

Lifting ranges:	Over rail surface	17.0m
	Below rail surface	13.5m
	Total ranges	30.5m



6-4-2 Transit Sheds

(1) Scale

3 transit sheds   3 x (140m x 50m) =   21,000m^2

(2) Arrangement

The area required for the treansit sheds was calculated by the following equation on the premise of accommodating 410,000 tons of cargoes, including coffee, cotton, seed of various kinds and others, as calculated for the new port in Chapter 3. In this case, however, the peak rate of monthly cargo handling volume was set at 3.0 in consideration of seasonal variation in the export of agricultural products.

Shed area required (S) = W/n.w.a.
Where W: Cargoes handled per year at sheds (tons)
n: Cycle time (times/year)
w: Cargo volume per unit area (ton/m^2)
a: Cargo accommodating rate

Shed space required for various cargoes is as shown in Table-6.1.

6-4-3 Warehouses

Warehouses will be used principally for storing imported goods. Using the same equation as that used for calculating the transit shed area, area required for warehouses has been calculated on the premise of handling 200,000 tons of imported goods. The area needed is about 14,000m^2. Two warehouses each 7,000m^2 in floor space are, therefore, anticipated. In this case, cycle time (n) is assumed 12 times/year.

6-4-4 Open Storage Yard

Of the warehouse site behind the transit shed for one of the three berths, 180m x 60m space will be reserved as the open storage yard.

6-4-5 Tugboats

Lately larger tugboats are beginning to be used and the pilots also prefer large tugboats, so for 15,000 DWT class ships two tugboats of 1000PS with variable pitch propeller and kort rudder should be sufficient.

Table-6.1 Area of Transit Shed Required by Items

Cargo	S	W	n	w	a	Remarks
	m^2	1000t	times/year	ton/m^2		
Cofee	850	54	36	2.5	0.7	1 sack $900^{mm} \times 650^{mm} \times 250^{mm}$ 68Kg
Cotton	6,720	174	36	1.2	0.7	$1400^{mm} \times 890^{mm} \times 550^{mm}$ 240Kg
Seeds	5,130	323	36	2.5	0.7	1 sack 46Kg
Other export goods	360	10	24	2.0	0.6	
Imports	7,500	216	24	2.0	0.6	
Total	20,560					

6-5 Land Utilization Plan

6-5-1 Scale

Wharf site:	56,000 m^2
Land for facilities related to wharf:	111,000 m^2
Public use and, others:	135,000 m^2
Land for fishing port and related facilities:	90,000 m^2
Total	392,000 m^2

6-5-2 Arrangement

The transit sheds and warehouses cited in 6-4 will be placed respectively in the wharf area and the area for facilities connected with the wharf. The latter will be used also for open storage yard, harbor administration facilities and port and harbor service operators. As that part of land for public use facing the mooring basin will possibly by exposed to direct effect of waves from the outer sea, this part will be preserved in the form of matching the slope of natural seashore so as to expect wave dissipating effect. The land behind will be used as green park or the remainder of land will be used for business section. Refer to Chapter 7 for land required for fishing port facilities.

The final draft plan for the land utilization will be presented in Chapter 14.

6-6 Other Related Facilities

6-6-1 Dock Roads

The truck requirement for transporting cargoes handled at the port will be about 2,000 a day even when the peak rate is taken into account. Even when traffic related to the port activities is considered, the number of motorcars would probably be less than 5,000 a day. In this circumstances, dock roads would be adequate for the time being. The 20-meter road land secured for the current use, therefore, will be sufficient to meet the requirements for the second-stage project planned for the future. However, as the road between Sipacate and Esquintla is congested even today around Democracia, this part seems to require some improvement along with progress made in the port and harbor construction project. No special plans have been drafted with regard to railway as it is not included in the first-stage project.

6-6-2 Other Related Facilities

Port and harbor construction and construction of hinterland city will require, in addition to port and harbor facilities, harbor administration facilities, water supply and sewer systems and power supply facilities. However, these facilities are of secondary importance for the port, the matter may be taken as making use of part of what will be consolidated in city planning. Regarding this question, therefore, the scale of such facilities that may be needed for the new city of Sipacate as of 2,000 will be hypothesized, as will be presented in Chapter 14, and supposing the project to be implemented, the port project will allocate construction fund in accordance with the extent of utilization of such supposedly constructed facilities.

Also regarding marina, availability thereof is not considered so urgent since the demand for maritime recreation on Guatemala is not expected to be so extensive, when the population of Guatemala, etc. are taken into account. However, as yachts navigating along the Pacific coast of the American Continents have no appropriate port of call between Acapulco and Panama, the demand for marinas for ocean-going cruisers is likely to become notable. Also, as large numbers of motorboats used for fishing in the canals and off-shore areas are found, planning of marinas capable of accomodating some 250 yachts and 250 motorboats respectively is considered reasonable. Marinas will probably located in front of the present Sipacate Village behind the canals, and the surrounding areas will be developed as a resort.

Planning of marina is considered a project attracting passionate interest in Guatemala, judging from what have been heard in that country, but with the idea of making use of part of the fishing port in the first stage, it is not included in the first-stage project.

CHAPTER 7. CONSTRUCTION PLANS OF FISHING PORT FACILITIES

Chapter 7. Construction Plans of Fishing Port Facilities

7-1 Present Situation of Fishing Industry

7-1-1 General

The fisheries in Guatemala depend primarily upon the trawling of shrimps. The trawling is now operated by two fishing companies, whose bases are at Champerico and San José on the coast of the Pacific. It is reported that the total number of fishermen in this country who are working along the shores of both the Pacific and the Atlantic is approximately 2,500, of which about 800 fishermen are working along the west of the Pacific (Estimate made by Fishing Department, Ministerio de Agricultura). However, these figures exclude the number of fishermen who are the crew of shrimp catching boats.

The fishing bases (fishing settlements) scattering along the coast of the Pacific are as shown in Fig.-7.1. At these bases, there are no facilities that could be called as a fishing port facility. And fishermen who are engaging in fishing on the open sea live mainly at such limited places as Champerico, San José, Hawaii and Monterrico. Others are engaging in such primitive fishings as hook and line, gill netting or cast netting in canals behind the dunes along the coasts. Their fishing boats are very small (less than 5 m) wooden ones equipped with outboard engines, which are called "canoe".

According to the report of Ministerio de Agricultura, the catch was about 2,100 tons. However, this figure shows only the catch of the above-mentioned two fishing companies operating from the bases of Champerico and others and does not include the catches of petty fishermen scattered along the shores throughout the country at all. The catches of such petty fishermen are unknown because no survey has been conducted by the Government. According to the annual report of F.A.O., the consumption of marine products per capita is about 1 kg per year in Guatemala. In actual, however, it is assumed on the basis of interview with fishermen at various districts that the yearly catch would be around 5,000 tons in this country.

The price of fish is comparatively high due mainly to the under-development of distribution system, unbalance between demand and supply etc. For example, the price of a shrimp having about 20 cm or more length is 0.3∿0.5 quezal/pound at fishing sites and 1 quezal or more/ pound at consuming place (Guat shows city), which is higher than the price of a middle-grade of meat.

7-1-2 Production of Marine Products

Table-7.1 shows the summary of the output of marine products during the recent 10 years announced by the Government. In these years, the amount is around 2,000 tons. This may be the result of the Government control over the number and size of fishing boats for the purpose to protect the fishing resourses along the coats. The main product is, of course, shrimp. The greater part of shrimps is frozen to be exported to foreign countries, which is one of the main means for the acquisition of foreign currencies by Guatemala.

Naturally, various kinds of fish are caught together with shrimps up to the rate of 10 to 1. Almost of all these fishes die during the selection of shrimps on board the ship (it takes about 2 hours to select a single catch of shrimps) and therefore, are thrown away into the sea after the selection. Thus, at least about 20,000 ∿ 30,000 tons of potential marine product is now being wasted. It will be necessary to consider the utilization of these marine products for some uses.

It takes about 21 days to make one round of shrimp fishing on the open sea, during which intermediate unloading of fish is once made. Table 7.2 shows the amount of landing per round by month in 1973.

Although the amount of fish caught by petty fishermen is unknown, it is said that some of them sail out to the open sea in canoes and catch about 5 ∿ 10 Kg fishes a day. They always work from about 5 to 9 hours in the morning. A fisherman who is fishing at Champerico says that he catches about 150 pounds of shrimps a day on the average, but this may be a special case. The number of operating day is 200 250 days a year.

7-1-3 Numbeɾ of Fishing Boats

The main force of fishing boats in Guatemala consists of 32 boats owned by the above-mentioned 2 fishing companies, which are made up as shown in Table-7.3. Of them,the largest boat is 127 G.T., 23 m long, 3.3 m draught and 6.5 m wide. Generally, they are old and gradually changed for new boats. (Due to the different method of measurement, they may not agree with the Japanese boats in tonnage.)

Besides the boats shown in the table, there are 2 steel boats having length of 35 feet and 1 steel boat which is called "launch" at Hawaii, and 40 of 16 feet fishing boats equipped with outboard engine which are called canoe at San José. In addition, a considerable number of wooden fishing boats having length of less than 16 feet equipped with outboard engines are observed operating in canals in many districts at our tield survey.

7-2 Present Problems

The present state of fishing industry in Guatemala is far behind in the terms of port facilities, fishing method, maintenance of statistic materials concerning fishing activities etc. This may be unavoidable because fishing industry has only a little weight in the economy of the country. However, there is a population of 2,500 fishermen (about 10,000 if their families are included) in actual and therefore, a national policy should firmly be established as to the current problems. Fishermen are engaging in a primitive fishing with a poor equipment, obtaining insufficient income to live.

Of course, the Government does not overlook the situation confronted with these petty fishermen. For example, the Government has plans to build a small refrigerating facility in the settlements of petty fishermen, provide a low-interest loan with them for the reconstruction of their fishing boats and the like, but these plans have not been realized yet because of no budgetary appropriation. On the other hand, fishermen themselves are now too primitive to be subsidized by the Government. For that reason, the Government has an intention to organize these fishermen at first into a cooperative society and then furnish funds to them through the said society in order to improve their living standard as well as their fishing activities. As shown in annexed list, however, such unions have not been organized so widely. In addition, financial system has not been developed and therefore, there is little opportunity for them to purchase jointly their fishing materials and tools. Of course, there is a way to ask for a loan from banks, but the loaning conditions are too strict for them to use the system.

Their fishing technique is poor and old-fashioned, too. It is necessary to improve the level of their fishing technique through education, the introduction of modern technique, various sorts of encouraging measures, etc.

So far, fishermen have strived to catch shrimps alone. The results of surveys conducted in various groups show that so much catch of shrimps than the present level cannot be expected in future. Furthermore, the greater part of shrimps has so far been exported, thus contributing little to the supply of protein foods to the people of Guatemala. It will be necessary, therefore, to expand their fishing activities into other kinds of fish than shrimps in order to develop fishing industry as a whole, increase the output of marine products and supply protein foods to the people. In this case, for the great cause of securing protein foods for the people, the Government should be at the head in developing the fishing industry and at the same time, consider to lead local fishermen toward off-shore-fishing through the promotion of concentration of local fishing activities. Off the shore of this country, there are promising tuna and bonito fishing grounds. Also, it will be necessary to consider the effective use of a large quantity of other kinds of fish than shrimps which are caught together with shrimps, but only thrown away into the sea.

7-3 Necessity to Construct Fishing Port Facilities

The reasons for integrating a plan to build fishing port facilities into the proposed port and harbor project are as stated below.

Firstly, it is necessary for the accommodations of 32 fishing boats which engage now in shrimp trawling along the coast of the Pacific. These boats sail out from the bases of Champerico and San José, where there is only a pier stretching out into the sea in conditions unsuitable for fishing boat mooring, respectively. In the both ports, there is no safe anchoring water surtace nor mooring facility for these fishing boats. Furthermore, the pier is too high from the water level to handle safely the catch from the boats. At present, shrimps are put into drum cans on the fishing boat and then transshiped to "pango" sampan. The pango comes along the pier and the drums are lifted onto the pier by a winch installed thereon. Thus, the cargo handling is highly poor in efficiency.

The fishing boats operating from the base of San José sail into or out canals, availing themselves of the tidal range and land their catches on the bank. But, due to the such disadvantages as shallow depth of water at the mouths of anal, rapid speed of tidal current and unfixed route of sailing, it is not only very inconvenient but also dangerous for the boats to sail into or out these canals. While, the fishing boats operating from the base of Champerico are repaired at a private repairing dock owned by a company on the bank of a canal near San José and thereofre, they are restricted by time to sail into or out the canal because of tide. This is one of causes why their operational efficiency is so poor.

Thus, it is necessary to construct modern fishing facilities for the stabilization of fishing industry in Guatemala through the settlement of the above-mentioned problems including the securing of safety mooring places, improvement of the working rate of fishing boats, rationalization of cargo handling and the like.

Secondly, as mentioned above, it must be seriously taken into account that a large quantity of other kinds of fish than shrimps which are caught together with shrimp trawling is thrown away into the sea. (Pesca, S.A. at Champerico is, under the guidance of the Japanese experts sent by O.T.C.A., making sausage of these miscellaneous fishes and selling, gaining public favor for being cheap.) Besides this, large size of fish out of them may be used as a fresh food, too. Most effective, however, may be the use of them as a raw material for fish meal. It is anticipated that approximately 3,000 tons of fish meal will be needed as a feed in near future in Guatemala. At present, the country depends entirely upon imported fish meal. But, since the poor catch of anchovy in Peru, the supply of fish meal cannot meet the demand throughout the world, resulting in the soaring of price (reported to be as high as 600 quezals/ton in Guatemala) and the increased difficulty for importation thereof. Therefore, if a large quantity of such a miscellaneous fish could be utilized, an immediate result would be brought on the people of Guatemala in the terms of the effective utilization of resources, saving of foreign currencies, creating a working place for the people and so on.

For the purpose, however, it will be necessary to supply smoothly the raw material for processing through the improvement of the fishing equipment on fishing boats, increase of the capacity of unloading facilities etc. Also, it will be needed to build processing plants and refrigerating facilities at suitable places. To settle these problems collectively, it is necessary to construct port and harbor facilities.

Thirdly, there is a matter of the encouragement of off-shore fisheries. As stated above, besides the shrimp fishing along the coast of the Pacific, there are only a few number of small fishing boats operating off the shore in this country. The greater number of fishermen is operating in inland canals. The reasons are: 1 there is no fishing harbor due to the enormous sum of money needed for the construction of fishing harbor as a sandy coast is stretched over a long distance along the Pacific and 2 it is extremely inconvenient and even dangerous for fishing boats to sail into or out the canals because their mouths to the open sea are either continuously changing or often closed due to the rapid movement of sand along the coast.

Being not so effective as stated above, the facilities at San José will be a good example to show that if there is any harbor facility, fishing boats could sail out to the open sea for fishing. At San José, about 40 small fishing boats use the high pier there and sail out for fishing. The Piled pier is not suitable for fishing boat mooring, so the boat is hanged up or down by winch which is selled on the pier. Also at Champerico, some of fishing boats utilize the similar type of facility. Furthermore, if they could sail freely through the mouths of canals into the open sea, the fishermen who are now forced to operate in canals would willingly sail out for fishing far into the open sea, resulting in the rapid strides of off-shore fisheries in Guatemala. For that, it is necessary to build fishing harbor facilities.

Fourthly, there is a matter of entering into a new generation of fishing. So far, Guatemala fishing has been depending entirely upon shrimp trawling. However, the shrimp resource is not so bright in future. It is necessary, therefore, to diversify the fishing activities, for example, to engage in tuna and bonito fishing, too. But, no more progress than the present level and scope of fishing activities could be expected from the present conditions of port and harbor facilities in the Pacific side, if any. It is necessary to construct modern fishing port and harbor in order to emerge from such old-fashioned fishing as centering around the shrimp trawling.

Lastly, there is a matter of economy. There are many problems on the advisability of the co-existence of fishing and commercial ports. If it is considered from the view points of the allotment of functions and the speciality of goods to be handled, it is desirable to build each port separately. Under such natural geographical conditions as along the Pacific coast in Guatemala, however, a huge sum of money would be needed for the construction of a new fishing port, and an excessive investment would be uneconomical especially in view of the present fishing activities in Guatemala. If a considerable sum of capital were already invested as in term of fishing port facilities there, it could be used, but none of it exists. Or, it may be assumed that commercial facilities could be constructed at a new port, while fishing facilities could be re-constructed either at Champerico or San José. However, such fishing facilities are practically nothing in both the bases and therefore, if any facility is to be built there, a huge amount of money will be needed.

Also, in the light of economic sphere developed in the rear, the proposed new harbor construction site is superior to Champerico or

San José. And it will be proper from both economical and geographical points of view to include the construction of fishing port facilities in the proposed new port construction project. If so, a functional and reasonable settlement could be made as to the utilization of new harbor when the layout of each facility is to be studied.

7-4 Fishing Port Facilities Construction Project (1975 - 1980)

7-4-1 Preconditions for Project

(1) Objective Boats

100 GT-class trawler:	35 boats
Small fishing boat less than 3 GT:	50 boats

The above figures have been calculated on the basis of some increase of the fishing boats which are now operating.

(2) Catch

Taking into account the expected operation of the ships stated in (1) above, the catch has been at as shown in Table 7-5.

7-4-2 Scale of Fishing Harbor Facilities

(1) Mooring Facilities

-4.0 m quay:	350 m
Ouay for landing (6 boats can be moored alongside at the same time):	150 m
Quay for preparation for sailing (2 boats can be moored alongside at the same time: 6 boats a day):	50 m
Quay for rest (16 boats can be moored vertically at the same time):	100 m
Quay for small boats:	50 m

(2) Slip for reparing (For 2 boats): 50 m

(3) Land for building of harbor facilities

As to the details and disposition of the facilities, refer to Table 7-6 and Fig. 7-2.

7-5 Outlook for Future

As a future goal of the fishing industry along the coast of the Pacific in Guatemala, the catch can be expected to be around 30,000 ∿ 40,000 tons a year. As stated above, about 30,000 tons of other fish than shrimp, which is now thrown away into the sea for the lack of hatch capacity on fishing boats and processing facility on the land, can be utilized for the production of about 3,000 tons of fish meal Guatemala will need in near future. For that, it is desirable to build a special transport and have it gather these miscellaneous fishes from fishing boats on the sea and carry them to bases on the land. This will be necessary for the protection of shrimp resource, too because the increase of large-size of fishing boats in number will result in the exhaustion of shrimp now that the said reasource is reported to be not so much dependable in future along the coast of the Pacific in this country.

There is a great possibility that if proper fishing facilities are constructed along the shore, the fishing activities of small boats that have so far been unable to sail out to the sea due to the lack of navigable mouths of canals and fishing harbor facilities along the sandy coast will remarkably be enhanced. In this sense, the construction of the proposed new fishing harbor facilities will be an epoch-making event for the fishing industry in Guatemala. When the proposed fishing harbor is built, a bonito fishing will also be developed there and furthermore, about 5,000 tons of tuna could be caught yearly there. For the purpose, it will be necessary to construct at least 10 of 200 ton-class tuna fishing boats.

The utilization of these marine resources will supply a good quality of protein food to the people of this country on one hand and provide them with an employment chance on the other. Also, the catch of tuna and the production of fish meal will make it possible to acquire and save foreign currencies for this country, thus contributing greatly to the national economy.

Fig.-7.1 Main Locations of Fishing Villages Along the Pacific Ocean Coast

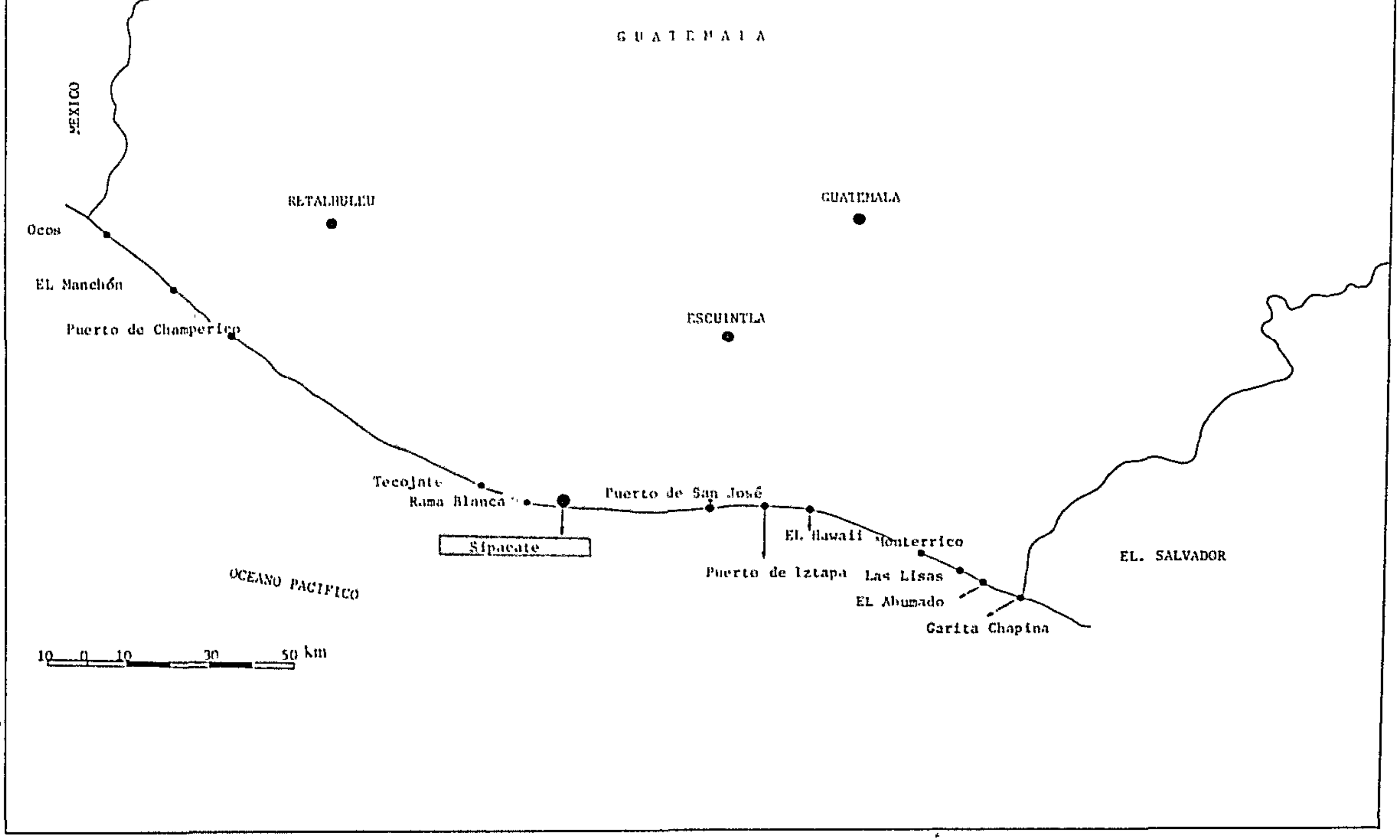


Table - 7.1 Catches in Recent 10 Years (1964 - 1973)

BOLEUN ESTADISTICO DE PESCA NO.6, DIVISION DE FAUNA

Year	No. of Fishing Craft	Lobster	Fish	Spring Lobster	Cuttlefish	Total	Remark
1964	19	2,900,450	463,055	37,616	8,396	3,409,517	lb. weight unit
1965	20	1,974,642	531,905	16,957	11,347	2,534,851	1 lb. = 0.4536 kg.
1966	24	3,117,585	684,628	25,141	4,090	3,831,444	
1967	29	2,435,855	615,454	22,193	9,869	3,083,371	1 kg. = 2.205 lb.
1968	20	1,482,682	627,294	9,045	4,266	2,123,287	
1969	23	2,149,289	650,757	7,335	2,459	2,809,840	
1970	26	3,560,618	768,861	9,699	3,793	4,342,971	
1971	28	2,941,230	962,469	17,469	6,426	3,927,594	
1972	29	2,780,893	906,976	16,688	2,736	3,707,293	
1973	29	3,804,241	920,501	14,341	468	4,739,552	

Note: 1. The above-listed is the landing belonged to Pesca S.A. and El Ganadero S.A.

2. The lobsters head is excluded from weight, but not the others.

3. The above listed is the landing along the Pacific Ocean coast.

Table-7.2 Operating Condition By Month (1973)

Month	No. of Parties Concerned	No. of Employed Vessels	Frequency of Trip	No. of Operating Days	Fuel Consumption (gal.)	Lobster (lb.)	Fish (lb.)	Spring Lobster (lb.)	Cuttlefish (lb.)	Total	Remark
1	2	29	67	723	167,444	229,723	67,444	592	-	297,759	1. Usually, the period of one trip is set to 21 days, during which a vessel sail back every 10th day for interim landing.
2	2	29	62	616	152,189	199,903	65,351	713	-	265,967	
3	2	30	65	696	160,943	220,139	59,591	1,446	-	281,176	
3	2	28	69	661	194,946	252,097	86,267	2,354	40	340,758	
5	2	27	51	640	168,425	265,928	79,857	2,076	153	348,014	2. The parties concerned are 2 in actuality, though reported as 3 according to the statistics.
6	2	26	32	661	144,888	217,631	47,929	847	90	266,497	
7	2	28	45	704	208,744	343,726	103,848	1,670	120	449,364	
8	2	29	50	744	145,192	329,298	83,691	1,476	-	414,465	
9	2	29	40	721	184,490	291,785	102,850	1,120	-	395,755	
10	2	30	45	721	205,040	457,272	88,583	858	35	546,748	
11	2	30	43	737	192,637	550,141	68,795	533	30	619,499	
12	2	29	51	701	227,515	446,598	66,296	656	-	513,550	
Total		28.7	620	8,325	2,152,453	3,804,241	920,502	14,341	468	4,739,552	

Table - 7.3 Fishing Craft by size (March, 1974)

Class (G.T.)	$50^t - 75^t$		$76^t - 100^t$		Over 100 tons		Total		Remark
	Number	Tonnage	Number	Tonnage	Number	Tonnage	Number	Tonnage	About 85t per boat on the average
	11	698	18	$1,630^t$	3	381	32	$2,709^t$	

Note: Only boats owned by the two companies

Table - 7.4 Cooperative Associations

Location	Name	No. of Members	Main Production Equipment	Administration Sea-area	Remark
Pto. de Ocós	La Curbina	31	Canoe	Pacific Ocean	
Pto. san José	Copesmar	50	"	"	
Taxisco	Monterrico	150	"	"	
Santa Rosa	EL Hawaii	26	Canoe, 35 ft. long, steel craft (2) Launcher (1)	"	
Pto. Sto Tomas	EL Caribe	12	Canoe, more than 35 ft. long steel craft	Atlantic Ocean	

Note: 1. The association members include the men who are not engaged in actual fishing.

2. Beside the above-listed, there was an association in Living Stone of the Atlantic area. It was, however, disorganized due to a financial deadlock.

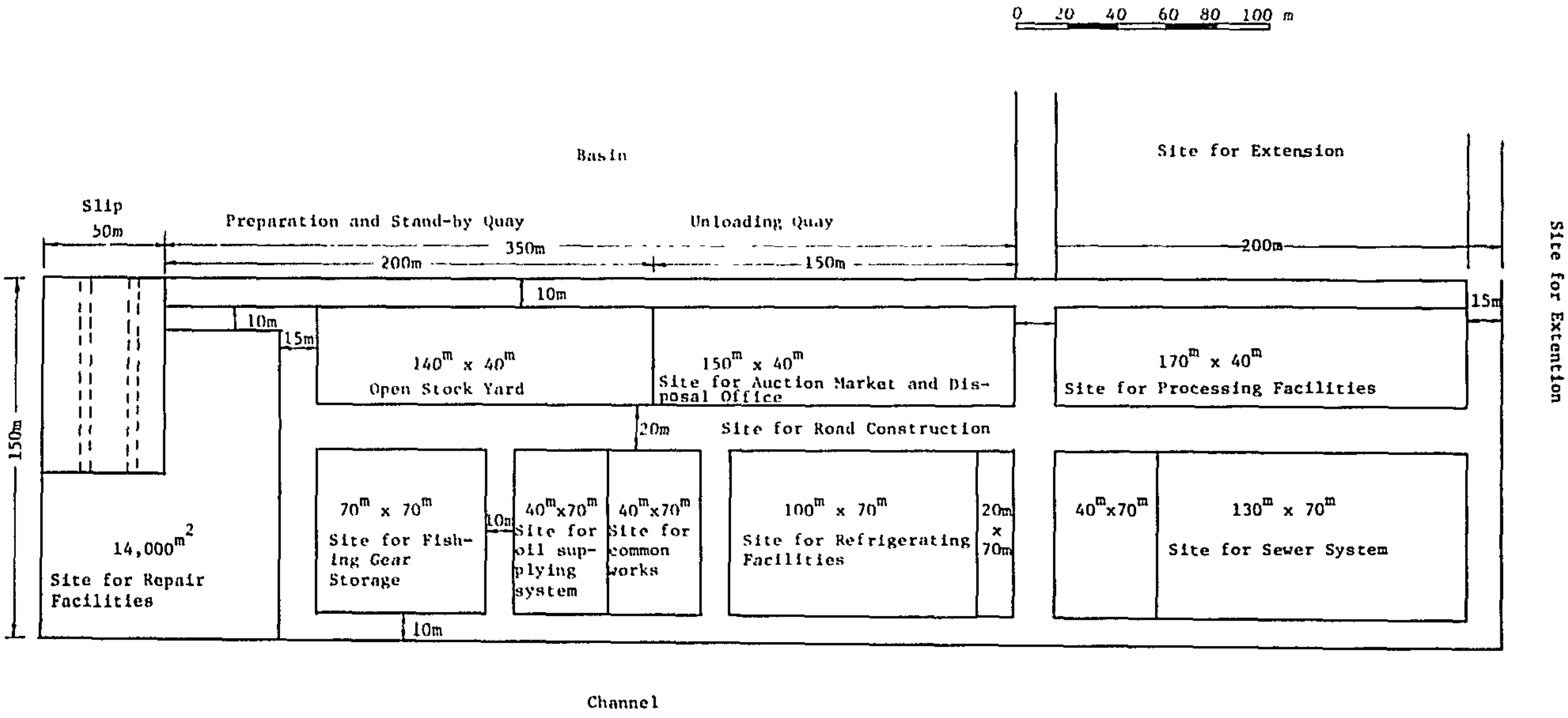
Table - 7.5 Calculation of Catch

Kind of Fish	Amount, T	Remarks
Shrimp	2,000	Trawler sails out 30 rounds a year (Actual: 22 rounds) and catches 8 tons per round. (8 x 30 x 35 ships = 8,400 tons)
		Small fishing boat operates 200 days a year and catches 50 Kg a day. (0.05 x 50 ships x 200 = 500 tons)
Others: Fish for food	1,100	Of the catch of 8,400 tons by trawlers, the catch of shrimps is set at 2,000 tons on the basis of actual results.
Others: Fish ball	400	To increase the operational efficiency of trawler, the reconstruction of the ship or the carrying of miscellaneous fish by a special transport will be considered and the assumption is made that the capacity of carrier increases from 6 tons to 8 tons.
Fish meal	5,000	From 5,000 tons of miscellaneous fish, 800 tons of fish meal will be produced.
Bonito	400	
Total	8,900 Tons	

Table - 7.6 Detailed Use of Land Required for Fishing Harbor

Detailed Use	Area (m^2)	Remarks
Auction market and disposal office	6,000	Catch per day: 180 tons
Open-air storage	5,600	Catch per day: 180 tons
Refrigerating facility	7,000	Storing capacity: 2,300 tons
Oil depot	2,800	Oil supply capacity: 1,200 tons
Sewage disposal	9,100	Sewage to be disposed: 3,000 m^3/day?
Processing facilities	9,600	Fish meal plant: 7,500 m^2; fish ball plant: 500 m^2; shrimp plant: 1,400 m^2; bonito plant: 200 m^2
Fishing gear warehouse	4,900	For the storage of fishing tackle to be used by 35 large boats and 50 small boats.
Common facility	2,800	For repairing facility of fishing tackle to be used by small boats.
Fishing boat repairing facility	14,000	Based on the example of Iztapb
Sub-total	61,800	
Roads	23,300	
Quay	3,500	
Green zone	1,400	
Sub-total	28,000	
Total	90,000	In future, the land for fishing laboratory, education, welfare and the like will be needed and in addition, the land for plants, processing facilities and refrigerating facility will have to be expanded.

Fig.-7.2 Land Utilization Plan for Fishing Port District



CHAPTER 8. DESIGN OF FACILITIES

Chapter 8. Design of Facilities

8-1 Breakwater

8-1-1 Design Conditions

In accordance with 4-3 and 4-4, Chapter 4, the design conditions for breakwater are as described in Table - 8.1.

8-1-2 Selection of Structure Mode

(1) Section constructed rectangularly with Coast Line

This section is most difficult in construction, since it must cut through the breaker zone. In addition, the prearranged construction site is a natural seaside, where no refuge, which will be utilized as an operating vessel base, exists at the time of starting the work. Consequently, it is preferable to adopt an end-on system combined with procedures applicable on land, in such method as armoring concrete covering is applied to rubblestone.

(2) Section constructed obliquely to Coast Line

For this section are required stones of great quantity to build a rubble mound breakwater. It is hard to obtain stones in this district, so that reduction of stones consumption is advantageous both in construction cost and process. Therefore, the composite breakwater of caisson type shall be built with stone of the minimum quantity and by speedy construction work. Also the preallotted mooring basin is comparatively so high in ground, that a caisson shall be constructed on the shoreside of the prearranged mooring basin and launched while dredgeing the mooring basin. Including the construction of caisson, therefore, the breadwater constructed by the caisson-engineering method as above suggested is suitable for this local district.

8-1-3 Structure

The structure of breakwater designed in accordance with 8-1-1 and 8-1-2 is as illustrated in Fig.-8.1 ~ 8.3.

8-2 Quaywall

8-2-1 Design Conditions

According to 4-3, 4-6 and 4-7 of Chapter 4, the design conditions for quaywall are as described in Table-8.2.

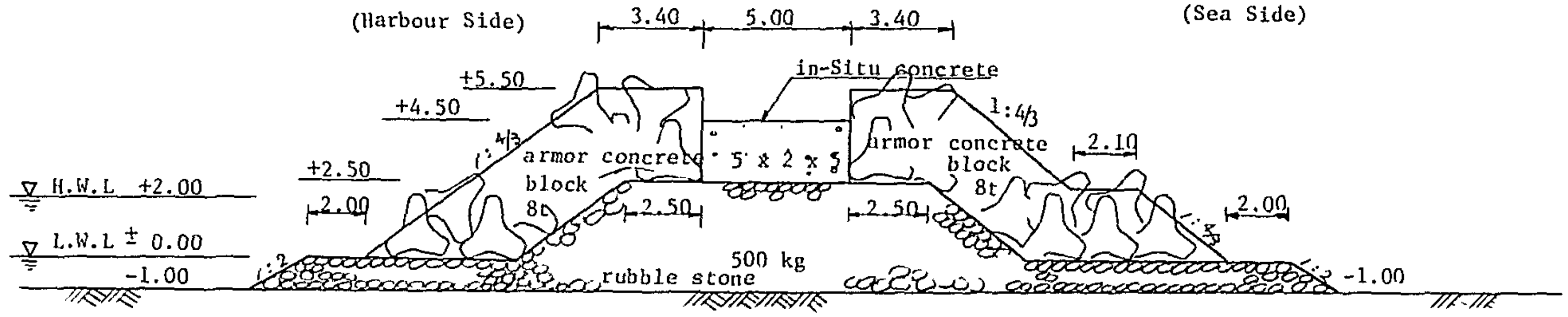
8-2-2 Selection of Structure Mode

The prearranged site for quaywall is comparatively so high in ground that it is advantageous both in construction cost and process to adopt a method reducing volume of dredgeing soil to the minimum.

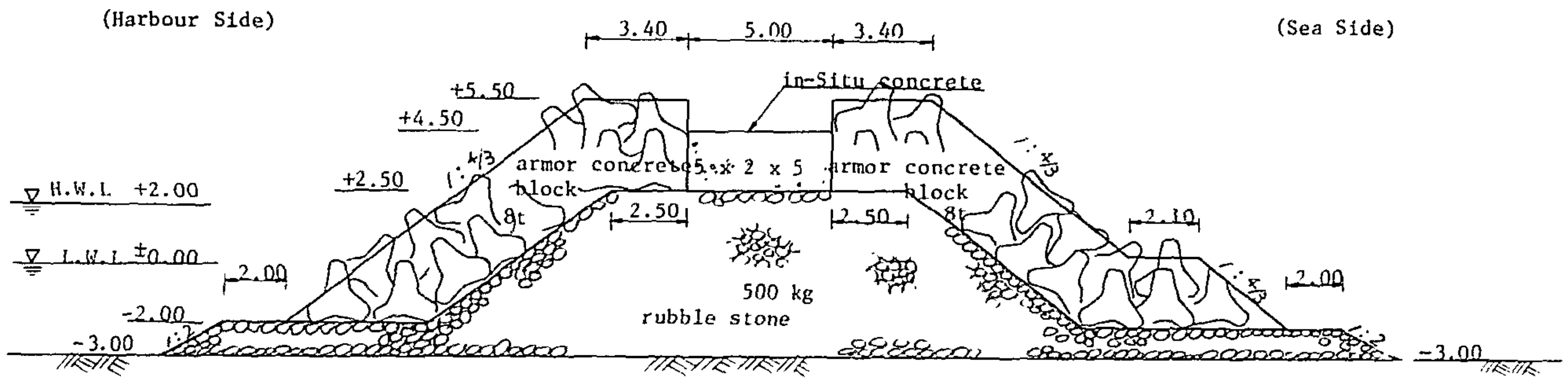
Fig.-8.1 Standard Cross Section of Breakwater (1)

Scale : 0 5
Unit : m

A - Section (Depth $\pm$ 0.0 ~ -2.0 m)



B - Section (Depth - 2.0 ~ -4.0 m)



C - Section (Depth -4.0 ~ -6.0 m)

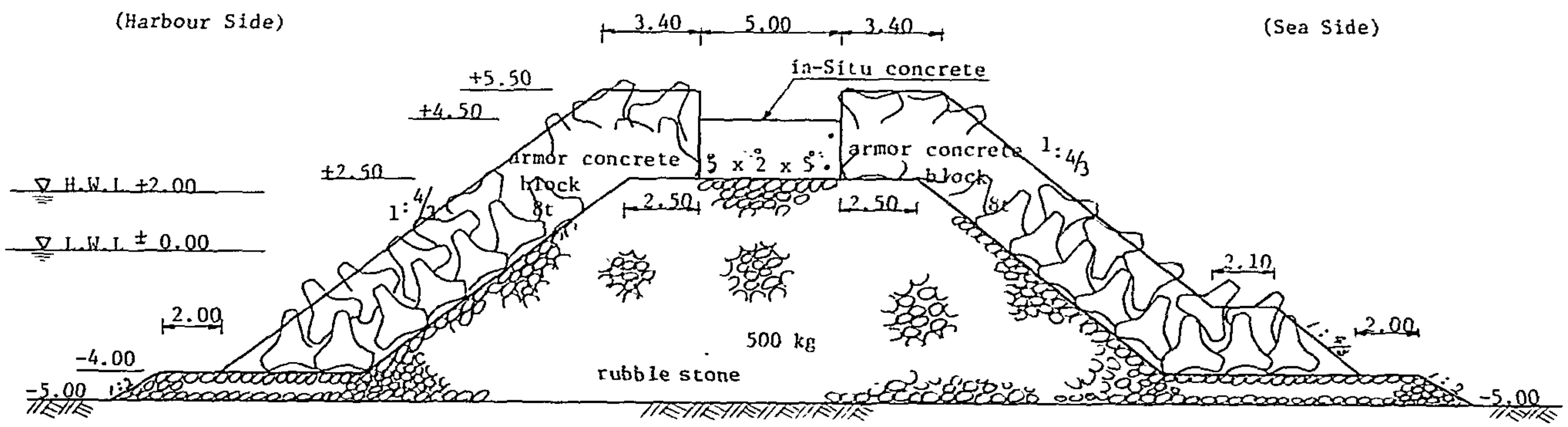
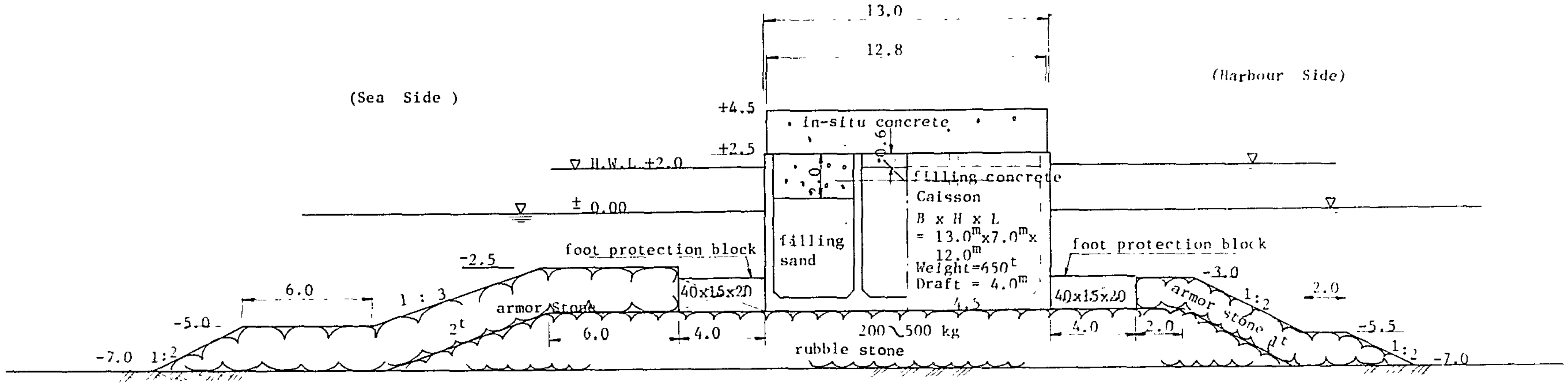


Fig.-8.2 Standard Cross Section of Brakwater (2)

Scale : 0 5
Unit : m

D - Section (Depth -6.0～-8.0m)



E - Section (Depth -8.0～-10.0m)

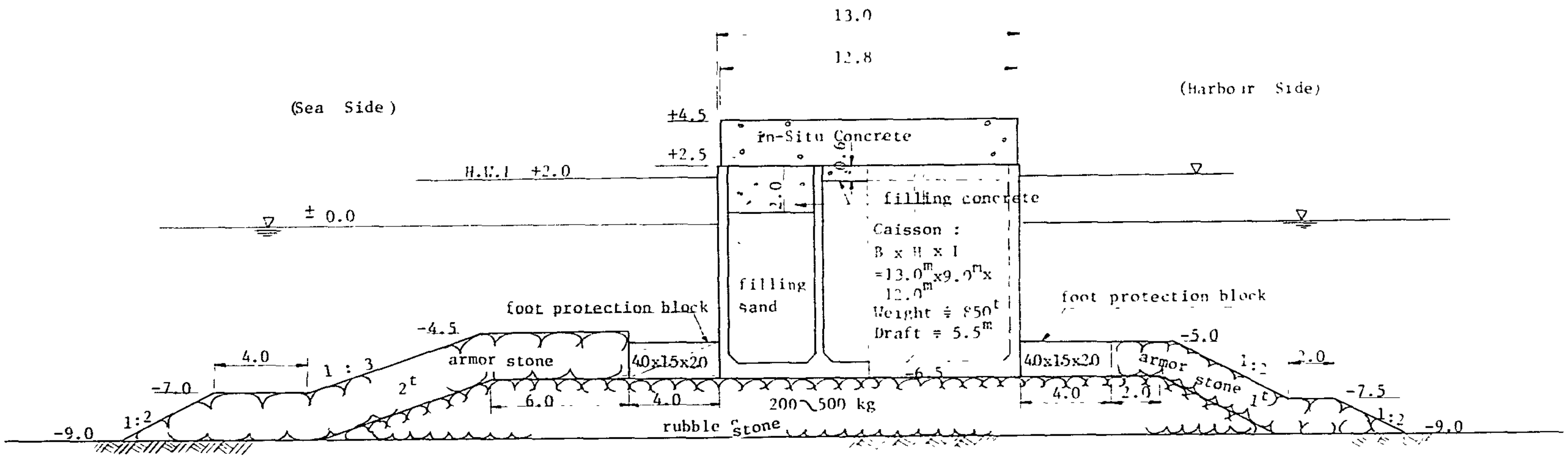


Fig.-8.3 Standard Cross Section of Breakwater (3)

Scale : 0 — 5
Unit : m

F - Section (Depth -10.0～-12.0m)

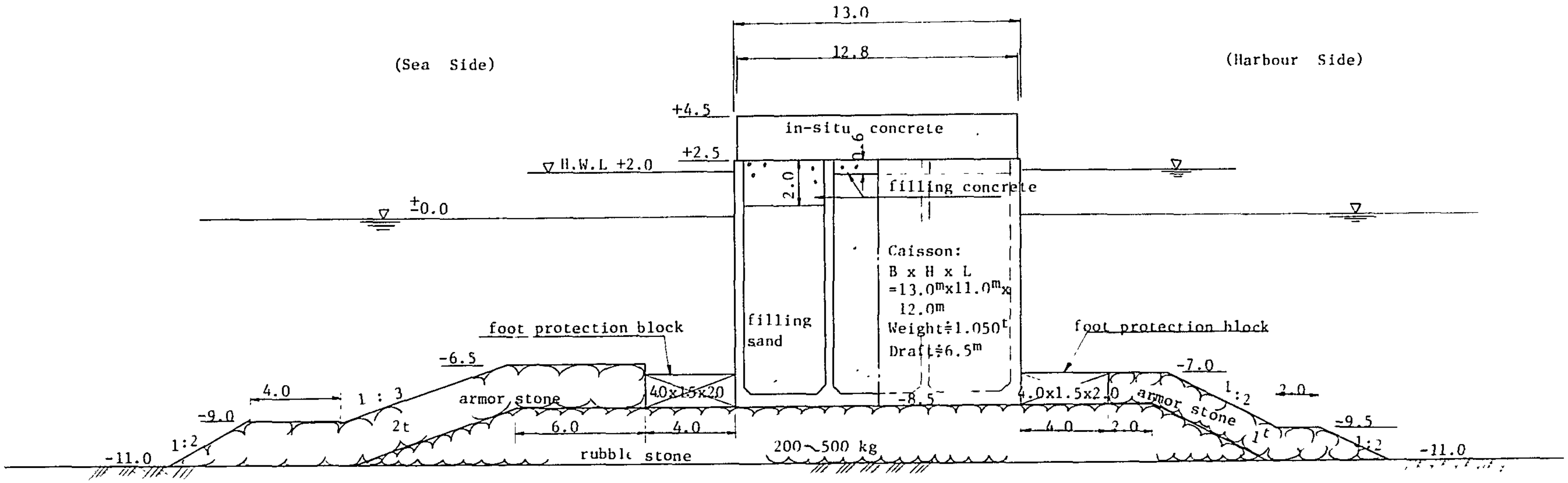


Table 8.1 Design Conditions for Breakwater Construction

(1) Design wave at the location where breakwater is constructed.	
Significant wave height	$H_{1/3}$ = 4.0 m , 3.5 m
Significant wave period	$T_{1/3}$ = 9.0 sec , 20.0 sec
Wave direction	N 150°E(±15°) ,N190°E(±15°)
(2) Design stillwater level	
Mean higher high water springs	H.W.L = +1.86 m ≒ 2.0 m
Mean lower low water springs	L.W.L = ± 0.0 m
(3) Working datum line	
Datum level	D.L. = ± 0.00 m

Accordingly, the pile anchorage typed steel sheet pile engineering method, in which piles are drived by work-on-land system and no soil excavation is required for anchor, shall be employed.

In the piled wharf engineering method, excessive cost is required for earthwork of the section above slopping surface slop protection of the slope section etc. In the vertical piled wharf engineering method, big steel pipe piles are needed for earthquake-proof design, resulting in higher cost by 12% as compared with the steel sheet pile engineering method, and in the case of vertical piled wharf, surchage on the upper superstructure is strictly regulated. From a view of utilization; therefore, this is not advantageous.

Also, in the batter piled wharf engineering method, long concrete piles are hard to be driven in since the prearranged site is solid in geological features.

8-2-3 Structure

The structure of quaywall designed in accordance with 8-2-1 and 8-2-2 is as illustrated in Fig.-8.4 and 8.5.

Table-8.2 Design Conditions for Quaywall

Quaywall / Item	-10.0 m Quaywall	-4.0 m Quaywall
(1) Shape conditions		
Cope level	+ 4.0 m	+ 3.0 m
Planned depth	-10.0 m	- 4.0 m *1
Designed depth	-10.5 m	- 5.5 m
Apron width	20.0 m	15.0 m
Apron grade	1/100	2/100
(2) External force conditions		
Related vessel	Cargo vessel D.W.T. 15,000	Trawler and Tuna boat 200 G.T.
Cargo handled	Cotton, coffee, sesami seed, fertilizer, automobile, machine	fish
Surcharge		
usual	3.0 t/m^2	1.0 t/m^2
during an earthquake	1.5 t/m^2	0.5 t/m^2
Design seismic coefficient		
horizontal seismic coefficient	K_h =0.15	K_h=0.15
vertical seismic coefficient	K_v =0.00	K_v=0.00
(3) Design stillwater level		
Mean higher high water springs	H.W.L. = +1.86 m	H.W.L. = +1,86 m
Mean lower low water springs	L.W.L. = ±0.00 m	L.W.L. = ±0.00 m
Residual water height	R.W.L. = +1.3 m	R.W.L. = +1.3 m
(4) Soil conditions		
Soil name	sand	sand
Angle of internal friction	$+4.0^m \sim +1.3^m$: ϕ=30°	$+3.0^m \sim +1.3^m$: ϕ=30°
	$+1.3^m \sim$: ϕ=35°	$+1.3^m \sim$: ϕ=35°
Bulk density	$+4.0^m \sim +1.3^m$: $\gamma=1.8t/m^3$	$+3.0^m \sim +1.3^m$: $\gamma=1.8t/m^3$
	$+1.3^m \sim$: $\gamma'=1.0t/m^3$	$+1.3^m \sim$: $\gamma'=1.0t/m^3$
(5) Others		
Approching velocity	0.10 m/sec	0.15 m/sec
Mooring post	100 ton	------
Mooring bollard	35 ton	15 ton
Durable years	50 years	50 years
Working datum line	D.L. = ± 0.00 m	D.L. = ± 0.00 m

* 1 This wharf shall be utilized as -4.0 m one in the first-term schedule, and as -5.0 m one in the second-term schedule.

* 2 R.W.L. = (HWL - LWL) x 2/3 = 1.86 x 2/3 = 1.3 m

Fig.-8.4 Standard Cross Section of -10.0m Quay Wall

Scale: 0 5
Unit : m

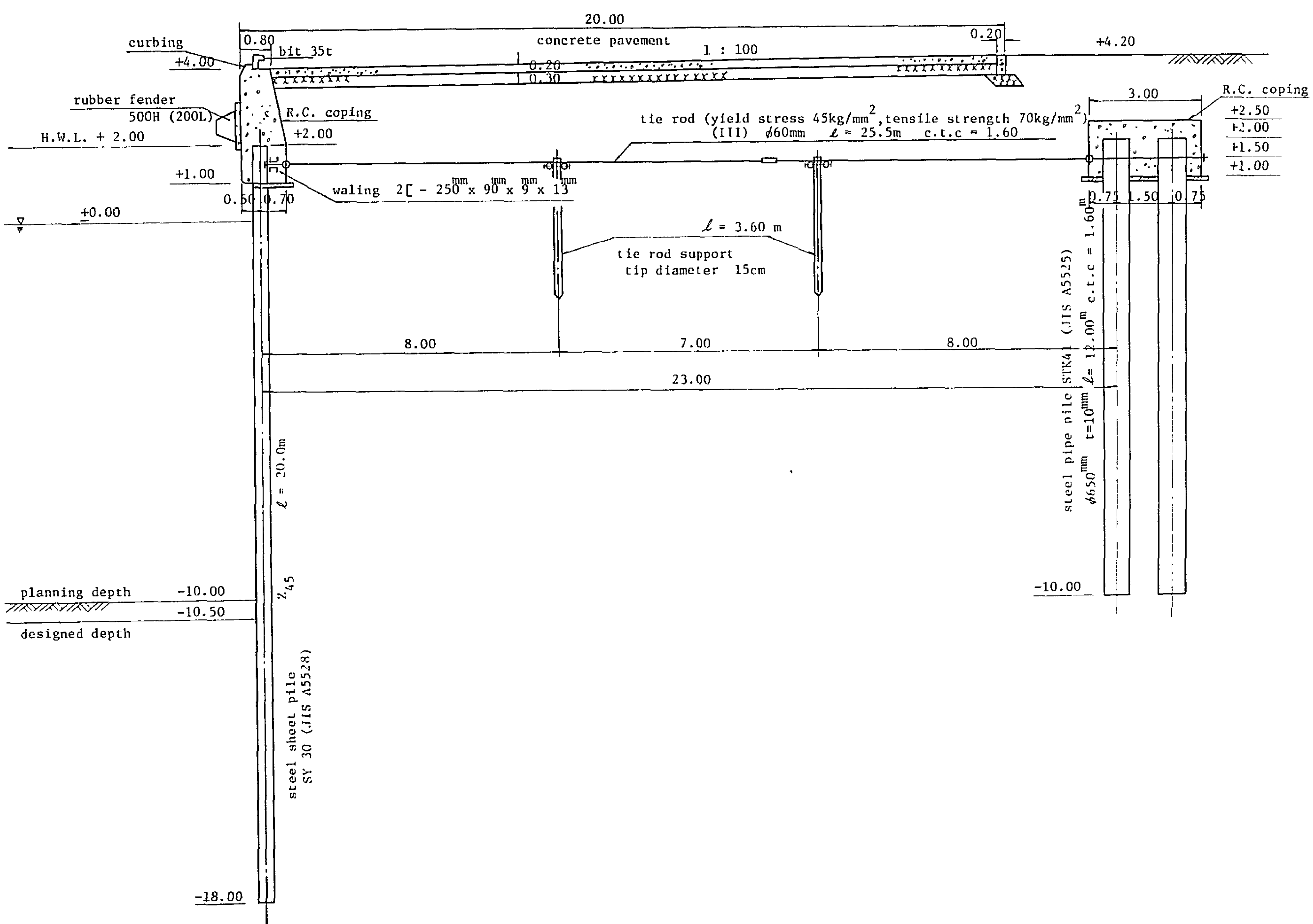
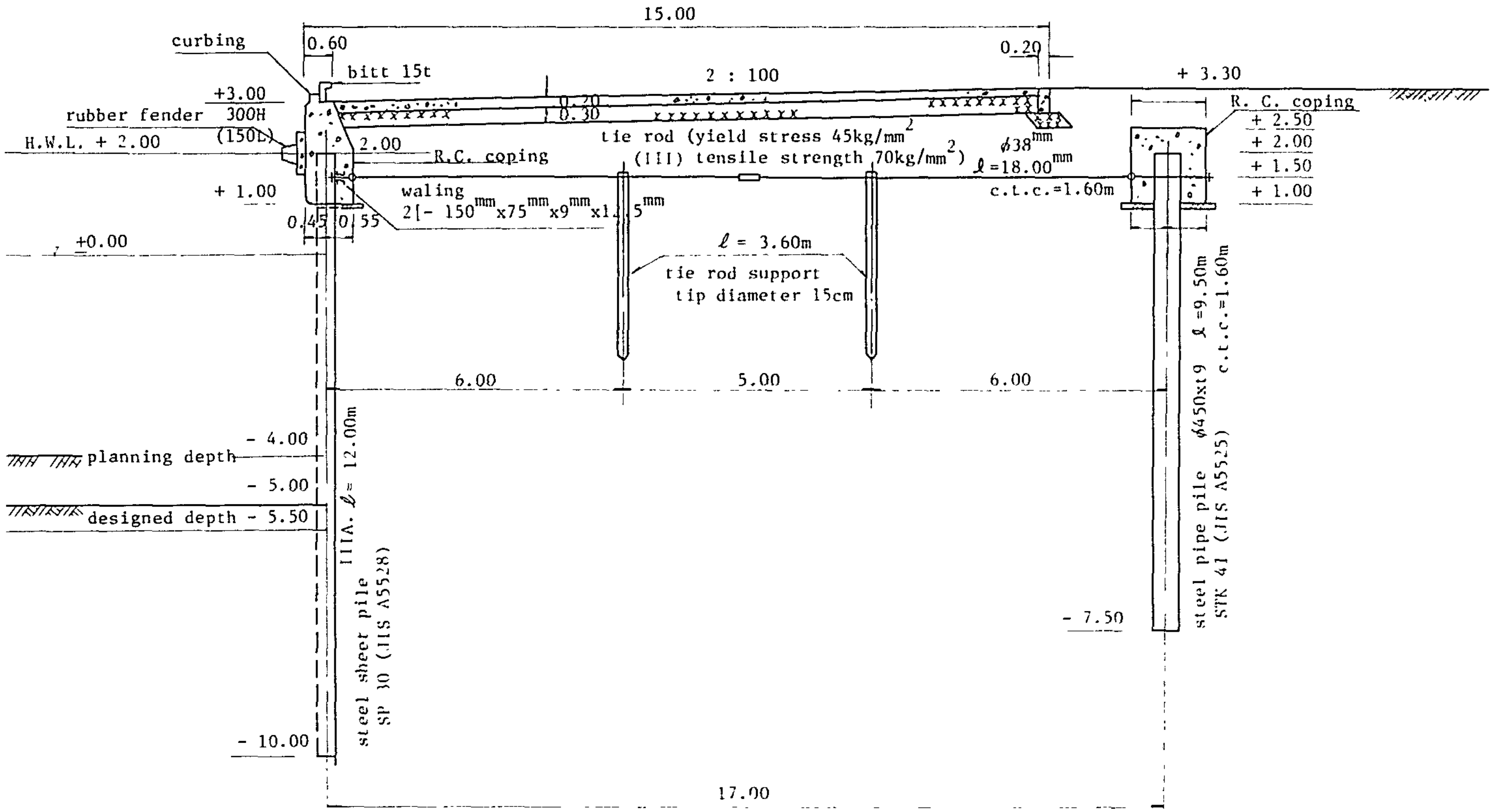


Fig.-8.5 Standard Cross Section of -4.0m Quay Wall

Scale: 0 5
Unit : m



8-3 Temporary Breakwater and Groin

8-3-1 Design Conditions

8-1-1 applies correspondingly to the Design conditions for temporary breakwater, groin etc.

8-3-2 *Selection of Structure Mode*

Since the construction work of temporary breakwater, groin et. is carried out within the break r zone similarly as 8-1-2 (1), the end-on system which is applicable on the sea from the land, shall be employed.

8-3-3 Structure

The structure of temporary breakwater, groin etc. designed in accordance with 8-3-1 and 8-3-2 are as illustrated in Fig. - 8.6 and 8.7.

8-4 The other Installations and Equipment

8-4-1 Quay Crane

(1) Type and Design Conditions

The crane is of rope-trolley, bridge crane as described in 6-4-1 (2), Chapter 6. The design conditions are as indicated in Table - 8.3.

Table-8.3 Design Conditions for Quay Crane

Load	40.0 t
Raid span	16.0 m
Outreach (from the face line of quay)	21.5 m
Total lift	30.5 m
Above rail surface	17.0 m
Beneath rail surface	13.5 m
Travelling distance	180.0 m

(2) Structure

The structure of quay crane designed in accordance with 8-4-1 (1) is as illustrated in Fig. - 8.8.

8-4-2 Transit Shed and Warehouse

The designing specification of transit shed and warehouse is as described in Table - 8-4, in accordance with 6-4-2 and 6-4 3, Chapter 6. The portrait is as illustrated in Fig. - 8.9.

Further, the cargo handling facilities for quay crane and transit shed etc. are summarized in Fig. - 8.10.

Fig.-8.6 Standard Cross Section of Temporary Breakwater

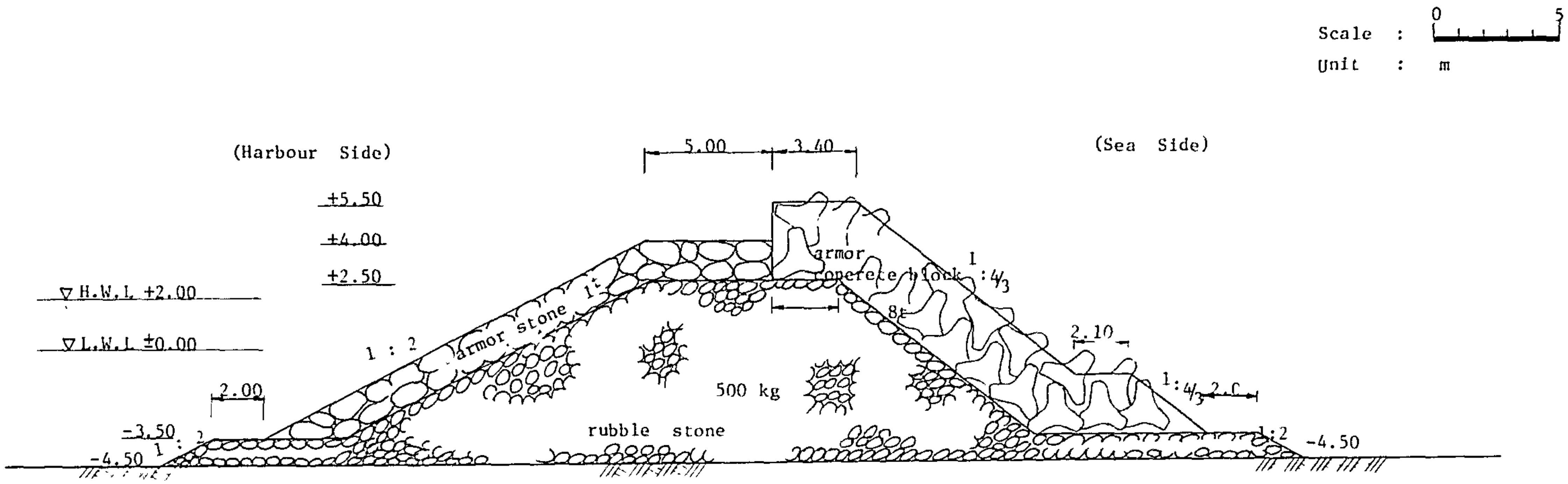


Fig.-8.7 Standard Cross Section of Shore Protection Facility. (Groin)

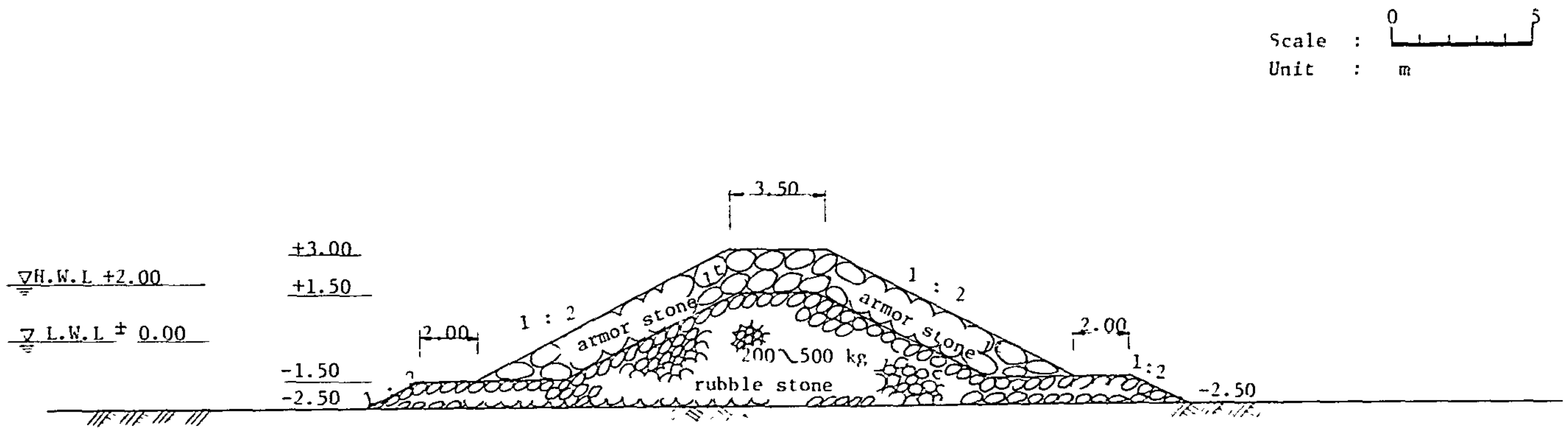


Table-8.4 Designing Specification of Transit shed and Warehouse

Span	50 m
Beam length	140 m
Eaves height	8 m
Effective eaves height	6 m
Area	7,000 m^2
Roof	Long steel plate, 0.5 m/m
Wall	Asbestos slate, 6.3 m/m
Foundation	Assumed bearing power of ground (Long term) 10 t/m^2
Entrance	Steel shutter, 4,500 x 4,00 mm

8-4-3 Tug Boat

The tug boats are 1,000 PS equipped with controllable pitch propeller and kort rudder in accordance with 6-4-5, Chapter 6. This designing specification is as described in Table - 8.5, and the reference particulars are as illustrated in Fig. - 8.11.

Table - 8.5 Designing Specification of Tug boat

Length (between perpendiculars).	25.00 m
Width	7.60 m
Depth	3.40 m
Draft	2.50 m
Gross tonnage	about. 160 ton
Main engine (Diesel engine)	500 PS x 2 Controllable pitch propeller
Crew	8

Fig.-8.8 STRUCTURE OF CRANE ON THE QUAY

Specifications

Type	Rope trolley typed bridge crane
Load	40.0 ton
Total Lift	30.0 m
Total Lateral Range	36.0 m
Rail	75kg/m, 16m span, 180m long

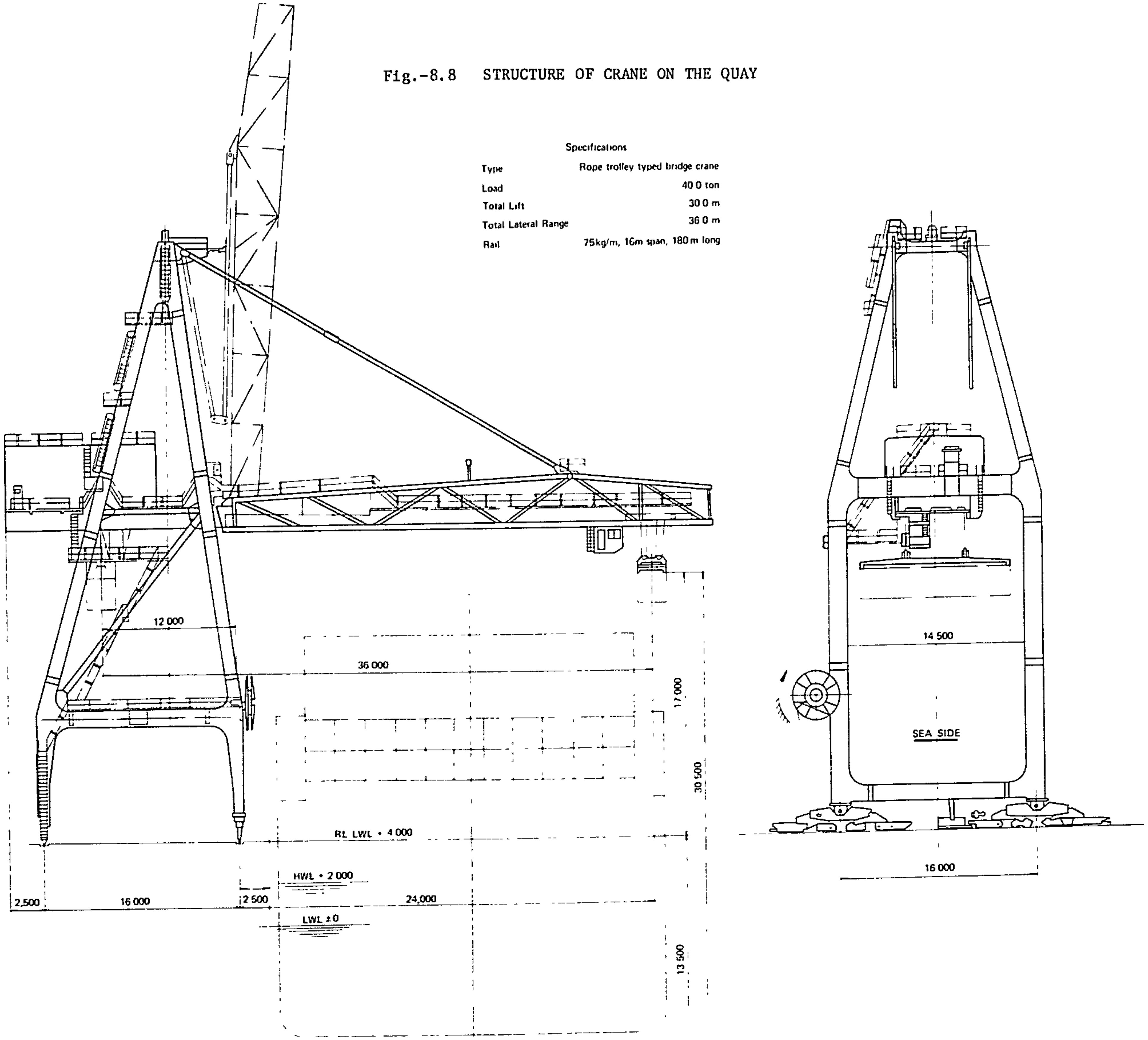


Fig.-8.9 Transit Shed & Warehouse

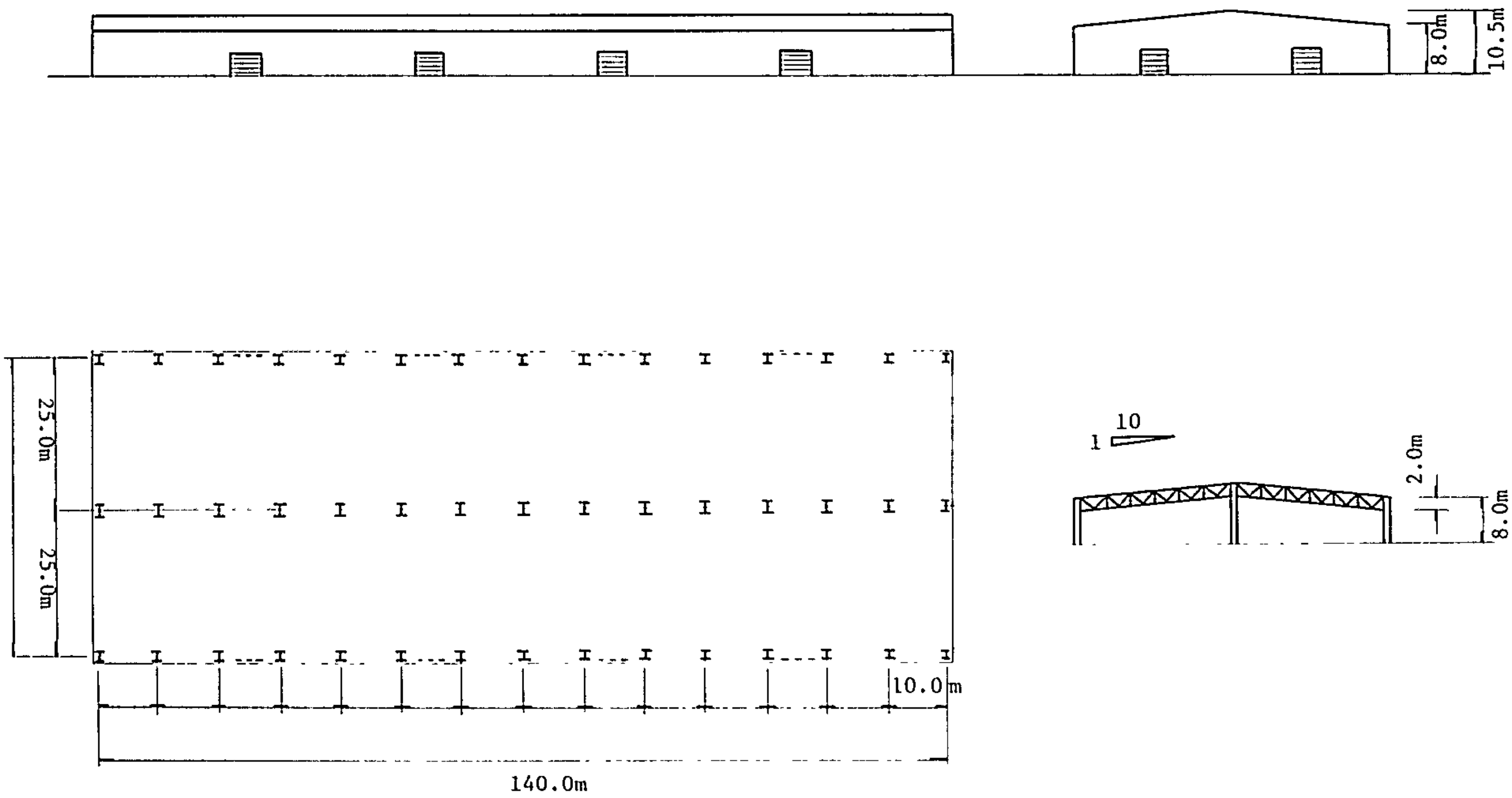


Fig.-8.10 Cargo Handling Equipment

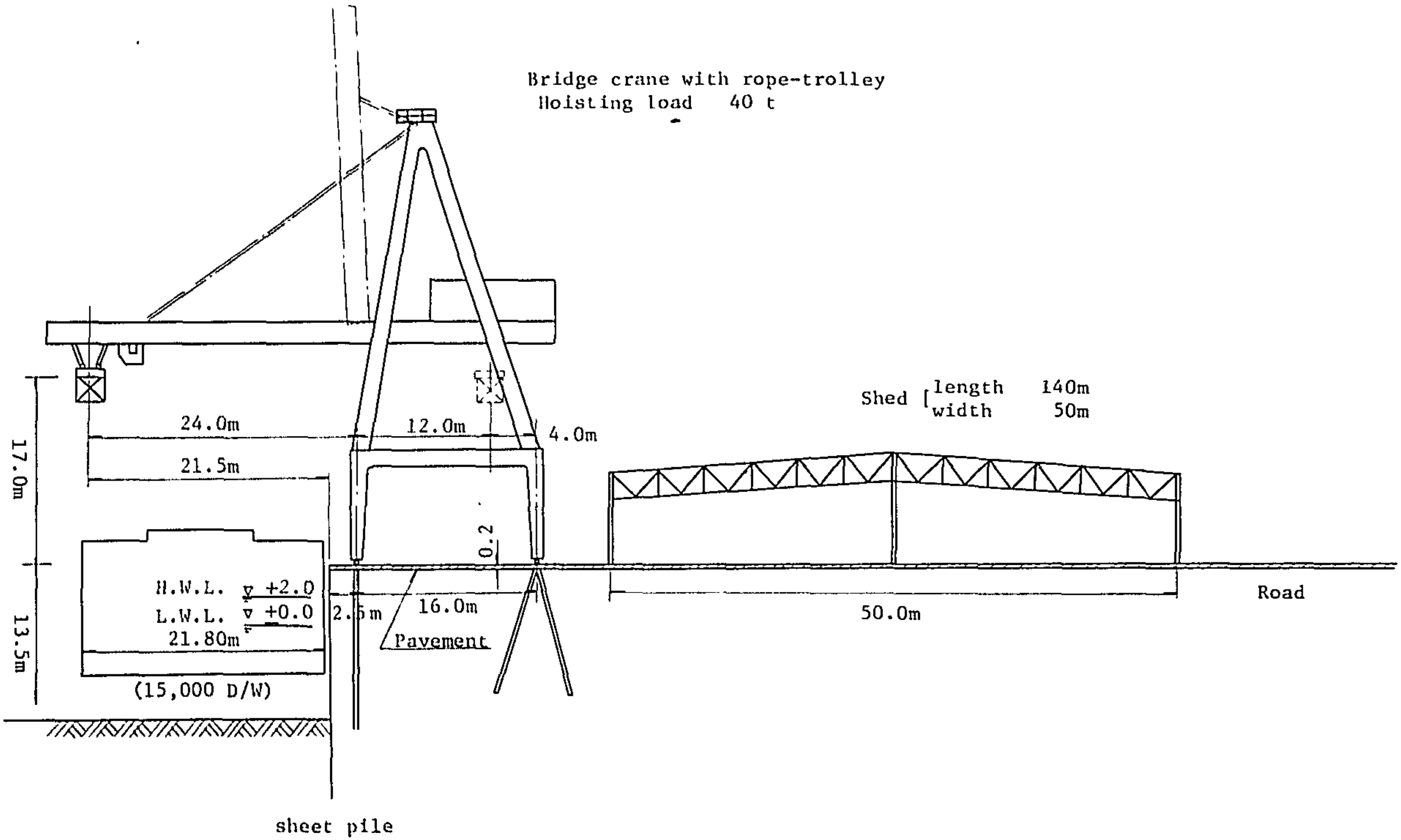
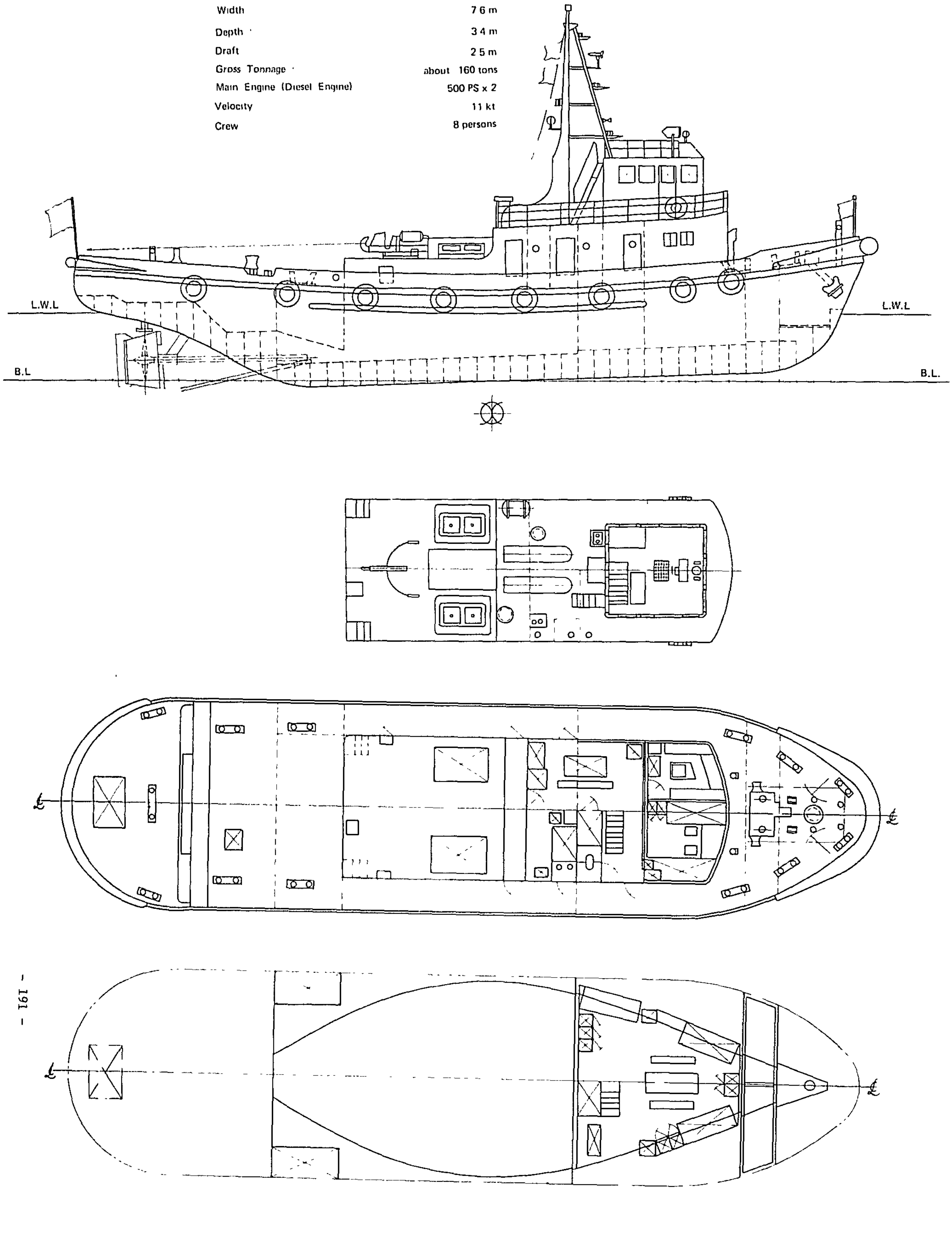


Fig.-8.11 TUG BOAT

Specifications

Total Length	28.3 m
Length between Perpendiculars	25.0 m
Width	7.6 m
Depth	3.4 m
Draft	2.5 m
Gross Tonnage	about 160 tons
Main Engine (Diesel Engine)	500 PS x 2
Velocity	11 kt
Crew	8 persons



CHAPTER 9. CONSTRUCTION METHOD AND SCHEDULE

Chapter 9. Construction Method and Schedule

9-1 Outline

The first term construction work for the new port is planned to be completed in the year of 1980. Driving this five years from 1975 to 1979, a quay wharf for international trade which is 10 m in water depth, consists of three berths and serves for 15,000 D/W class ships, will be constructed in the commercial port area, and a quay wharf for fishing boats of 400 m with water depth of 4 m will be set in the fishing port area as a component of fisheries wharf. Further, mooring basins of 10 m in water depth and 110,000 m^2 in area will be connected with the passage of 10 m water-deep, 120 m - 260 m wide and 1,500 m long; in addition, those covering 60,000 m^2 for the small vessels of 4 m water-deep, in the fishing port area. Also, in order to ensure maritime traffic safety in the port area and calmness in the mooring basin, the East Breakwater of 1,000 m and the West Breakwater of 430 m will be constructed.

The yearly processing condition of main facilities is as illustrated in Fig. -9.1

9-2 Plan for Constructing Main Facilities

(1) Formal and Temporary Breakwaters

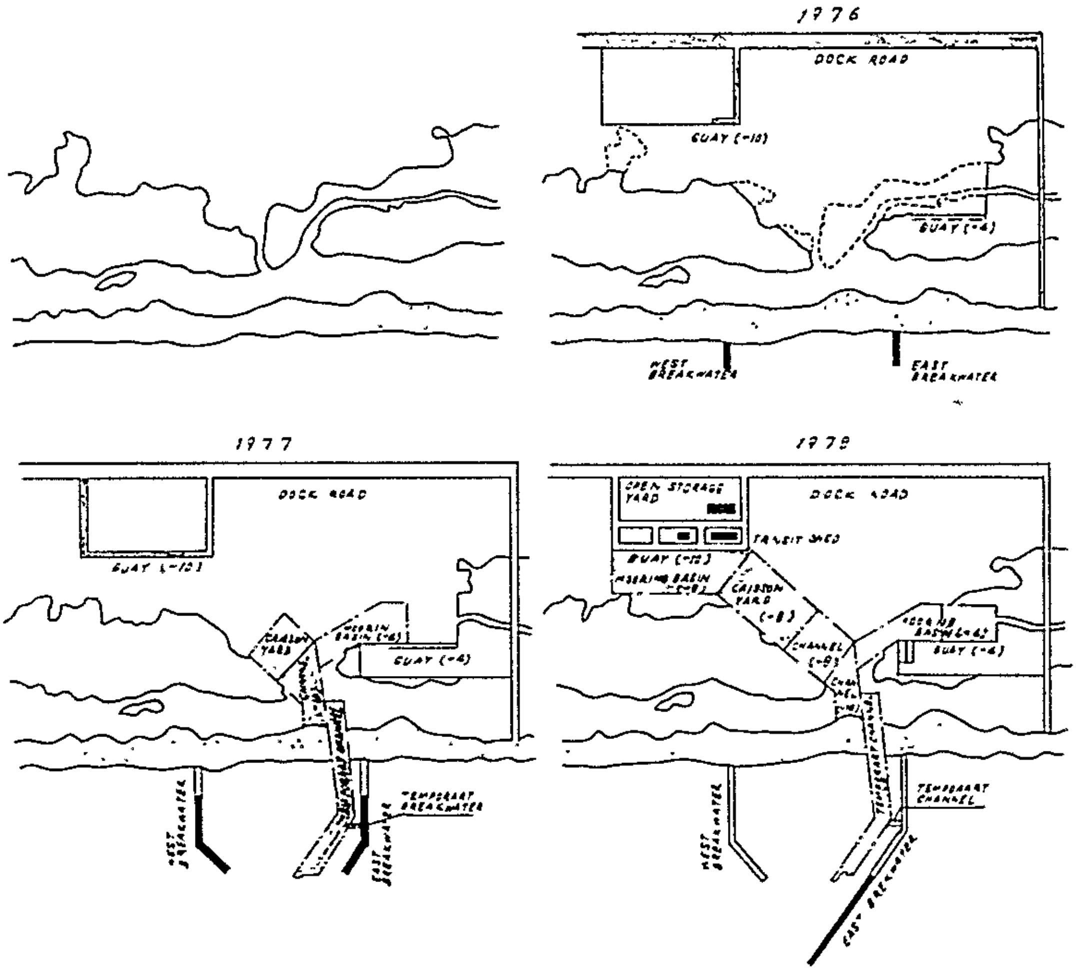
Judging from the structure of artificially excavated port, the breakwaters should be completed as early as circumstances permit since they are the most important basic facilities. Consequently, the foundation work for both East and West Breakwaters will be started from 1976, and both breakwaters to the turning points as well as the temporary breakwaters will be completed by the end of 1977 to secure the base site for working on the sea and the channels necessary for taking caissions in tow. From 1977, the foundation work will be extended so that the standard structure work can be started. Coping with this step, the construction work is arranged in such manner as a rapid construction method, and breakwaters will be completed except that for the top section, at the end of 1978, thus ensuring calmness in the inward area of the port for dredging work.

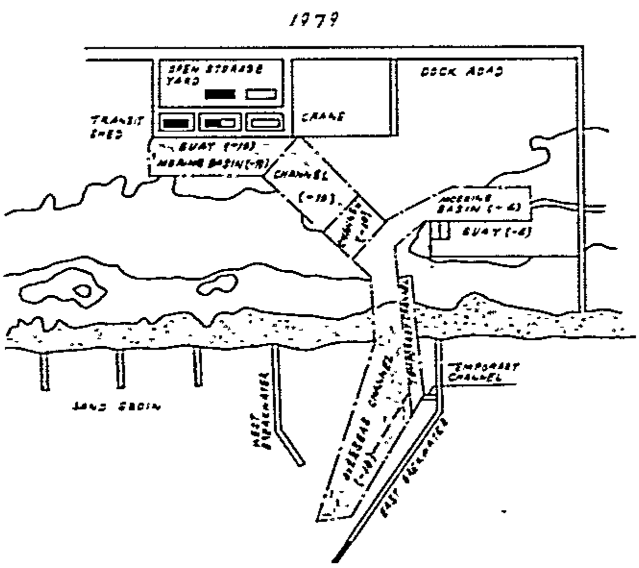
The top section is treated the final year of 1979, thus completing the work process as a whole.

(2) Quay

The construction of quay is processed by taking the dredging schedule for mooring basin located in front of quay, sheltering efficiency of breakwater and the engineering requirements for relative installations into careful consideration. For the reason that a part of the facility under construction is required to be used as working

Fig.-9.1 YEARLY PROCESSING CONDITION OF MAIN INSTLLATIONS





Note: [dashed box] Shows the excecution of each year site, the construction work is processed in such order as quay for fisheries wharf starts to be constructed in 1976, to be partially utilized in early 1978 and is completed by 1979. The quay for wharf of international trade, which consists of three berths and serves for 15,000 D/W class vessels, starts to be constructed in early 1977, and will be completed by the end of 1979 by taking the yearly plans and engineering requirements for dredging work for front area, shed, warehouse, cargo-handling machine etc. into consideration, thus starting to be utilized with water depth of 8 m in the middle of 1979.

(3) Mooring Basin and Temporary Channel

To prevent rebuilding by time and to equalize operation, the dredging work is regulated in work process and application area according to sheltering efficiency of breakwater and equipping condition of mooring wharf. Consequently, the constructing process following the dredging work in the inner port proceeds to the outer port in correspondence to the progress of breakwater work, and shall be completed by the end of 1979 when the breakwater and the other relative installations will be completed. Thus, a dredger will be sent to Sipacate in 1977, and immediately after the completion of temporary breakwater in the same year, the excavating work for temporary channel will be started. Taking dredging of vessels entering into the port, the proper time for dredging work for base site of sea working and for front area of mooring wharf, fabricating process of caisson in passage and water basin etc. into consideration, the fisheries wharf water basin will be processed by dredging in 1978, the trading wharf water basin and the outer port passage in 1979.

(4) Sand Groins

The sand groins are important facilities which play a role of preventing the erosion of the South Coast in coping with the construction of both east and west breakwaters in the first term. Accordingly the tidal phenomena end ground configuration shall be investigated by 1978 when the breakwaters will be almost completed. And based upon the actual conditions obtained, the groins shall be completed by the end of 1979.

(5) Roads

Simply paved roads will be set in 1976 and completed by pavement in the year of 1978. They are planned for the purpose of transporting the construction materials for the new port, directly connected with the existing trunk road and utilized as roads for constructing work.

9-3 Construction Method for Main Facilities and Construction Work Installations

9-3-1 Construction Method

(1) Breakwaters, Temporary Breakwater and Sand Groins

① Carrying and depositing of rubblestones → ② Levelling of a rubble bed → ③ Manufacturing, luaching and installation of caissons →

④ Manufacture and installation of wave-breaker blocks → ⑤ Manufacture and installation of foot protection blocks → ⑥ Carrying and depositing of armor stones →

⑦ Levelling of armor stones → ⑧ Placing of coping concrete

① - 1 Rubblestones are carried by dump-truck to the site from the quarry in the neighbourhood of Escuinta located approximately 90 km north of Sipacate.

① - 2 Depositing procedures are divided into land- and sea- deposition. With respect to foundation, rubblestones land-carried are directly thrown into the sea by dump-truck. As for the enbankment section of caisson, rubblestones are loaded on self-propelling carriers at the shipping point and deposited into the sea.

② The land-levelling of foundation's upper facial surface and of facial slope of wave breaking works, and the submarine-levelling of bottom face for caisson-, wave breaking- and fost protecting works of caisson's embankment section are processed by stone-masons and divers.

③ - 1 The fabrication of caisson is processed on the sandy platform which is produced by the land readjustment of the area prealotted for dredging the main passage.

③ - 2 Concrete placing is carried out by discharging operation by the pump car, after transporting with the agitater from the plant.

③ - 3 The caisson is launched on the sand ground by dredging its front side, using a large pump dredger for channel and bacin.

③ - 4 After launching, the caisson is taken in tow by a tug boat to the site for installation and set by engineering service of floating crane and flooding to caissen.

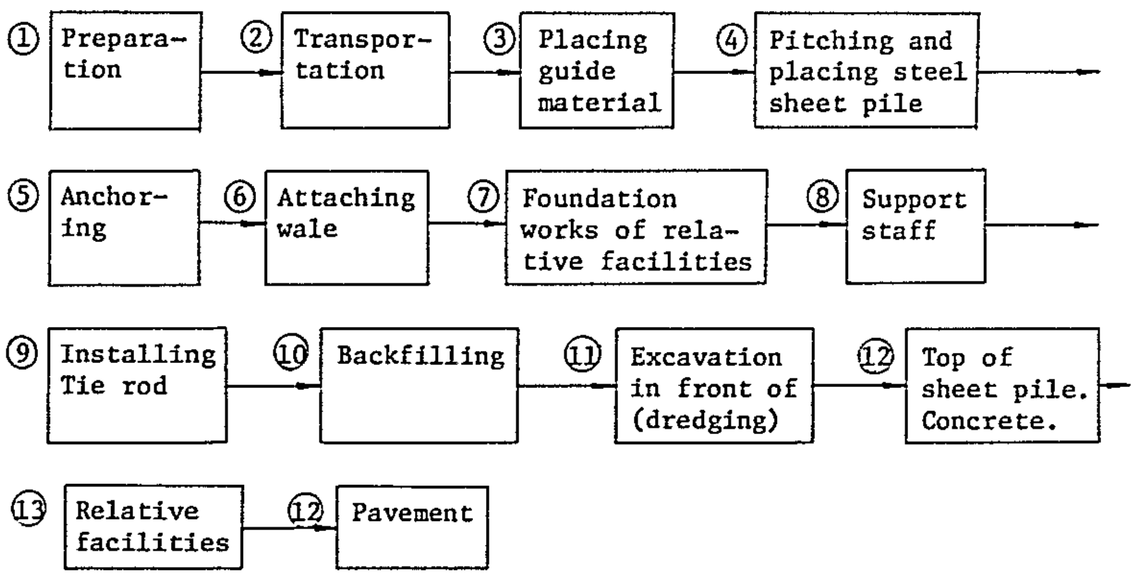
③ - 5 Immediately after the installation of caisson, sand from Sipacate is deposited in caisson.

④ The wave breaking block is manufactured by the method of carrying concrete to the shuttering.

⑧ - 1 Coping concrete is placed in two processers to eliminate the unevenness of top height, caused by sinking of the structure body, at the time of completion as much as possible.

⑧ - 2 Concrete is placed by a concrete pump car or a concrete mixer boat of the plant, after the handling at field by the agitator from the plant. In particular, sufficient attention should be paid to quality control.

(2) Quay



③ In order to ensure exact location of driving and stability of steel sheet piles in processing, solid guiding material shall be prepared. The material used is, however, removed for other purpose after the completion of driving.

④ - 1 The driving method is of driving in panels in principle.

④ - 2 The setting of steel sheet piles is conducted by driving a certain number of piles at one time and leveling to the designated depth, using a drop hammer or a vibro hammer.

④ - 3 Eveness of driving is affected by turning and inclining of steel sheet piles, so that the method of drouble piles driving by diesel hammer is employed.

⑤ The steel pipe piles are set by confirming exact location and angle. Also remedial arrangement shall be applied as required even during the driving work. The driving has to be conformable with the designated depth, and sufficient attention should be paid before as well as after the driving operation.

⑦ Since it is considered that the pile driving in foundation, contained in the incidental work, causes damages to tie rod, the driving work should be processed after the steel sheet pile work. The work procedure for steel pipe pile driving is applied correspondingly to that of steel sheet pile driving.

⑪ - 1 Excavation of front area is carried out by a large pump type dredger. Avoiding partial, deep excavation, the dredging is processed with a certain designated depth evenly all over the area concerned, so that sectional displacement of sheet piles may be eliminated.

⑪ - 2 At the time of dredging, inspection should be made on the displacement of interlocking joint installed, and if it is found, the operation shall be stopped immediately, taking necessary measures for remedy.

⑫ When the displacement of steel sheet piles is restored, after backfilling of the backside of sheet piles and excavating of the front side are over, concrete of the topside shall be placed.

(3) Dredging (Passage, mooring basin and temporary channel)

① Common temporary facility.
Preparation of taking a ship and transportation.
→
② Land sand discharge piping system.

Removal of land sand discharge piping system.
→

③ Maritime sand discharge piping system.
No. zero submarine pipeline.
Removal of facilities.
→
④ Dredging
→
⑤ Reclamation.
Spillway.
Sand discharge pipe line.
Removal of facilities.

②, ③, 5 - 1 The form of sand discharge piping and its piping course shall be selected on the basis of construction work purposes as well as conditions of construction site, and so arranged that soil and sand can be discharged and can be spread all over the reclamated area by making the piping course as short as possible. For this project, standards and number of pump boats used, nature of soil in dredging area, nature of soil and height of ground in piping course, weather, tidal phenomena, location of spillway etc. shall be investigated and referred as data.

②, ③, 5 - 2 As for piping form, floater pipe, sinking and placing pipe, steel holding frame, wooden holding frame and 3-pole holding frame as adopted.

④ In dredging form, judging from the conditions, such as nature of soil, work volume, work term, dredging depth, disposing procedure for soil and sand, configuration of ground etc., pump type dredging method is adopted.

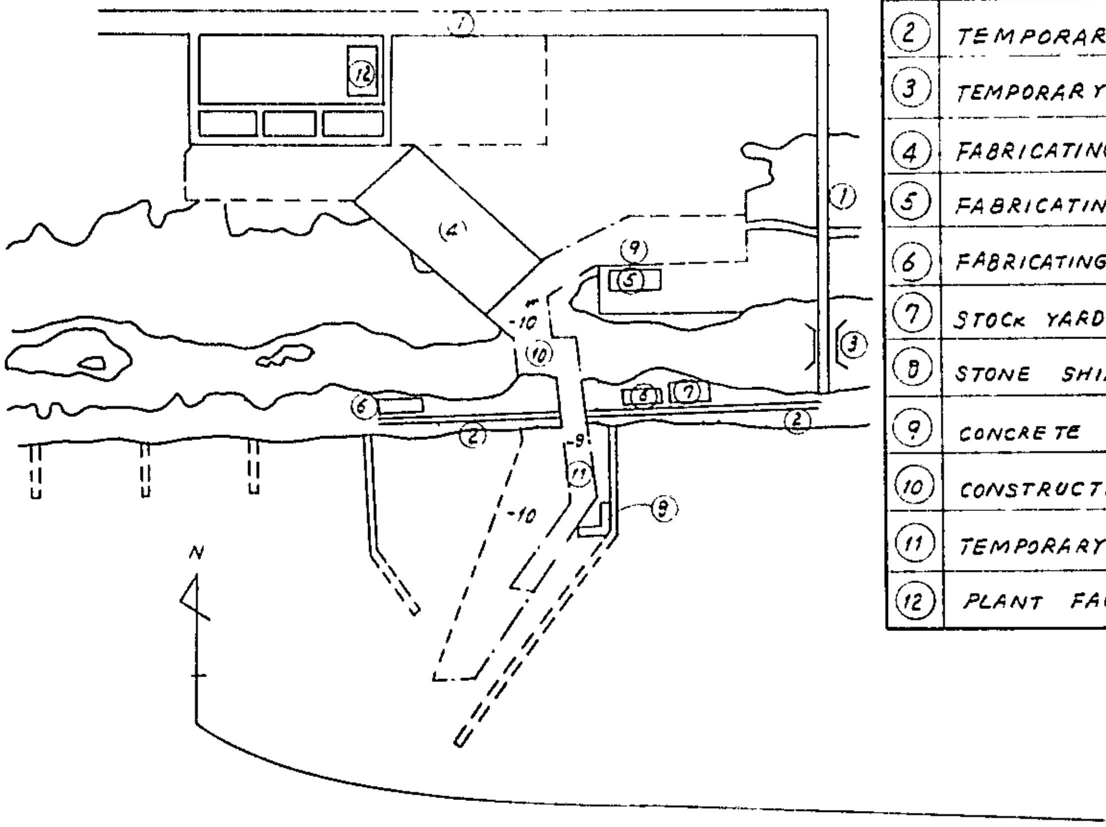
⑤ Since the nature of soil is much in sand content, the blowing-out method is applied to the arrangement of piping course for reclamation.

9-3-2 Facilities for Construction Work and Arrangement

Facilities for work in operation site, material transportation road, and construction craft base are placed on the assumption that they will be utilized as main facilities in future, so that their removal or withdrawal is restricted to the minimum extent. Further, taking the step that the operating area may be devided into the East and the West in future due to the formal construction of channels into consideration, the facilities for work will be arranged by giving priority to the economical East Breakwater side.

The arrangement of facilities for work is as illustrated in Figure-9.2.

FIG - 9 2 ARRANGEMENT OF FACILITIES FOR WORK PLAN



NO	PURPOSE
1	ROAD FOR TURNING-IN CONSTRUCTION MATERIALS
2	TEMPORARY ROAD
3	TEMPORARY BRIDGE
4	FABRICATING YARD OF CAISSON
5	FABRICATING YARD OF CONCRETE BLOCK
6	FABRICATING YARD OF WAVE BREAKING BLOCK
7	STOCK YARD OF RUBBLESTONE
8	STONE SHIPPING YARD
9	CONCRETE BLOCK SHIPPING YARD
10	CONSTRUCTION CRAFT BASE
11	TEMPORARY CHANNEL
12	PLANT FACILITIES

9-4 Procurement of Ship's Machines and Construction Materials

9-4-1 Ship's machine

In the existing situation, construction crafts cannot be procured in Guatemala, so that the procurement perfectly depends upon the overseas market. Accordingly, the fixed costs, such as costs of transportation, equipment-disassembling, depreciation etc. for vessels, will increase. However, this does not affect considerably the management of so large-scale project as the construction work of New Port in which the vessels operations usually cover several work processes. While, the articles as land machines can be sufficiently procured in Guatemala where the stock is available, though those machines contains some problems in performance. The machines of unavailable kind have, however, to be procured from the overseas for using in universal purpose in future. Plan for utilization of main marine machines by construction work type is as shown in Table-9.1.

- Table-9.1 A list of Marine Machine - for construction

9-4-2 Construction Materials

Amoung construction materials excluding steel and rubber products, soil and miscellaneous stone, lumber, cement etc. can be procured in the local district. With respect to stone, aggregate and etc. as used in a large quantity, however, place and procedure for gathering, transportation means and etc. are necessary to be investigated. The main construction materials are as shown in Table-9.2

- Table-9.2 Used plan of the Main - Construction Materials

9-5 Labour Plan and Circumstances Concerned

It is comparatively easy to obtain common labourers in the local district. The availability of technical workers is limited, except those concerned with engineering machine, road and bridge. Particularly, workers engaged in marine construction work, seamens, divers etc. are almost unavailable, so that technical workers have to be invited from the overseas until the local persons acquire the necessary technics. Plan for labour employment is as in Table-9.3

- Table-9.3 Labor Employment Plan -

Table-9.1 List of Ship's Machineries Used

Name	Capacity	Unit	Quan-tity	Propriety of local Supply	Total number of working days	Remarks
Pump dredger	D6000PS Non-propelling	ea	1	No	610	Dredging, Breakwater caisson launching
Windlass ship	15 ton hanging D200PS Self-sailing	"	1	No	610	Ditto
Floating crane	50 - 100 ton hanging Non-propelling	"	2	No	120	Placing of Caisson, and concrete apron block
Ditto	25 ton hanging Non-propelling	"	4	No	1050	Installation of tetra-pods placing
Ditto	3 ton hanging Self-sailing	"	1	No	460	Piping work for dredging
Tug boat	D 450 P.S	"	1	No	150	Placing of caisson
Ditto	D 180 - 250 P.S	"	4	No	1350	Placing of tetra-pods for foot protection
Ditto	D 40 P.S	"	4	No	1000	Placing of tetra-pods
Pontoon	200 ton loading Non-propelling	"	1	No	50	Placing of concrete apron block
Ditto	100 ton loading Non-propelling	"	8	No	2150	Placing of tetra-pods
Ditto	30 ton loading Non-propelling	"	1	No	460	Piping of dredging
Carrier	300 m^3 loading Self-sailing	"	4	No	2000	Rubble of break-water. Filling of caisson
Diving boat	3 ton hanging 30 P.S Self-sailing	"	26	No	11,000	Trimming of a rubber bed of breakwater. Submarged pipeline of dredging
Land machine	Various grade			Yes		Various material transport, Piling of steel sheet pile and steel pipe. Striking of shuttering. Concrete placing.

Table-9.2 Consumption Plan for Main Materials

Material	Item	Standards	Unit	Quantity	Remark
Soilland stone	broken stone	200-500 kg/ea	m^3	250,000	Breakwater-rubble base
	rubbles-stone	1000-2000 kg/ea	"	85,000	Breakwater-armor stone 1000kg/ea 20,000m^2 2000 65,000
	cement		ton	31,000	
	sand		m^3	48,000	
	ballast		"	95,000	
	filling sand	silt fraction - below 20%	m^3	71,000	Filling breakwater caisson
	crushed stone	base and sub-base materials -grading adjustment	m^3	7,000	wharf, etc.
Steel materials	steel sheet pile	Z 45 L = 20 m	sheet	1,520	wharf (-10m)
	"	III A L = 12	"	1,000	-4.0m quay
	steel pipe	650 m/m L=12 m t=10 m/m	pcs	760	wharf (-10m)
	"	450 m/m L=9.5 m t=9 m/m	"	250	-4.0m quay
	tie rod	60 m/m L=25.5 m 38 m/m L=18 m	set	630	wharf 60 m/m 380 sets -4.0m quay 38 m/m 250 sets
	steel bar	deformed SD - 30 SR - 24	ton	2,300	
etc.	lumber oil				

Table-9.3 Labour Employment Plan

(Unit: Person)

Job title	Home	Overseas	Total	Remarks
General worker	77,300	2,800	80,100	
Special worker	6,300	800	7,100	
Manager (Caretaker)	7,000	100	7,100	
Scaffolding man	1,100	1,500	2,600	
Stone mason	2,000		2,000	
Moulder	11,800		11,800	
Steel bar man	7,200		7,200	
Welder	300		300	
Common crew		49,500	49,500	
High-grade crew		16,300	16,300	
Diver		11,000	11,000	
Rope handler		11,000	11,000	
Sailer	11,000		11,000	
Total	124,000	93,000	217,000	

Note: The respective personnel is shown in total number (man-day).

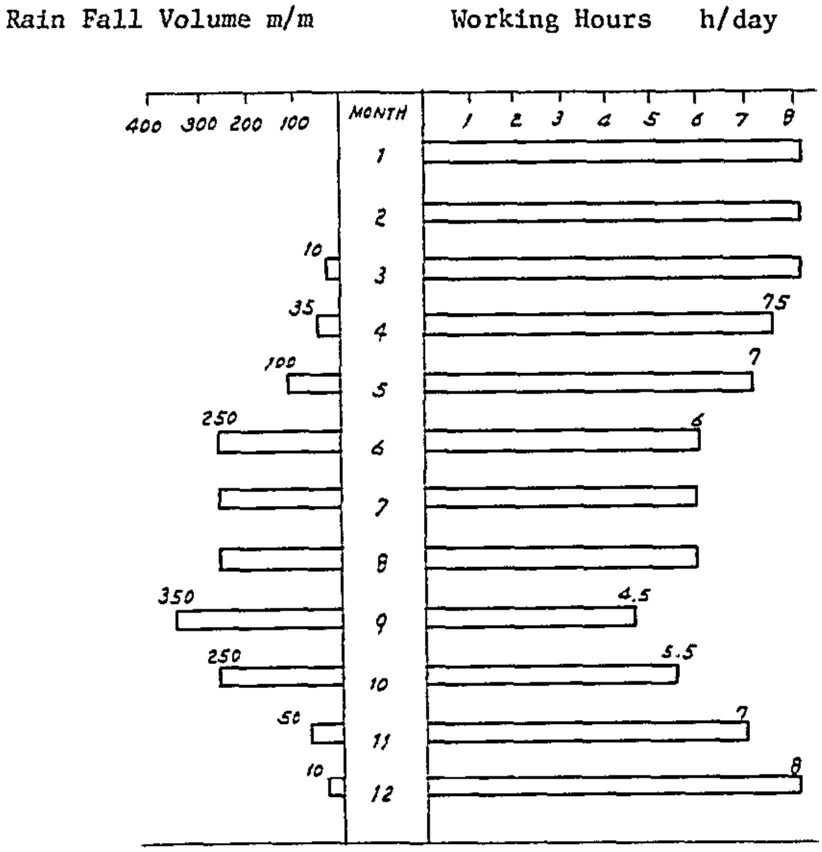
9-6 Plan for Work Process

It should be taken into serious consideration that the construction work of New Port operated at the coast directly faced to the ocean is affected by the particular weather in the Central America. Namely, the construction work can be conducted during the dry season covering the period from November to April, but working hours are affected by raining hours during the rainy season covering the period from May to October: at the Sipacate Coast, for instance, working days available per year have been estimated as 240 though different according to work contents. Refer to Table-9.4 prepared by the local information.

- Table-9.4 Number of Days available - for Work by Month

Month	No of days restricted	Number of non-operating days			Number of days available for work
		Weather, Tidal, Phenomenon	Special leave Sunday - holiday	Total	
1	31		7	7	24
2	28		6	6	22
3	31		7	7	24
4	30	1	8	9	21
5	31	3	7	10	21
6	30	6	7	13	17
7	31	7	7	14	17
8	31	7	6	13	18
9	30	10	7	17	13
10	31	7	7	14	17
11	30	1	7	8	22
12	31	0	7	7	24
Total	365	42	83	125	240

- Fig. 9.3 Hours availble for Work by Month -



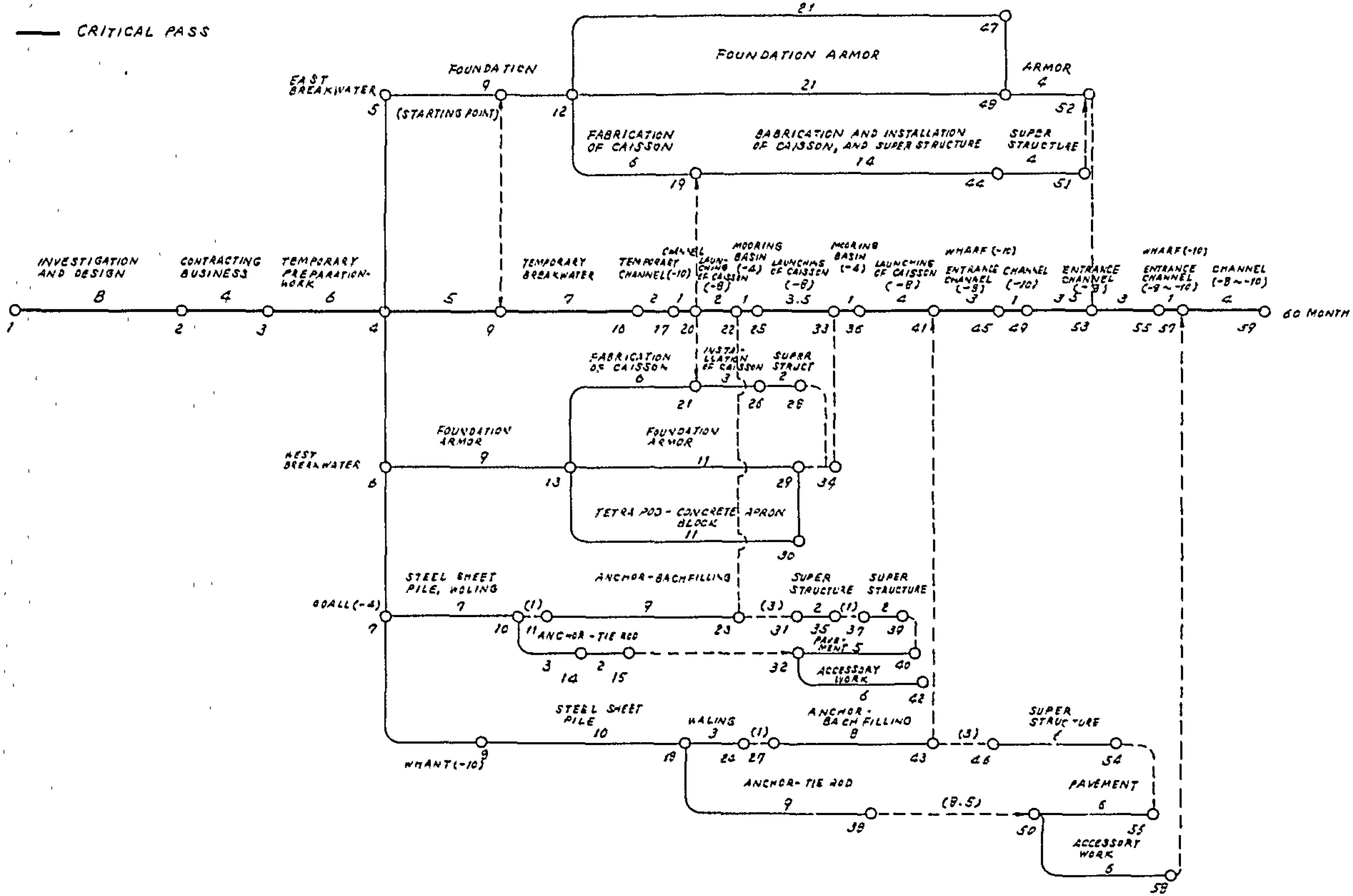
Work processes belonged to respective work types are shown in Table-9.5. The critical path which regulates engineering term of the whole construction work is illustated in Figure-9.4. The engineering term of the whole construction work cannot be shorten unless otherwise the dredging process which decided this engineering term is reduced. Consequently, the whole construction work can be completed in 5 years according to the economic condition, while the arrangement of facilities in 3.5 years.

TABLE.-9.5 YEARLY SCHEDULE BY CONSTRUCTION WORK IN THE FIRST TERM

CONSTRACTION WORK ITEM	CONTENTS	UNIT	QUANTITY	1975	1976	1977	1978	1979	REMARKS
				1 3 6 9 12	1 3 6 9 12	1 3 6 9 12	1 3 6 9 12	1 3 6 9 12	
INVESTIGATION AND DESIGN		SET	1						
CONTRACTING OFFICE WORK		"	1						
TEMPORARY PREPARATION WORK		"	1						
EAST BREAKWATER	FANDATION / ARMER	m^3	129.000 / 63.000						
	FABRICATION AND INSTALLATION OF CAISSON	PCS	69						
	TETRA-PODS, CONCRETE APRON BLOCK	"	4020 / 350						
	SUPER-STRUCTURE	m^3	21.200						
WEST BREAKWATER	FOUNDATION / ARMOR	m^3	62.000 / 12.000						
	FABRICATION AND INSTALLATION OF CAISSON	PCS	12						
	TETRA-PODS, CONCRETE APRON BLOCK	"	3710 / 60						
	SUPER-STRUCTURE	m^3	6850						
TEMPORARY BREAKWATER	BASE / ARMER	m^3	19 000 / 3800						
	FABRICATION AND INSTALLATION OF CAISSON	PCS	1080						
QUAY WALL (-4.0)	STEEL SHEET PILE / WALING	SHEET / m	1000 / 400						
	ANCHOR TIE ROD	PCS	250 / 250						
	ANCHOR SECTION BACKFILLING	m^3	910 / 11.100						
	SUPER STRUCTURE CONCRETE	m^3	980						
	PAVEMENT	"	1150						
	ACCESSORY WORK	SET	1						
WHARF (-10)	STEEL SHEET PILE / WALING	SHEET / m	1520 / 605						
	ANCHOR-TIE ROD	PCS	760 / 380						
	ANCHOR SECTION BACKFILLING	m^3	2750 / 34 560						
	SUPER STRUCTURE CONCRETE	m^3	2220						
	PAVEMENT	"	2300						
	ACCESSORY WORK	SET	1						
DREDGING	TEMPORARY CHANNEL(-6)	m^3	370 000						
	CHANNEL	"	530 000						
	LAUNCHING CAISSON	"	1,922,000						
	MOORING BASIN (-4)	"	660.000						
	(-10)	"	1.662.000						
	ENTRANCE CHANNEL	"	606.000						
GROIN	BASE / ARMOR	m^3	39 000 / 15.000						
PORT ROAD	50m / 20m	m	4.000 / 1500						
TRANSIT SHED		BLDG	3						
WAREHOUSE		"	2						
CARGO HANDLING EQUIPMENT		EA	1						
OPEN STORAGE YARD		m^2	68 550						
TUG BOAT		EA	2						
DREDGING EQUIPMENT		SET	1						
ADMINISTRATION FACILITES		"	1						
WATER SUPPLY EQUIPMENT		"	1						
SEWAGE EQUIPMENT		"	1						
ELECTRIC AND COMMUNICATION SYSTEM		"	1						

FIG.-9.4 PROCESS OF MAIN WORKS IN THE FIRST TERM

— CRITICAL PASS



9-7 Problems to Be Considered or Investigated from a Viewpoint of Construction Plan

(1) Construction Materials

1) *Stone:*

The construction of breakwater, a basic facility in constructing New Port, depends on the supply of stone. To cope with the demand of 250,000 m^3 in the first term plan, it is necessary to secure the quarry (stone pit) which is qualified for constantly producing stones easy in selection and for furnishing stones at a stabilized price. There is proper quarry in the neighbourhood of Eskintra located approximately 90 km from Sipacate. Estimate costs delivered to the construction site are as follows, though transportation cost is comparatively high due to long distance.

(Unit : Quetzals/m^3)

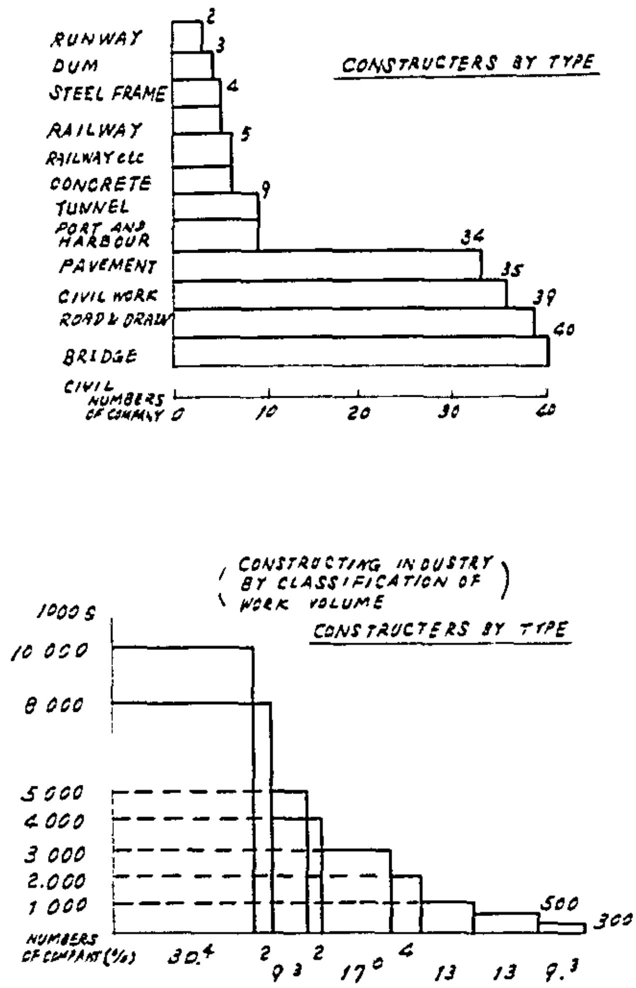
License fee of quarrying and Equipment cost	Quarrying & selection cost	Scrap loading & dosposing cost	Transportation charge	Miscellaneous cost	Total
1.0	2.4	1.2	15.0	4.9	24.5

2) Cement:

In Guatemala, cement is produced by NOVELLA S.A. only daily production capacity of which is 890 tons, a new factory belonged to the company, which has the production capacity of 2000 tons per day, is now under construction, resulting in a bright prospect of home supply due to the realized production increase. Thus, 30,000 tons of cement, necessary for 120,000 m^3 of concrete in total volume to be placed for the construction work of New Port, can be easily supplied by home production.

(2) The exsisting conditions of constructing industry and constructers are as shown in Figure-9.5. The land industry is reliable enough in technical ability and engineering experience aquired with the machines posessed. However, the constructers who have obtained actual results in marine engineering work are only 9 out of 46 companies. In recent years no work of this category has been undertaken within the country. Such being the circumstances, the cooperation by over-seas constructers is considered necessary, and at the same time the construction work will be made practicable by technical assistance or lead.

- Fig.-9.5 Constructing Industry and Constructer -



(3) Landing Zone of Imported Construction Material and Machine Parts.

Since there is no proper site for landing of long steel material for construction, constructing machine and machine parts and disassembling equipments of construction crafts in Guatemala at present, Port Acajutla of El Salvador is used as the site. The road reaching to Sipacite is well-arranged and has no particular defect in transportation.

(4) Repair Facility for Small Vessels

There are two shipyard equipped with slipway in Iztapa which works for fishing boats, and as repair facilities for small vessel. However, since the repair parts for vessel or engine are procured from the overseas, delay of repair work, increase of cost are caused due to transportation of long distance. To eliminate such defects, exchange parts of a large quantity should be prepared and also repair facilities should be improved.

(5) Engineering Term for dredging entrance passage

The Sipacate Coast shows variations respectively in the rainy season and in the dry season due to the difference of force between the Ocean and the inner channel. Consequently, by conducting the construction work more effectively in the dry season from November to April, high stability and safety at the time of operation should be ensured, and it is necessary to avoid reconstructing by time.

(6) Securing of Base for Marine Working

Both San José and Chanperico, the two exsisting ports in Guatemala, have no external facilities in the Ocean. The base for marine working, located near the operation site, should be arranged in the early step of work in such manner as it will be available for easy, temporary anchoring to maintain the effectiveness of operations outside the port and to improve the safety thereof.

(7) Investigation of Fabricating Procedure for Caisson

In constructing process of the New Port, the construction of breakwaters shall be given the first priority as far as the circumstances permit, and dredging and construction of wharf should be proceeded within the shelter of breakwaters. The breakwaters is 1,430 m in overall length, and 71 caissons are necessary for them. In case the fabricating facilities for caisson is not available, the number of to be fabricated is limited and further it is unnecessary to secure the facility also in futre, the process of caisson fabrication for the sand foundation is more advantageous than the fabricating procedure by mean of caisson platform, slope way, dry dock, floating dock etc. or the procedure of fabrication at other ports and bringing to the site, from the view-point of security of working site, construction period of facilities, construction cost etc. Mud-dock method to be referred is considered disadvantageous since excessive water-penetration in ground and depth of excavation contain a problem in respect to the effectiveness of well point, and also increase of draining installation and of excavation with produces uneconomical results. To remedy such defects, therefore, the sand ground readjust method has been employed.

The details on launching caisson are as described below.

1) Since the foundation ground is composed of evenly hard sand, almost even dredge sloping can be expected.

2) The fabricating place for caisson is a prealotted site which will be dredged as the central passage in future and where the proper height of ground can be secured by soil-cutting and soil-banking.

3) Diesel D6000PS class pump dredger will be commissioned for dredging of passage. It is not required to precure pump dredger respectively for operating vessels to conduct caisson launching.

4) Calm sea area having the water depth of 10 m is secured off the yard. The sea area is qualified for temporary stay and the other conditioned.

(8) Investigation on Requirement for Dredging

The soil of Sipacate coast has a great influence on the operating factors for pump dredger.

1) The dredging capacity varies greatly due to the soil conditions and discharging distance. In particular, since the discharging distance exceeds 2300 m in the work of outer passage, the dredging capacity falls remarkably.

2) Parts for dredger have to be replaced due to wear. Taking the related particulars, such as operating loss, parts cost, transportation charge, repair cost etc. into consideration, sufficient investigation and study should be made in regard to the soil at the area of marine dredging.

(9) Removal of Dredged Soil and Sand

Dredged soil and sand are removed to the low green area at the back of the harbor but the low green area acts as a retarding basin in the rainy season at the flooded time of rivers which are flowing through the region. Based on a fact that, seen from the evidences of trees and shrubs, the water level rose by floods in the past is supposed to have been about 50 cm, there will be no effect by the swollen water level on the stretch of hills. It is required to study carefully prior to the soil removal so that no damage will be caused to the river basin by the soil dumping.

(10) Maintenance of Port Facilities

It is clear, seen not only from statistical data of waves but also from aerial photography and field survey that the sand drifting on the Sipacate coast is moving westward. However, the location of the new port is far away from the principal rivers such as the Achiguate and the Coyolate where drifting and accumulation is regarded as a great abundance, seeing from the size of the river basin and the rainfall in the rainy season, and then dredging for maintenance purposes is regarded as small. However, by the construction of a breakwater, erosion and silting which might take place along the breakwater and therefore the Sipacate coast is unignorable together with the maintenance dredging of the passage and the inside of the port, for maintenance and administration of the function of the port facilities in the future.

CHAPTER 10. FUND PROGRAM

Chapter 10. Fund Program

10-1 Total Investments Classified by Construction Works

The prerequisites for computing sums for investments are as follows:

(1) Machine parts and materials that cannot be supplied within Guatemala shall be imported from Japan.

(2) Import prices from Japan shall include no import tarrif nor business tax.

(3) Compensation for fishery and sites, and the expenses for removing housing facilities and installations have not been appropriated.

(4) Development of stone pits and road construction expenses for transporting materials from the pits to the existing roadways shall not be estimated.

(5) The unit cost of labor shall be applicable based on the prices as of March, 1973, and the unit cost of principal materials shall be applicable as of April, 1974, in Guatemala. However, increases in price shall not be estimated.

(6) Unit cost of chartered vessels, machinery and appliances shall be applicable, refering to the Japanese computation standards for their rent.

The above prerequisites were adopted as reference.

(7) Reserve funds were estimated at a rate of approx. 5% of the total operating funds.

10-2 Foreign Currency and Domestic Currency for Construction Cost by Years

The total sum of investments for the 1st stage of Project is 55,280,000 quetzals, of which 32,670,000 queztals are in foreign currency corresponding to 59% of the total.

Objects of foreign currency were limited within the following contents.

(1) Among the construction materials, steel materials and specially processed materials for construction purposes such as fenders that cannot be supplied within Guatemala.

(2) Among the vessels and machines for executing the project, costs for transportation, depreciation, rent of construction equipments or purchasing expenses of machinery, all of which depends on foreign nations.

(3) Among the labor cost, dispatching charges of crew members of the crafts, and not only divers but those technical workmen who engage themselves in special types of operations such as driving sheet piles and steel pipe piles, manufacturing and installation of caissons and blocks.

The construction cost in foreign currency and domestic currency by year is shown in Table-10.2: List of Construction Cost in Foreign Currency and Domestic Currency by Year.

As to detailed field survey for natural conditions, refer to Table-10.3. It shows the time schedule of field survey.

Table 10-1 Investment Amount by Construction Work

(Unit: 1,000 Quetzals)

Division	Installation	Construction Work Item	Quantity	Foreign Investment	Domestic Investment	Total
Civil works cost				25,290	18,530	43,820
	Breakwater		$1,430^{m}$	6,480	12,420	18,900
		East breakwater	1,000	4,860	9,060	13,920
		West breakwater	430	1,620	3,360	4,980
	Temporary breakwater		100^{m}	130	800	930
	Groin		3ea x 150m	580	1,480	2,060
	Wharf		$1,005^{m}$	5,640	940	6,580
		quaywall (-10m)	605	4,520	680	5,200
		quaywall (-4m)	400	1,120	260	1,380
	Dredging		$4,910,000^{m3}$	12,320	1,650	13,970
	Dock road		50m x 4km 20m x 1.5km	140	1,240	1,380
Cost of facilities				6,880	3,910	10,790
	Equipment of cargo handling and storage			6,100	2,430	8,530
		Transit shed	3 bldg.	1,870	850	2,720
		Warehouse	2 bldg.	1,250	570	1,820
		Cargo handling equipment	1 ea	1,360	100	1,460
		Open storage yard	$68,550^{m2}$	90	820	910
		Tug boat	2 ea	1,530	90	1,620
	Fishing port facilities			0	360	360
	Control and operating facilities			780	1,120	1,900
		Administration facilities		30	470	500
		Water Supply facilities		300	200	500
		Sewage treatment facilities		180	420	600
		Electric & communication facilities		270	30	300
Engineering & Supervision				500	170	670
Total				32,670	22,610	55,280
Contingency						2,720
GRAND TOTAL						58,000

Note: price in May 1974

Table 10.2 Foreign & Domestic Capitals appropriated to yearly construction cost

(Unit: 1,000 Quetzals)

Installation Item		Division of capitals	1975	1976	1977	1978	1979	Total
Civil Works Cost	Breakwater	Total Foreign Domestic	120 90 30	1,590 530 1,060	8,630 2,950 5,680	6,960 2,360 4,600	1,600 550 1,050	18,900 6,480 12,420
	Temporary breakwater	Total Foreign Domestic		300 50 250	630 80 550			930 130 800
	Groin	Total Foreign Domestic					2,060 580 1,480	2,060 580 1,480
	Wharf	Total Foreign Domestic	60 40 20	3,450 3,400 50	1,070 770 300	550 130 420	1,450 1,300 150	6,580 5,640 940
	Dredging	Total Foreign Domestic	70 50 20		4,170 3,690 480	4,220 3,720 500	5,510 4,860 650	13,970 12,320 1,650
	Dock road	Total Foreign Domestic		230 20 210		1,150 120 1,030		1,380 140 1,240
	Total	Total Foreign Domestic	250 180 70	5,570 4,000 1,570	14,500 7,490 7,010	12,880 6,330 6,550	10,620 7,290 3,330	43,820 25,290 18,530
Cost of facilities	Cargo handling and storage facilities	Total Foreign Domestic			180 20 160	5,110 3,450 1,660	3,240 2,630 610	8,530 6,100 2,430
	Fishing facilities	Total Foreign Domestic				360 0 360		360 0 360
	Control and operating facilities	Total Foreign Domestic			200 200 0	1,100 400 700	600 180 420	1,900 780 1,120
	Total	Total Foreign Domestic			380 220 160	6,570 3,850 2,720	3,840 2,810 1,030	10,790 6,880 3,910
Engineering and supervision		Total Foreign Domestic	180 145 35	170 135 35	145 110 35	110 75 35	65 35 30	670 500 170
Sub-total		Total Foreign Domestic	430 325 105	5,740 4,135 1,605	15,025 7,820 7,205	19,560 10,255 9,305	14,525 10,135 4,390	55,280 32,670 22,610
Contingency		Total Foreign Domestic						2,720
GRAND TOTAL		Total Foreign Domestic						58,000

Note: price in May 1974

Table - 13.3 Survey - Annual Programs

(Unit - 1000 Quetzals)

Name of Survey	1975	1976	1977	1978	1979	Remarks
Soil exploration	71 (Boring 17 posts)	7	7	7	7	Boring machine to be procured in 1975 Subsequent to 1976: contingency
Topographical survey	28 (1km x 2km)	7	7	7	7	Subsequent to 1976: contingency
Sounding	28 (1km x 5km)	10	10	10	10	1976: echo-sounder to be procured
Shoreline survey	13	13	13	13	13	Width 5km Twice a year
Tide observation		17 Preparation	8 Observation	8 Observation	25 Observation - analysis	
Wave observation	23 Preparation	12 Observation	12 Observation	12 Observation	12 Observation	Procurement of 4 units of wave recorder in 1975
Others	27	31	50	50	33	Designing etc.
Total	190	97	107	107	107	

Remarks: These survey expenses are disbursed from a portion of project expenses. Also, the difference between the project expenses of 250,000 quetzals and the survey expenses of 190,000 quetzals represents "other administrative expenses".
Prices are expressed in terms of the value of May 1974.

CHAPTER 11. ECONOMIC APPRAISAL OF NEW PORT CONSTRUCTION

Chapter 11 Economic Appraisal of New Port Construction

11-1 Economic Significance of New Port Construction

This project is to bring into existence a quite modern port in the Pacific coast area of Guatemala, which has not been favored with satisfactory ports probably on account of difficulties in construction, though the country has the coast line as long as 300 kilometers. As the new port has calm waters free from continual attack of swells and storms and is provided with completely equipped quays, enabling ships to directly moor for cargo-handling, it will be considered a safest, highly efficient and favorable port, comparing with ports of neighboring countries and will attract ships from various countries as a favorite port.

The contruction of new port will play a fundamentally important role as an effective strategy for development of the Pacific coast area, which is highest in the desity of economic activities in Guatemala and is favored with high potentiality of development. The influence the new port will exercise seems to make great contribution in future to development of the whole Guatemala.

The extensive economic influence the new port will produce of Guatemala by completion of the present project appears to be as explained hereunder.

(A) Improvement of transportation system of import and export cargo.

1) Drastic saving in direct cargo handling· cost and time by dispensing with lighter cargo handling.

2) Irrespective of the mode of packing and weight of cargo, all kinds of cargo can be handled effectively.

3) It is not necessary for a ship to wait for berth, which will decrease time for a ship to stay at the port.

4) The inland transportation will be saved and decreased, as it is no more necessary to depend on ports in neighboring countries.

5) Measures can be quickly taken to cope with increase in demand for cargo transportation and innovation of transportation in future.

(B) Encouragement of industrial and regional development.

1) In the new port area the industries, which will support the function of port, will be concentrated and a new port city will be formed.

2) As the imports of raw materials and exports of products will be economical, the domestic agriculture and industry will be further developped and also formation of the industrial zone in the area centering around the port will be accelerated.

3) Construction of fishing port facilities will activiate the coastal and pelagic fishery, as a result of which the new port will become a base for fishing industry in the Pacific coast.

4) The new port area will proper as a base for diversified ocean-type recreation, fully utilizing ocean, natural waterways and abundant Nature in the surroundings.

5) The progress of development in the new port area and the Pacific coast area will alleviate excessive concentration of various activities in the capital and will contribute to balanced development in the whole country.

(C) Expansion of foreign trade

1) Expansion of trade with West coast of North America, Asia, Australia, etc. and reinforcement of the network of marine routes will be promoted.

2) The decrease of transportation cost at the port will enhance competitive power of agricultural products, etc. to encourage the exports and also strengthen possibilities to develop new export products.

11-2 Method of Economic Appraisal

(A) Analysis of Cost and Benefit

For economic appraisal of the new port construction will be empolyed the cost and benefit analysis from the standpoint of Guatemala's national economy.

As mentioned in 11-1, the effects of the present project will be quite large and exercise influence on various fields. The results of influence will be more largely realized not only by the contruction of new port but also by linking the new port construction with other various projects based on utilization of the new port.

Here a method will be employed, which is to obtain internal rate of return during the period of analysis by comparing the cost required for the construction of present project with the measurable benefit directly obtained by completion of present project. This method has a merit to abstract the difference in the way of depreciation as well as the interest and is generally employed for studying feasibility of various projects at present. A period of 30 years is considered to be appropriate for the analysis, even in view of future development of Guatemala, transportation innovation, etc.

In measuring the benefits, comparison is made between the situation when the new port has been completed as planned and the same when the new port is not constructed in any way and the differences found out in the comparison is considered to be the benefits of the new port construction.

(B) Volume of cargo handled by the new port

As for the capacity of cargo handling at the new port, it is based on supposition that the proper capacity of each berth 10 meters in depth of water is 150 thousands tons annually and the total capacity of 3 berths is 450 thousands tons. It is supposed that the port facilities are newly provided in case there is demand for more cargo handling.

The demand for cargo-hardling at the Pacific ports is based on assumption that it will increase according to the trend till 1980 as shown in 3-1. The volume of cargo at the new port will be subject to increase as shown in Table 11-1 from the latter half of 1979 when the quays start to be used till 1981 when the capacity of cargo handling will reach to 450 thousands tons, according to the assumption mentioned below. The volume of cargo handled at the 3 berths won't change after 1981.

Whether there exists the new port or not will change the flow-pattern of cargo as below.

1) In case there does not exist the new port, the hiterlands of San José port, Champerico port and Acajutla port will be as shown in Fig.-11.1 judging from the transportation distance and item of cargo to handle.

2) The each cargo-handling capacity of San José.port and Champerico port is assumed to be 130 thousands tons according to the actual result of the recent 5 years and the cargo exceeding this volume in each hiterland will be handled at Acajutla port.

3) In case the new port exists, the cargo shipped via San José and Acajutla as mentioned above will be handled at the new port, according to the fundametal policy mentioned in 3-3.

Also, as for the distribution of cargo origins and destinations in the hiterland of each port, classified according to the product group, it is assumed that the extent of dependence of each hiterland area on Pacific coast ports is same as at present. With this assumption, the calculation of the distribution is made according to the share of the economic index by zone as shown below. The result of this calculation is shown in Fig.-11.2.

	[cargo]	[index]
- Export -	Coffee:	Coffee production (1966 to 1971 in average)
	Cotton:	Cotton production (")
	Linter:	Cotton production (")
	Seeds :	Cotton seed production(")
	Others:	Number of factories (1972)

- Import -	Agirculatural and marine products	: Population (1973)
	Fertilizer	: Coffee and cotton production (1966 to 1971 in average)
	Industrial raw materials	: Number of factories (1972)
	Metal products	: Population (1973)
	Automobiles	: Population (1973)
	Others	: Population (1973)

11-3 Cost

Cost required for the new port construction is as mentioned in Chapter 10.

It is estimated that the amount of 17 thousands quetzals is required every year in average as maintence cost for dredging the channel and basins, which may be done during the period of analysis. Also, the sum of 3,080 thousands quetzals is added up for the expense to renew cargo-handling machine and tug boats in 2000. The expense of each year during the period is as shown in Table-11.2.

11-4 Benefit

Among the effects the new port construction will bring forth, the benefits grasped quantitatively by this analysis are as shown in the following items.

- Dispensing with cargo handling by lighter.
  - Saving in cargo handling cost.
  - Decrease in number of days for a ship to stay at the port.
  - Decrease in number of days for cargo to be retained at the port.
  - Saving in expense for reinforcing work of San José port facilities.
- Elimination of necessity of depending on the port of neightboring country
  - Saving in Acajutla port charge.
  - Saving in demurage, at Acajutla port
- Saving in the inland transportation cost.
- Increase in fishing catch.

11-4-1 Dispensing with Cargo Handling by Lighter.

As the cargo, which would pass through San José port in case the new port is not constructed, is handled at the new port, the cargo handling is completely liberated from lighter. As its results, there will be saving in the cargo handling cost, decrease in number of days for a ship to stay at the port, decrease in the number of days for cargo to be at the port and saving in the expense for reinforcing San José port facilities such as piers, etc. which are the benefits obtained from the new port construction.

(1) Saving in cargo handling cost

1) Cargo handling cost by use of lighter.

While the data concerning the cargo handling cost at San José port could not be obtained, the cargo handling cost by use of lighter can be calculated, according to the data available at the Port Authority of Champerico on the Pacific coast, which is same as San José in the scale and cargo handling method. In details, the direct cost required for cargo handling at this port in 1973 is 694 thousands quetzals and the volume of cargo in this year is 116 thousands tons. Therefore the cargo handling cost per ton is 6.0 quetzals.

2) Cost of quay cargo handling system.

The cargo handling cost at the new port is assumed to be 2.8 quetzals per ton excluding capital costs such as rental.

3) Amount of saving in cargo handling cost.

According to 1) and 2), the amount saved in cargo handling cost as a result of no more need of cargo handling by lighter is 3.2 quetzals per ton. This amount of saving per ton is multipled by tonnage of cargo, which will be switched to the New port from San José port as mentioned in 11-2. Thus the amount of saving in a year as shown in Table-11.3 is figured out.

(2) Decrease in the number of days for a ship to stay at the port.

The enhancement of cargo handling capacity at the new port will decrease of the number of days for loading and unloading at the port and also the number of days for demurrange due to port congestion.

1) Cargo handling capacity at San José port.

At San José port always 3 gangs are attending to cargo handling. The system for cargo handling at the port is that 2 gangs handle the cargo of the first ship and the remanning 1 gang handles the cargo of the second ship. According to the harbor diary of Champerico port employing the same cargo handling system, per day in one ship 450 tons of cargo are being handled on the average. According to the staffs of both ports, the cargo handling capacity of one gang per hour is about 15 tons. Since the cargo handling is continued at night, in figure the capacity turns out to be 600 tons per day and per ship (15 tons/gang·hour x 2 gang/ship x 20 hours/day).

However, it happens that the cargo handling is supended due to swells or storms. Therefore, the cargo handling may be considered to be done actually 75% of the estimated capacity.

In view of the above situation, it can be said that San José port has 1.5 berths, each berth having the cargo handling capacity of 450 tons/day·ship.

2) Cargo handling capacity of the new port.

A cargo ship entering the new port will have 5 hatches on an average, permitting 8 gangs at most to handle the cargo. But judging from the volume of cargo loading and unloading, etc. 3 gangs inaverage are supposed to attend to the cargo handling. Therefore the cargo handling capacity of the new port is obtained as below.

Cargo-handling capacity per berth
of the new port .... 15 tons/hour gang x 3 gangs/ship x 20 hours/day = 900 tons/ship.day

3) Volume of cargo loading and unloading in average per ship.

No detailed data is available regarding the average volume of cargo loading and unloading per ship at the Pacific coast ports of Guatemala. But at Champerico port according to the actual result in 1973, the volume is 1100 tons per ship. Moreover in the recent 5 years the volume has increased by 140%. The actual result at Acajutla port in neighboruing country, showing the volume of 1900 tons per ship, is also to be kept in view. It is therefore assumed that the volume of cargo loading and unloading is in average 1500 tons per ship.

4) Decrease in the number of days for a ship to stay at the port.

Under the conditions mentioned in 1), 2) and 3), the decrease in the mumber of days for a ship to be at the port is calculated as below. The number of days for a ship to wait for berth is based on the "queuing theory."

	Number of days for cargo handling	Number of days for a ship to wait for berth	Number of days for a ship to stay at the port
San José	3.4	2.0	5.4
New Port	1.7	0.1	1.8
Decreased number of days	1.7	1.9	3.6

5) Saving in cost by decrease in number of days for a ship to stay at the port.

The average tonnage of cargo ships entering the new port is 10,000 to 15,000 D/W. The expense per day for a ship to stay at the port is considered to be 6,000 quetzals. If this expense is multipled by the number of decreased days as obtained in 4) and the number of ship entering the port, the benefit due to decrease in the number of days for a ship to be at the port turnes out to be as shown in Table-11.3

(3) Decrease in the number of days for cargo to be kept at the port.

1) Decrease in the number of days for cargo to be kept at the port.

The number of days for cargo to stay at the port for loading and unloading is decreased by 3.6 days as mentioned in 4) of (2).

2) Time value of cargo.

The time value of cargo indicates how much expense can be paid for the decrease in time involved for transportation of cargo. Here even conservatively it is considered that the import and export cargo has the time value, equivalent to 10% interest against the price. The average price of cargo in Guatemala is estimated to be about 700

700 x 0.10 x 1/365 ------- 0.19 quetzal/ton·day

3) Saving in cost by decrease in the number of days for cargo to be kept at the port.

According to 1) and 2), the annual benefit by decrease in the number of days for cargo to be kept at the port turns out to be as shown in the Table-11.3.

(4) Expense for Reinforcing Work of facilities at San José Port.

Instead of the new port construction, if San José port is to be used for a long period of time, at least the pier should be reinforced to such an extent that the work is almost same as new construction. The expense for the work is estimated to be about 5,000 thousands quetzals.

11-4-2 Elimination of Necessity of Depending on Port in the Neighboring Country.

In case the new port is not constructed, as mentioned in 11-2 handling a large volume of cargo will be dependent on Acajutla port in El Salvador, an adjacent country. As its result, Guatemala will have to pay the port charge and the demurrage will be increased possibly due to congestion at Acajutla port by cargo from Guatemala. In other words, these two expenses have to be added as benefits from new port construction, which would eliminate necessity of depending on port in the neighboring country.

(1) Port Charge to be paid to Acajutla port.

The port charge, which exporters or importers of Guatemala and shipping companies, carrying cargo of Guatemala, are paying to services rendered by Acajutla port, is 10 quetzals per ton, according to data in 1973.

The total amount of this port charge, which will have to be paid to the neighboring country in case the new port is not constructed, is obtained by multiplying the charge per ton by the volume of cargo shipped via Acajutla and turns out to be as shown in the Table-11.4.

(2) Demurrage at Acajutla port.

In recent years remarkable increase is seen in the volume of cargo of El Salvador via Acajutla. Even if Acajutla port handles El Salvador's own cargo only, the present increasing trend of cargo will in 1984 compel all ships entering Acajutla port to wait for berths about one day at the port. Accordingly it is appropriate to assume that El Salvador will complete large expansion and adjustment of Acajutla port in 1984. However, if Guatemala has not the new port, dependence on the present capacity of Acajutla port till it is expanded will result in some heavy congestion. On the supposition that conditions of ships entering Acajutla port, the cargo handling capacity of the port, etc. are the same as those of the new port as mentioned in 11-4-1 (2), the demurrage is calculated by the number of days for waiting obtained by the "queuing" theory. The number of days for demurrage in 1983 is 10 days according to the theory. However, in actuality, in such a heavy congestion, a part of cargo will be routed to Santo Thomas port or others and the number of days for demurrage will become less. Therefore, the figure has been adjusted to be 5 days. Also, it has been decided that the volume of cargo equivalent to the same in the first ferm of project of the new port will exercise in the long range only little influence on Acajutla port after it will be expanded and adjusted in a large scale. Therefore the benefit in this regard obtained after 1983 has been eliminated.

11-4-3 Saving in the Inland Transportation Cost.

(1) Change in inland transportation pattern.

The change in the transportation pattern according to the product group is calculated according to the fundamental idea of inland transportation, mentioned already in 11-2 (2).

(2) Transportation Distance.

The inland transportation almost all depends on trucks. Therefore, in transportation between ports and their hinterlands the shortest route via arterial highways is considered to be the transportation route and its distance is regarded to be transportation distance. (Table-11.5)

(3) Transportation unit cost.

As a result of hearings from large truck companies in Guatemala, a distance/freight chart is prepared as shown in Fig.-11.3. By this chart, the transportation cost by truck is estimated to be 0.04 quetzals per ton in the highways and 2.0 quetzals per ton at the terminals, where cargo is loaded or unloaded.

$c = 0.04 \times D + 2.0$

C = Transportation cost (Q/t)
D = Transportation distance (Km)

(4) Saving in the inland transportation cost.

The total figure obtained by multiplying the change of transportation pattern according to product group mentioned in (1) by the transportation distance mentioned in (2) indicates the volume saved in the inland transportation. By multiplying the figure indicating the saved volume in transportation by the transportation unit cost in the highways, the amount saved is figured out as shown in Table-11.6.

11-4-4 Increase in Fishing Catch.

The economic benefit from construction of the modern fishing facilities is as explained in Chapter 7. Here the increase in catch is measured as a most direct benefit, which will be brought forth by increase in frequency of sailing-out, supported by adjustment and improvement of cargo handling system and repairing system.

The difference between the target of catch at the 1st term of new port project and the average catch for the recent 5 years is shown below. On the supposition that 50% of the price of fish comprises labor cost, capital expense, maintenance expense, etc., the benefit amount is calculated to be 1,660 thousands quezals per year. While the use of new facilities will start in 1978, in the first year the benefit is estimated to be half of the standard annual benefit.

(Fish)	(Increased quantity of catch)	(Benefit amount)
Shrimp	500 tons	750 thousand quetzals
Edible fish	1,100 "	550 " "
Fish for processing	5,400 "	160 " "
Bonito	400 "	200 " "
Total	7,400 tons	1,660 thousand quetzals

11-5 Comparison of Cost with Benefit.

The table-11.6 has been propared by gathering all the benefits according to the premises mentioned above. In the Fig.-11.4 is shown the result of making discount from the cost and benefit of the present project thus obtained by various discount rates. The outcome shows that the is internal rate of return is16 % and the ratio of cost to benefit is 1:1.42 at 10% discount rate. Accordingly, the present project is judged to be mostly feasible from the standpoint of national economy.

The benefits are measured rather conservatively, considering that the present project is the first term project of the overall plan. In other words, the reorganization of port function in the whole country, merchandising new agricultural products, industrialization of the surrounding area of the port, etc. are eliminated in measuring the benefits. If these benefits are added, the internal rate of return would be enhanced.

Furthermore, for the present project about 60% of the cost comprises the investment in breakwaters, channel and basins, many of which would serve to the port activities for the second and following term projects. In this regard, it may be said that the investment amount against the volume of cargo handling is larger than the second and following term. For instance, on suppostion that the whole cargo in the Pacific coast area is handled by the new port in order to increase the cargo to handle at the new port as the first term project, the situation at that time is examined. As in this case the new port has to be provided with 4 berths instead of 3 berths, the additional cost of about 5,000 thousand quetzals is required. However the internal rate of return would be increased to 18%. In this instance, however, there would take place various problems to seltle, such as a serious social problem caused by eliminating in a short period of time the base of Champerico totally depending on the port activities, influence on the national finance by expanded investment scale, etc. which are judged to make the materialization of the present project harder.

Before conclusion, explanation is made on influence on Acajulta port by the construction of new port. The port in neighboring country will lose the income of port charge paid for the cargo from Guatemala, which will be routed to the new port after it is constructed. However, as clarified already in 11-4-2, serious congestion in Acajutla port could be avoided by the construction of the new port. In other words the expansion of Acajutla could be started 4 or 5 years later than in the case new port is not constructed. This is enough merit to offset the loss in the port charge income. Under the circumstances, materialization of the present project would largely contribute to desirable development of Guatemala as well as El Salvador.

Table - 11.1 Volume of Cargo handled at the new port (1st term project)

(1000 Tons)

Year	Volume of Cargo at the Pacific coast Ports for the 1st term of project.	New Port	In case the new port is not built. San José	Acajutla	Champerico
1979	521	196	130	261	130
1980	557	427	130	297	130
1981	580	450	130	320	130
1982	580	450	130	320	130*
↓	↓	↓	↓	↓	↓
2005	580	450	130	320	130

* The volume of cargo handled at Champerico port is gradually switched to the new port with its expansion.

Table - 11.3 Benefit from eliminating cargo handling by lighters

(1,000 quetzals)

Year	Saving in cargo handling cost	Decrease in the number of days for a ship to stay at the port	Decrease in the number of days for cargo to stay at the port	Cost for reinforcing work of San José port	Total
1978				5,000	5,000
1979	208	936	44		1,188
1980	416	1,872	89		2,377
1981	416	1,872	89		2,377
↓	↓	↓	↓		↓
2005	416	1,872	89		2,377

Table - 11.2 Cost of New Port

(1,000 quetzals)

Year	Construction Expense	Expense for maintenance and dredging	Expense for rehabilitating facilities	Total
1975	451			451
1976	6,022			6,022
1977	16,058			16,058
1978	20,429			20,429
1979	15,140			15,140
1980		18		18
1981		18		18
1982		18		18
1983		18		18
1984		18		18
1985		18		18
1986		18		18
1987		18		18
1988		18		18
1989		18		18
1990		18		18
1991		18		18
1992		18		18
1993		18		18
1994		18		18
1995		18		18
1996		18		18
1997		18		18
1998		18		18
1999		18		18
2000		18	3,080	3,098
2001		18		18
2002		18		18
2003		18		18
2004		18		18
2005		18		18

Table - 11.4 Benefits from eliminating necessity of depending on port in the neighboring country

(1,000 quetzals)

Year	Acajutla port in case the new port exists			Acajutla port in case the new port does not exist				Cargo from Guatemala via Acajutla port		Total
	Volume of cargo handled	Utilization rate (ρ)	Number of days for demurrage	Volume of cargo transported from Guatemala	Volume of cargo handled	Utilization rate (ρ)	Number of days for demurrage	Port charges	Demurrage	
	(1000 tons)		(days)	(1000 tons)	(1000 tons)		(days)			
1979	1,265	0.64	0.2	261	1,527	0.77	0.5	1,305	262	1,567
1980	1,346	0.68	0.3	297	1,643	0.83	1.0	2,970	1,188	4,188
1981	1,426	0.72	0.4	320	1,746	0.89	1.7	3,200	2,176	5,376
1982	1,506	0.76	0.5	320	1,826	0.93	3.4	3,200	4,352	7,552
1983	1,586	0.80	0.7	320	1,906	0.97	10.2	3,200	6,400	9,600
1984	1,666	Expansion and adjustment of Acajutla port		320	1,986	x	0	3,200	0	3,200
↓				↓		↓	↓	↓	↓	↓
2005				320		x	0	3,200	0	3,200

Note. 1. As for the volume of cargo handled at Acajutla port in case the new port exists, it is figured out according to the estimation by time series equation, after the volume of cargo from Guatemala is deducted from the volume of cargo handled for the recent 5 years at Acajutla.

2. Utilization rate.

$$\rho = \frac{Q}{S \times H \times 365}$$

Q = Volume of cargo handled at the port.

S = Number of berth.

H = Cargo handling capacity of berth per day.

Table - 11.5 Distance between ports and major hinterlands

(Km)

Districts \ Ports	Representative city	San José	Champerico	Sipacate	Acajutla
Central District					
...Guatemala, Sacatepequay, Chimaltenanjo	Guatemala	100	227	133	190
South District					
...Escuintla	Escuintla	52	171	77	160
...Suchitepequez	Mazatenango	155	60	127	260
...Retalhuleu	Retalhuleu	181	48	154	290
West District					
...San Marcos, Quezaltenango	Quezaltenango	220	100	193	410
Mid-West District					
...Totonicapan, Solola	Totonicapan	240	114	218	470
South-East District					
...Santa Rosa, Jutiapa	Jutiapa	277	393	305	140

Table - 11.6 Benefits

(1,000 quetzals)

Year	Benefit from eliminating cargo-handling by lighter	Benefit from eliminating dependence on port in neighbouring country	Saving in inland transportation cost	Increase in fishing catch	Total
1978	5,000			830	5,830
1979	1,188	1,567	467	1,660	4,882
1980	2,377	4,188	1,077	1,660	9,302
1981	2,377	5,376	1,169	1,660	10,582
1982	2,377	7,552	1,169	1,660	12,758
1983	2,377	9,600	1,169	1,660	14,806
1984	2,377	3,200	1,169	1,660	8,406
↓	↓	↓	↓	↓	↓
2005	2,377	3,200	1,169	1,660	8,406

Fig.11-1 Hiterland of each Pacific coast port

Notes:

- Boundaries.
- Prefectural border.
- ● Principal city in each Prefecture.

A : Principal hinterland area of San José port.

B : Principal hinterland area of Champerico port.

A + B : Principal hinterland area of Acajulta port.

Fig. 11-2 Distribution of Cargo Origins and Place of Consumption by District

DISTRICT

Middle district: Guatemala, Sacatepequez, Chimaltenango
Mid-west district: Totonicapan, Solola
West District: San Marcos, Quezaltenango
Retalhuleu
Suchitepequez
South east district: Santa Rosa, Jutiapa

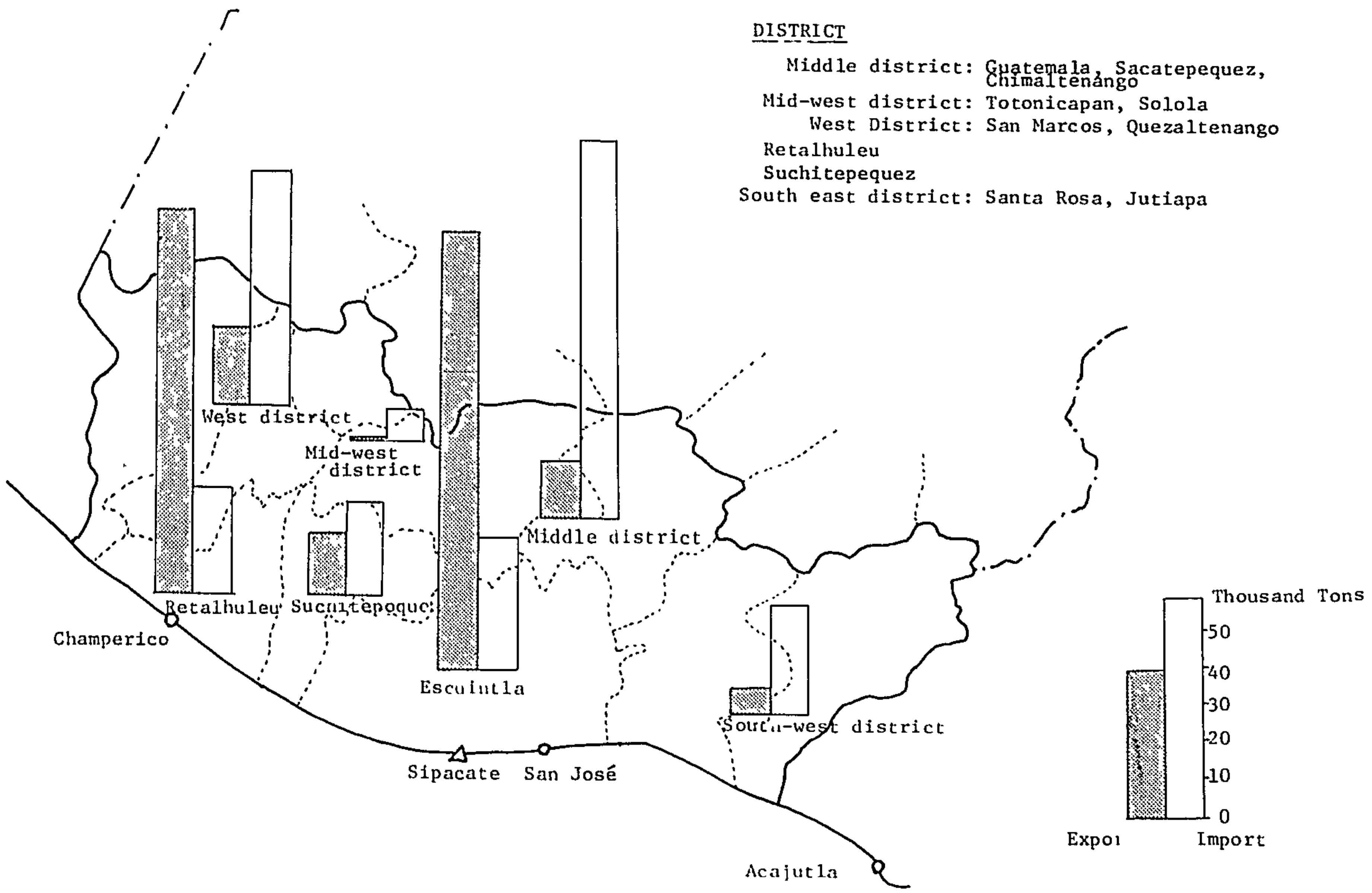


Fig. 11-3 Freight to Distance

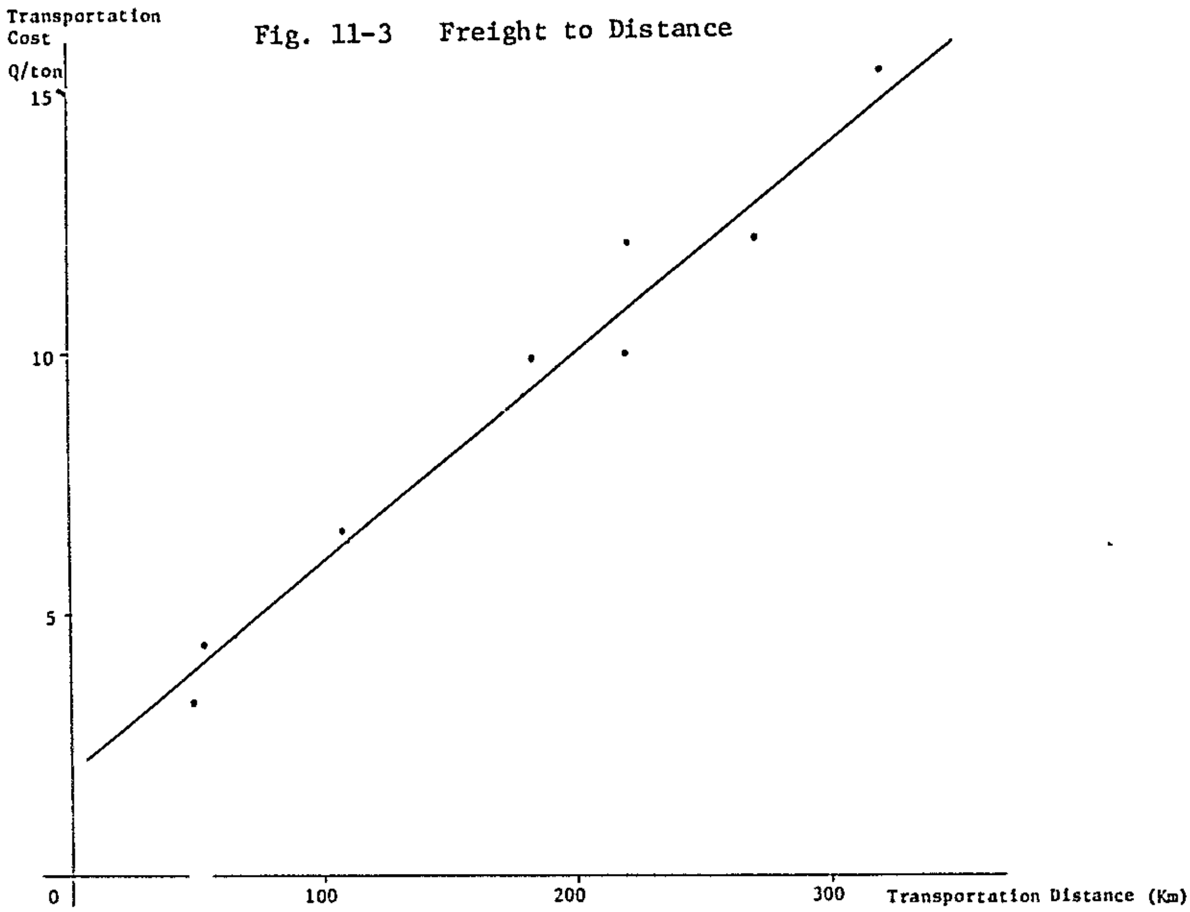
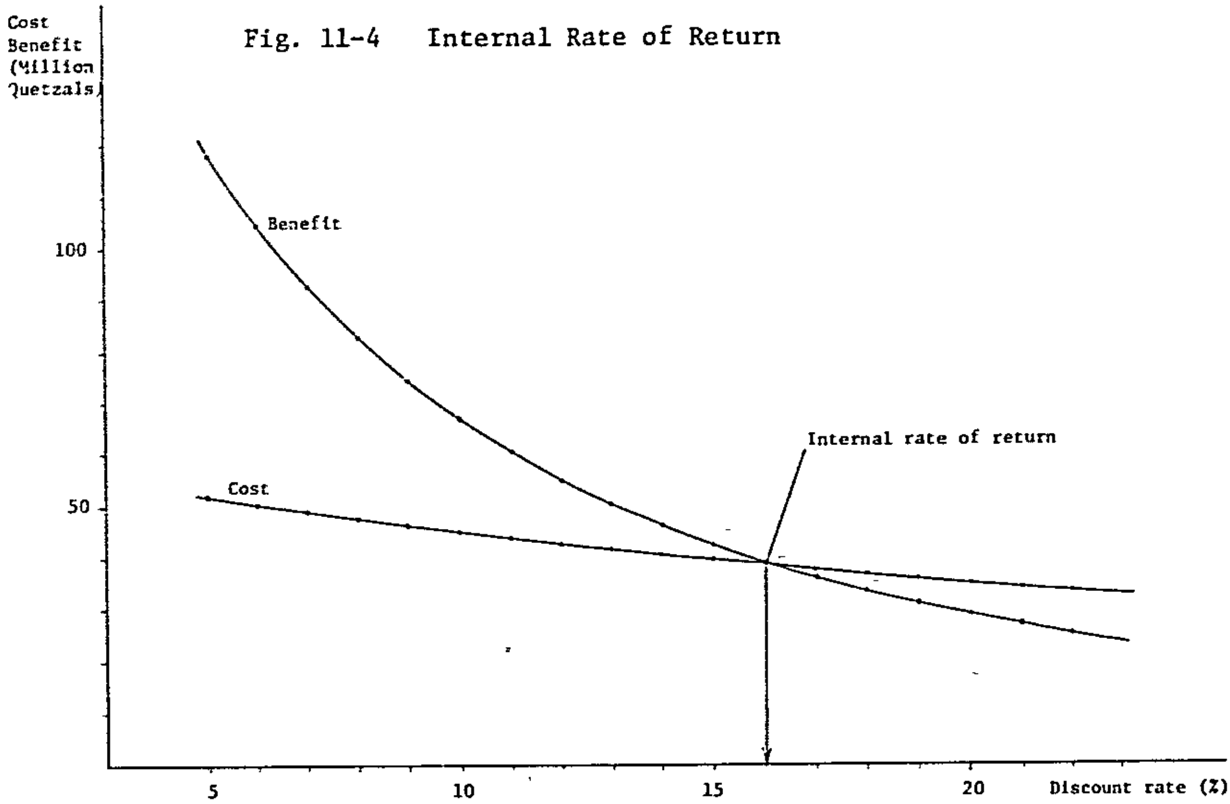


Fig. 11-4 Internal Rate of Return



CHAPTER 12. OPERATION OF PORTS

Chapter 12. Operation of Ports

12-1 Administrative and Operation System

All fundamental harbor facilities in the ports of Guatemala are now nationalized. Santo Tomas, Puerto Barrios and Champerico Ports are each under the administration and operation by a public corporation, while San José Port is operated by a private harbor transport company.

(1) San José Port

The piled pier, the nucleus of harbor facilities in San José Port, was constructed by the International Railway Corporation of Central America about 90 years ago. But the harbor facilities in the port were nationalized several years ago when the railway was nationalized for the purpose of improvement of its management and services.

San José Port is under the administration of the railway corporation FEGUA, but the operation of the facilities is entrusted to Agencia Maritima S.A. Therefore, operation of the port is conducted by Agencia Maritima S.A., which pays the rent of the piled pier to FEGUA. Agencia Maritima S.A. is in charge of the loading and unloading of cargoes to and from the piled pier and ships and handling and storage of cargoes as well as the transportation of passengers, agency service of domestic and foreign transport companies and offer of supplies to ships.

Agencia Maritima S.A. is in possession of barges, railway siding and other facilities necessary for conducting its business, except the piled pier. It has received permission from the Ministry of Finance for the business, which is conducted under supervision of the Ministry.

It has its head office in the capital city of Guatemala and its business office in San José. The business office is in charge of field work along with the control of workers engaged in the work and the maintenance and administration of facilities owned by the company.

The head office is in charge of summing up of contracts with shipping companies, receipts of fees and amounts of cargoes handled and other kinds of clerical work.

When the new port is constructed, it is supposed that the amount of cargoes handled in San José Port will be considerably reduced. Therefore, full consideration should be taken on measures to be taken for Agencia Maritima S.A.

(2) Champerico Port

The piled pier of Champerico Port was also constructed by a private German company some 80 years ago.

The harbor facilities were nationalized later by the Presidential Ordinance No. 334, 1955, with the operation of the port being conducted by the Champerico Port Public Corporation, Empresa Portuaria Nacional De Champerico.

The corporation is under the jurisdiction of the Ministry of Finance, and carries out, under its supervision, the maintenance and administration of the piled pier, handling of cargoes (transportation in the port and warehousing) and other kinds of business, without any help from private companies.

It also takes charge of supplying water and power to people living in the surroundings of Champrico Port.

The corporation is managed by the Board of Directors composed by the President and two directors. Its action policy is decided by the Board of Directors. The President represents the corporation as a person responsible for its administration and operation. Besides these members of the Board of Directors, there are two substitute directors and general secretary appointed. The members of the Board of Directors are appointed by the Chief of State through recommendation of the Minister of Finance.

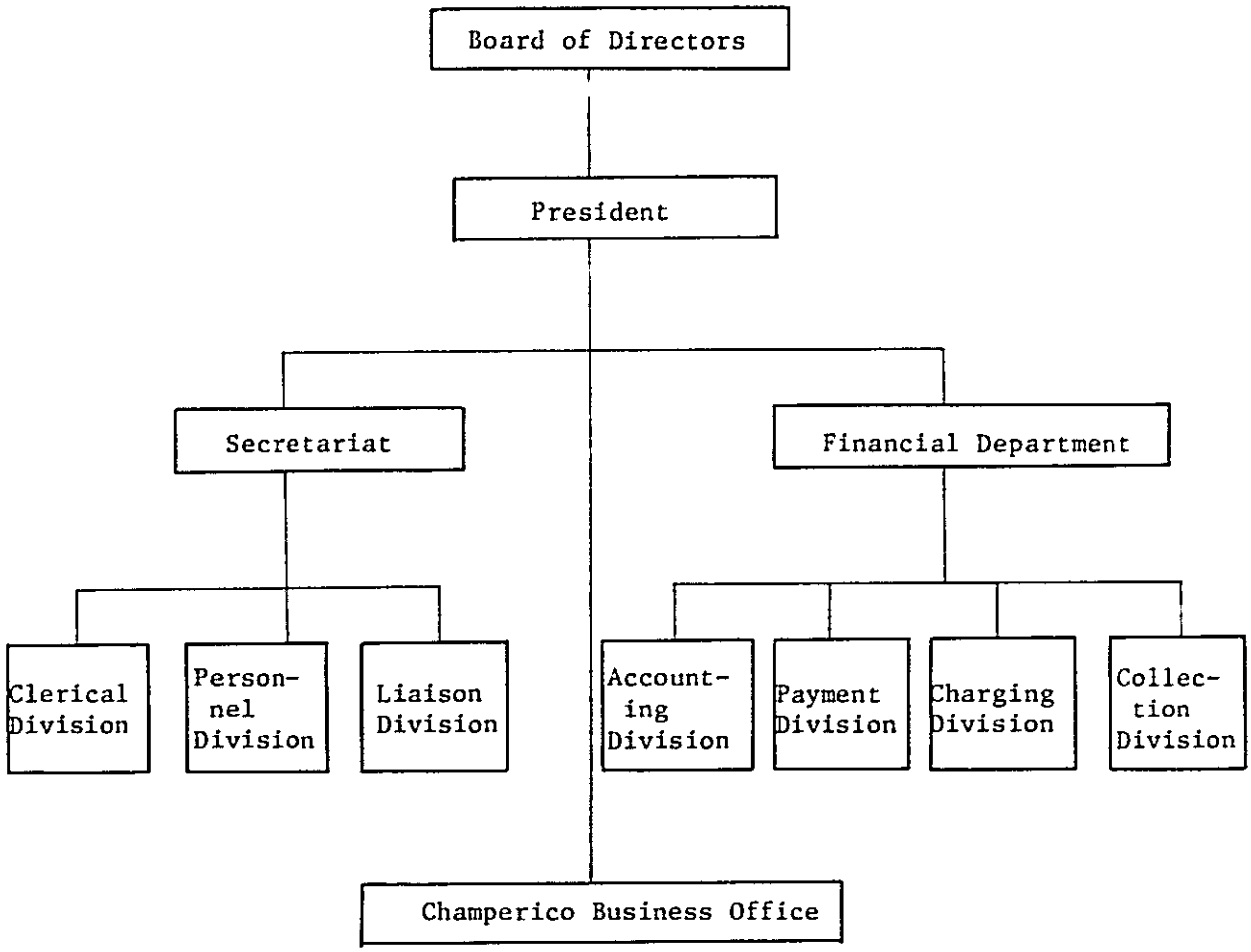
The corporation has its head office in Guatemala City and a business office in Champerico. The head office is composed of the clerical, personnel and liaison sections. The business office is in charge of the field work in Champerio Port. The summing up of contract data and other kinds of clerical work are conducted at the head office. (Fig.-12.1)

(3) Santo Tomas Port

Santo Tomas Port is a state-run port constructed by the government in 1955. At the initial stage, it was directly administered by the state, but has been placed under the administration and operation of the Santo Tomas Port Public Corporation, Portuaria Nacional Santo Tomas De Castilla, since it was established by the Presidential Ordinance No.63 in 1963.

The corporation carries out under the supervision of the Minister of Finance not only the maintenance and administration of the facilities but also such kinds of business as passengers' getting on and out of ships and cargo's loading and unloading in the port, as well as foreign and domestic transport agencies' services and offer of supplies to ships. It also takes charge of the lighthouse, channel marks and piloting and provides water and power to people living in the surroundings of Santo Tomas Port.

Fig.-12.1 Organization of Champerico Port Public Corporation



The corporation has the Board of Directors, general managership and various administration and operation organs for the management, administration and operation of the port.

The Board of Directors is composed of one chairman, one deputy chairman, three directors and two substitute directors, and decides the basic action policy of the corporation. Board members are recommended by the Minister of Finance and appointed by the President.

The general manager represents the corporation and carries out the decisions made by the Board of Directors. He is under obligation to be present at meetings of the Board of Directors. Although he has no right to vote, he has a voice and can make his opinion recorded in the minutes of the meetings.

Under the general managership are the following bureau and sections. The corporation's head office (the central office) is located in Guatemala City and its business office in Santo Tomas. (Fig.-12.2)

1) Secretariat

2) Deputy manager (Assistant to Manager)

3) Audit, accounting and statistics sections

4) Legal expert and technical sections

5) Personnel and public relations sections

6) Shopping service section

In the above organization, one administrator directly attached to the general manager performs the administration and operation of Santo Tomas Port.

The business office is in charge of field work and other kinds of work is carried out by the head office.

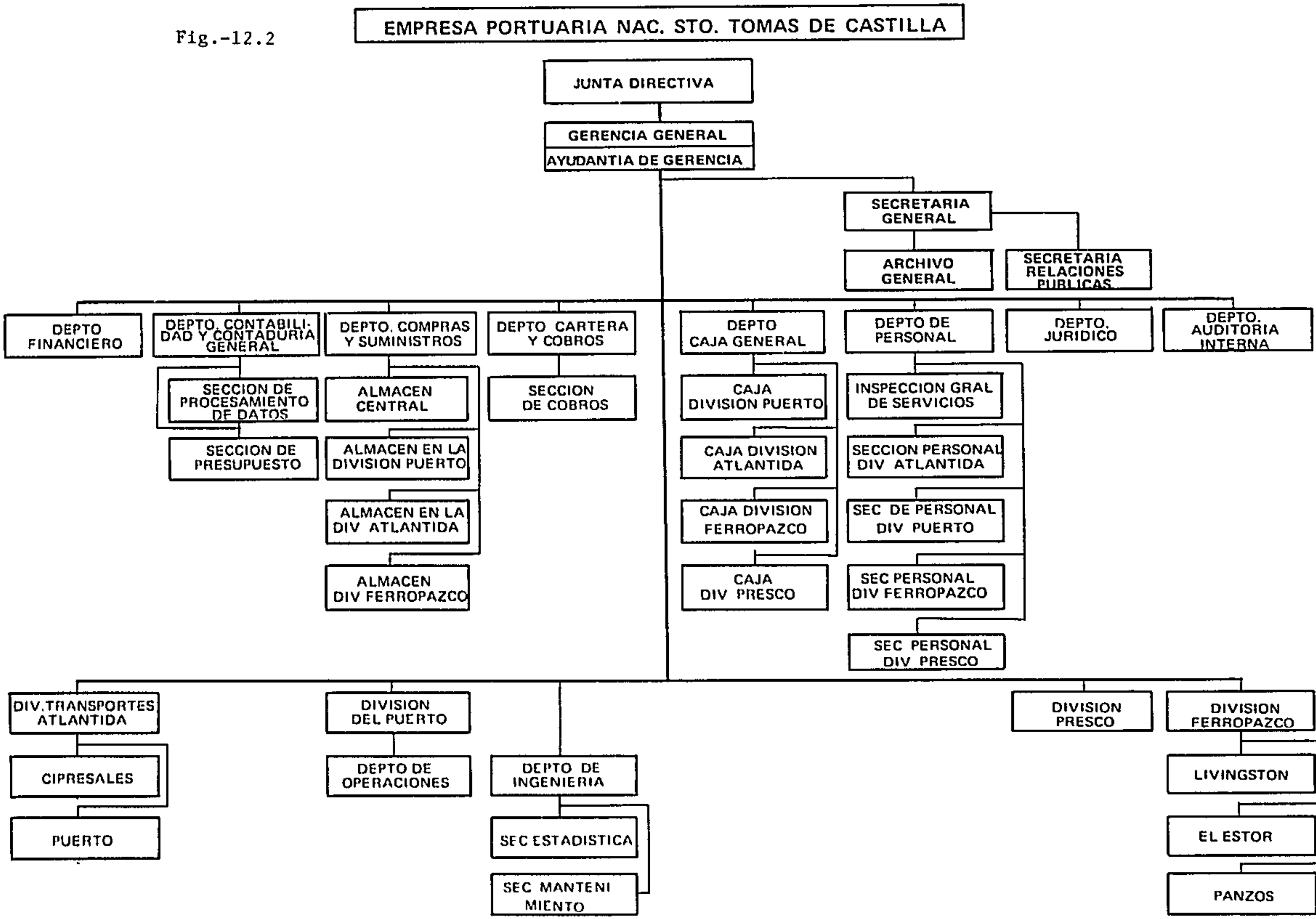
(4) Puerto Barrios Port

Puerto Barrios Port was constructed at the beginning of the 20th century by the International Raiway Company of Central America and used by the United Fruit Company, a U.S. Company's affiliate, for the shipment of bananas and other products.

But the port is now nationalized following the nationalization of the railway company. Its administration and operation are entrusted to the Puerto Barrios Port Public Corporation which has been newly created under the railway company.

Since this port is not 10 kilometers away from the modern port of Santo Tomas, its unified administration with Santo Tomas Port is now under study.

Fig.-12.2



EMPRESA PORTUARIA NAC. STO. TOMAS DE CASTILLA
JUNTA DIRECTIVA
GERENCIA GENERAL
AYUDANTIA DE GERENCIA
SECRETARIA GENERAL
ARCHIVO GENERAL
SECRETARIA RELACIONES PUBLICAS
DEPTO FINANCIERO
DEPTO. CONTABILIDAD Y CONTADURIA GENERAL
SECCION DE PROCESAMIENTO DE DATOS
SECCION DE PRESUPUESTO
DEPTO. COMPRAS Y SUMINISTROS
ALMACEN CENTRAL
ALMACEN EN LA DIVISION PUERTO
ALMACEN EN LA DIV ATLANTIDA
ALMACEN DIV FERROPAZCO
DEPTO CARTERA Y COBROS
SECCION DE COBROS
DEPTO CAJA GENERAL
CAJA DIVISION PUERTO
CAJA DIVISION ATLANTIDA
CAJA DIVISION FERROPAZCO
CAJA DIV PRESCO
DEPTO DE PERSONAL
INSPECCION GRAL DE SERVICIOS
SECCION PERSONAL DIV ATLANTIDA
SEC DE PERSONAL DIV PUERTO
SEC PERSONAL DIV FERROPAZCO
SEC PERSONAL DIV PRESCO
DEPTO. JURIDICO
DEPTO. AUDITORIA INTERNA
DIV. TRANSPORTES ATLANTIDA
CIPRESALES
PUERTO
DIVISION DEL PUERTO
DEPTO DE OPERACIONES
DEPTO DE INGENIERIA
SEC ESTADISTICA
SEC MANTENIMIENTO
DIVISION PRESCO
DIVISION FERROPAZCO
LIVINGSTON
EL ESTOR
PANZOS

12-2 Port Charge

The present port charge is complicated, with different charges being imposed on the same cargo according to cargo handling conditions. Actually, charges are fixed minutely for all possible cases.

Taken up here for example are charges at Champerico Port which adopts the cargo handling system by lighter and those at Acajutla Port in the neighboring country on the Pacific coast which adopts the cargo handling system on quay wall. The following are the outlines of both port charges.

(1) Charges at Champerico Port

Charges at this port are roughly divided into two parts - one imposed on ships to enter and the other on cargoes handled.

(a) Charges on ships

. Entrance charges	40 Q
. Light charges	3.5 Q
. Pierage	5 Q

Other main items include inside-ship cargo handling charges, whose unit charges are fixed according to the kinds of work of cargo handling workers. Concerning overtime charges, those for lighter, pier and handling works are to be paid by shipping companies.

(b) Charges on cargoes

Charges on cargoes are roughly divided into those for lighter, pier and handling works. Charges for each work are stipulated according to import and export goods, whose main items are listed below. -

	Ligher work Charge	Pier work Charge	Handling work Charge	Total
	Q/t	Q/t	Q/t	Q/t
(Exports)				
Cotton	6.2	1.3	0.9	8.4
Coffee	5.1	3.3	0.4	8.8
(Imports)				
Fertilizer	4.2	0.9	0.9	6.0
Steel	7.8	1.3	0.9	10.0
General Merchandize	11.8	3.3	0.9	16.0

(2) Charges at Acajutla Port

As mechanization for cargo handling, especially of bulky cargoes, is in progress in this port, harbor charges are divided into two categories - one for general cargoes and the other for bulky cargoes.

(a) Charges on ships

- Service for bringing ships alongside the pier and away from it. 0.136 Q/GT

- Demurrage

Demurrage	1.6 Q/m (unit ship length)		on the 1st day
	1.2	"	on the 2nd day
	0.8	"	on and after the 3rd day

- Mooring cable 0.6 Q/day 1000 G.T.

(b) Charges on Cargoes

Primary charges include Wharfage and Storage, which are fixed according to the kinds of cargoes and the types of their packing.

	Wharfage Q/t	Storage Q/t	Handling charges from silo
(General Cargo)			
Cotton	8.8	Export 2.0	
Linter	6.4		
Coffee	10.4		
Steel	8.0	Import 2.2	
Machinery	10.4		
Automobile, etc.	14.4	6.2	
(Bulky Cargo)			
Sugar	5.4	1.0	
Cotton seed	2.4	1.0	0.4
Fertilizer	2.2	1.0	

Charges on primary machines are shown below: -

- Crane (35 tons) 40 Q/hour
- Forklift (3.2 tons) 8 Q/hour
- Tractor for flatcar 8 Q/hour

12-3 Administration and Operation System at the New Port

Judging from the present system of administration and operation of the ports in Guatemala and railway in and from ports being run by the state as explained in Paragraph 1, it will be better for the new port to be administered and operated by the state through a public corporation.

But on the occasion of the new port construction, it will be necessary to establish the structure for development as well as for administration and operation of ports, such-as stated below.

(1) Strengthened government organization for construction and administration of ports

The government office to supervise the new port construction project is the Ministry of Communication and Public Works. But there is no special bureau to take charge of harbor problems in the Ministry. In order to push ahead with the new port construction project, it is necessary to create a Harbor Bureau (a tentative name) for unitary control of planning, construction, administration and operation of ports.

At the same time, the government's right to supervise public corporations which directly administer and operate the existing ports should be transferred from the Ministry of Finance to the Harbor Bureau to be created. The new Bureau should also be in charge of the work to compile harbor statisties.

Now, special emphasis should be placed on the urgent necessity for training technicians for the construction of the new port, in view of a small number of harbor technicians in Guatemala. Even after the completion of the new port, they should be attached to the Harbor Bureau to take charge of the program for improvement and development of ports in Guatemala.

(2) Main administrative body after construction of new port.

For the creation of a main administrative body after the construction of new port, roughly two methods can be considered. One is to establish a new public corporation for unified administration of all ports throughout the country on the occasion of the construction of the new port (case I). The other is to establish a new public corporation for independent administration of the new port. (Case II)

1) Case I

When the new port's habor facilities start service, a new public corporation will be established to unify harbor public corporations set up in all existing ports including San José Port which will be promoted to a state-run port, and unified administration of all ports including the new ports will be enforced.

The unified administration by one public corporation, will have the following advantages.

(a) As a result of the construction of the new port, there will be adverse effects on San José and Champerico Ports, such as marked decrease in the amount of cargoes handled in the two ports, especially giving rise to a problem of compensation to Agencia Maritima S.A. But these problems can be solved in the frame-work of the entire organization.

(b) The head offices of public corporations and Agencia Maritima S.A. in the existing ports are all in Guatemala City, with their business offices located in their respective ports. Therefore, if new business offices are set up under the new public corporation, there will be no fear of the service to decline due to the unification. Moreover, the overlapped head office structure can be simplified and replenished by the unification and service activity strengthened.

(c) Through the unitary administration and operation of all ports, functional assignment of work to the ports will be decided and cargoes to be handled by them will be adjusted, making it possible to obtain effective operation of harbor facilities.

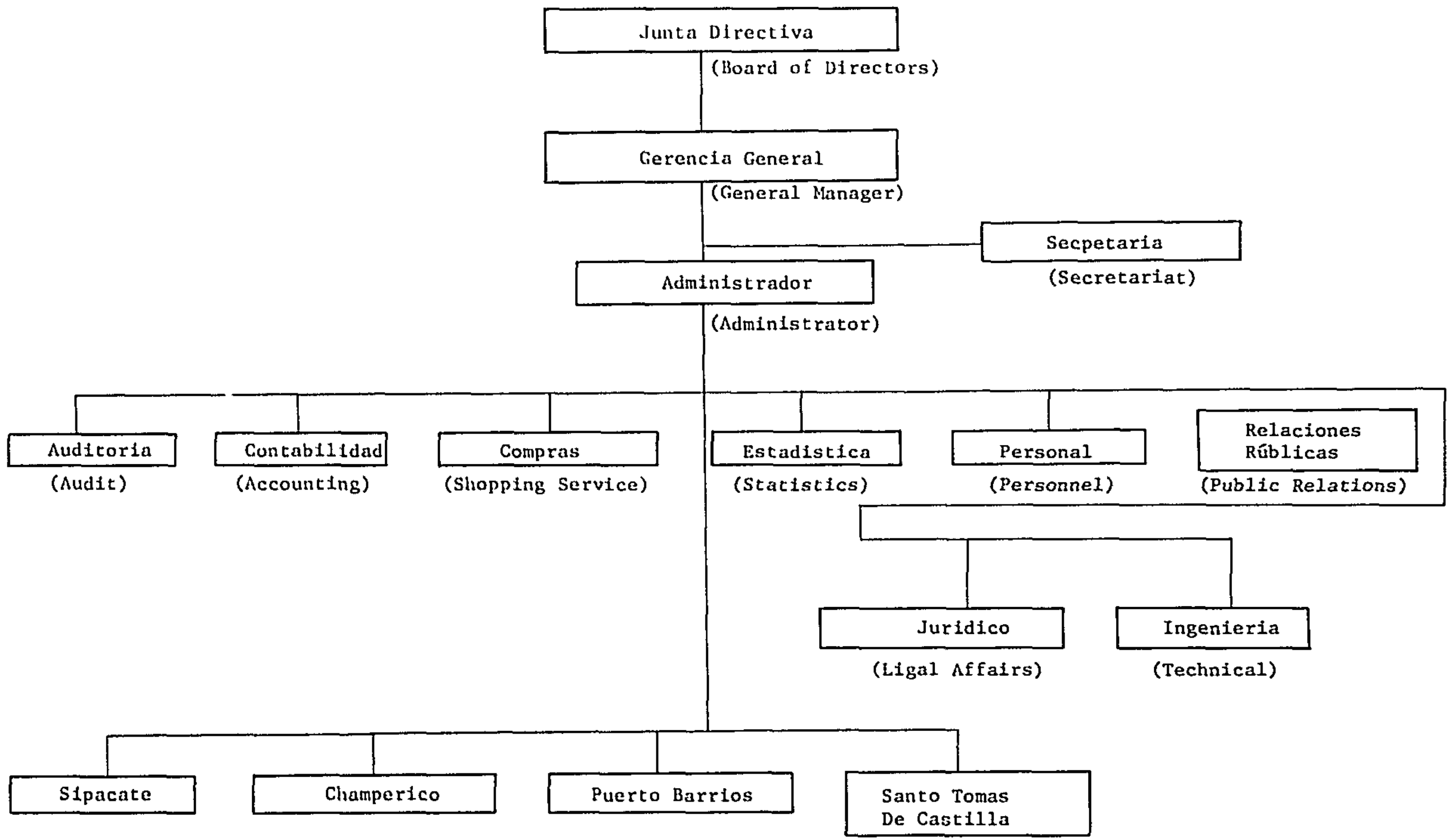
(d) The above is considered desirable for early realization of the land-bridge system which is an international transport route of container cargoes through Guatemala by means of a rapid transit railway connecting the new port on the Pacific coast and Santo Tomas Port on the Atlantic coast.

Therefore, the public corporation should locate its head office in Guatemala City and its business offices in the localities of the ports. All work should be concentrated to the head office and conducted there except field work which is to be dealt with at business offices. (Fig.-12.3)

In addition to the administration and operation of the ports, the public corporation to be newly created should make various public service facilities available in areas around the ports (such as power, water and oil supplies, fire service, etc.), so as to be equipped with the character of its being a central organization for regional development.

If the establishment of a new public corporation for the unified administration and operation of all ports in the country is difficult soon after the construction of the new port, the setting up of a new public corporation to unify the administration and operation of all Pacific coast ports including the new port will be a solution.

Fig.-12.3 Organization for Administration and operation of New Port after It's Construction



2) Case II

A new public corporation is to be established, separatly from the existing ports. In this case, none of the advantages pointed out in Case I can be expected. But the advantage of Case II can be found in lack of the complicated problem in Case I of changing the organization due to unification and abolishment of the existing public corporations.

In addition to the administration and operation of the new port, the public corporation will offer water, power and other public service facilities to people living in the port area. For this purpose, the public corporation should set up the board of directors and other organizations. Its head office should be located in Guatemala City and its business office in the locality of the port. All work is to be conduted at the head office except the field work which is to be dealt with by the business office.

CHAPTER 13. FINANCIAL ANALYSIS OF THE NEW PORT

Chapter 13. Financial Analysis of the New Port

13-1 Purpose of Financial Analysis

In order to determine the feasibility of the new port construction, it is necessary to work out, above all, two types of analyses completely.

The first is economic analysis stated in Chapter 11, which makes a comparative study between social costs and benefits related to the project.

The second is financial analysis which is dealt in this chapter. Financial analysis aims to find whether it is possible for the new port, when considered as an autonomous economic entity, to maintain soundness, and to be managed without going to bankruptcy or other impasses, under forseeable conditions. It also aims to study the conditions required for satisfactory operation of the port, and to make any necessary suggestions.

If funds for the port construction are to be introduced from financial institutions at home and abroad, it is the responsibility of economic analysis to show that the funds will be used most effectively in line with the objective of these institutions, or from the borrowing country's viewpoint to demonstrate the rationality of using the funds for this project in favor of others.

The following studies, however, fall into the category of fianacial analysis: First, the degree of certainty of repayment based upon the original conditions of the loan, and second, arrangement of the policy and of the conditions of the project itself for successful implementation of the project.

Compared with economic analysis, financial analysis is more practical and reflects more the realities of the world. Therefore, each time an assumption becomes real and determined, new analysis should be conducted, so as to provide complete data with which the decision maker can choose the best alternative. In this sense, analysis carried out in this report is strictly the first step in the overall financial analysis of the project, and not the final one.

13-2 Method of Financial Analysis

For the purpose of fulfilling the objective stated in the preceding section, we have carried out the analysis in the following order:

(1) Examinations of input factors

There are various input factors for financial analysis, but they can be roughly classified as follows:

(A) Decision factors
- Harbor tariff (revenue per ton)
- Proportion of government's equity investment

(B) Event factors
- Amount of cargo handled in port
- Amount of investment and cost of depreciation
- Labor and operation cost
- General administration cost
- Maintenance cost
- Loan interest
- Others

Decision factors (A) are ones whose values can be decided, to a high degree, by the decision maker by his own judgement. As shown above, they include harbor tariff and the proportion of government's equity investment.

Event factors (B) are ones whose values are largely dependent on outside conditions. The project administrator might attempt to bring those values to a desirable level, but the degree to which he may succeed is not as great as in the case of decision factor.

The amount of investment listed above as an event factor, may also be considered as a decision factor. However, through economic analysis its most desirable scale has been suggested in Chapter 11, and there is great possibility that actual construction cost are incurred apart from the intention of the project administrator. Hence, the above classification has been made.

The standard case, explained later, is made upon assumptions of event factors considered to be most probable at this moment. As for decision factors, values in the standard case tend to become somewhat arbitrary, since they should be decided definitely after the trial results have been obtained.

(2) Forecasting of financial conditions of the new port and sensitivity analysis

Financial conditions were simulated on income statement, balance sheet and funds statement basing upon the generally accepted accounting principles. In case it becomes necessary to acquire funds to satisfy conditions of the loan, it is assumed that interest free government subsidy is always available.

Therefore, the scale of subsidy will serve as an effective indicator to show financial feasibility of the project.

A computer program with the features shown in Exhibit 1 was used for calculation, and the time horizon for the calculation was set for 25 years.

13-3 Main Factors for Financial Analysis

Assumptions for what may be called the standard case have been obtained through examinations of main factors of the project's financial analysis.

As briefly stated in the preceding section, our aim with event factors is to obtain the most probable value for each factor and to gain a sense of their respective movable ranges. As for the values of decision factors, they should be decided only after feeding back the trial results. In this section, simply a few examinations will be made on their ranges.

13-3-1 Examination of Event Factors

(1) Amount of cargo handled in port

In 1973, the amount of cargo handled in the Pacific coast port of Guatemala was 350,000 tons. In 1980, the total amount of cargo estimated item by item will reach 557,000 tons. (Refer to Chapter 3)

If 130,000 tons of the total cargo is to be handled in the existing Champerico Port at least until 1980, the amount of cargo handled in the new port in 1980, the year of its opening, will be 427,000 tons.

As for the amount of cargo that will be handled in the port beyond 1980, it is extremely difficult and not appropriate to sum up estimated values by item, based on the present trade structure. Therefore, in the standard case, the growth rate of the amount of cargo handled in the new port beyond 1980 is estimated rather conservatively, at 5 per cent per annum.

(2) Investment amount and depreciation cost

The amount of cargo to be handled in the new port is shown in a graph below. It is impossible to meet the demand for cargo handling for the 25 years following 1978 with the first stage investment plan (3 berths). (Fig.-13.1)

If the maximum amount of cargo handled per berth is set at 150,000 tons, the first stage investment is expected to reach saturation point in 1981 (the fourth year), and the second stage investment (another 3 berths) in 1995 (the 18th year). Therefore, in the standard case, the first stage investment is arrnged for 1978, the second stage investment for 1981, and the third stage investment for 1995. (Note 1)

The straight line method is used for depreciation. The assumed lives of various facilities are shown in Exhibit 2. (residual value 0) Fifty years set as the life of the breakwater, quay wall, dredging etc., is considered to be almost the same as in Acajutla.

(Note 1) The actual investment will most likely be made during the construction period of 5 years or so, but here, the writer assumes that it is made in one single year to make the calculation simpler. Since the middle point of the construction period is treated as the year of investment, the financial internal rate of return will not be affected by the single-year calculation.

(3) Labor and operation costs per ton

In this financial forecasting program, labor costs paid to on-the-spot workers and their supervisors, and operation costs which include ordinary maintenance cost, are treated as variable costs. In other word, these costs are assumed to increase in proportion to the growth of the amount of cargo handled in the port.

Actually, a large part of on-the-spot workers would be regular employees on straight wages. In addition, maintenance cost of machinery and equipments may also be considered as fixed cost.

However, it will be safer and more practical to treat these costs as variable if we really want to grasp long-term financial conditions of the new port. Much of their fixed cost nature will be lost in the long run.

In fact, energy cost, such as power and fuel expenses, and supply cost, such as consumption of ropes, can be considered almost as variable cost.

The amount of $2.5, the same as in the case of Acajutla in 1973, is adopted as labor cost per ton. This cost includes not only ordinary salaries and wages, but also bonuses and other expenses such as social security expenses.

Similarly, operation cost per ton is set at $0.6 as in Acajutla, 1973. The operation cost in Acajutla, however, includes capital costs, such as rental, but they are minute enough to be ignored.

The cost of labor and operation per ton together reaches $3, a figure which may be a little higher compared with those of other studies. (Note 2) The cost includes, however, not only pure labor and operation costs but also other miscellaneous expenses. Therefore, it is not overly conservative as a basic figure in financial analysis of the new port. (Note 3)

(Note 2) As an example of this kind of study, there is the "Analysis of Ports Costs and Investment Possibilities in Central America", Central American Ports Study, (Oct. 1, 1971), by International Bank for Reconstruction and Development. This study sets the basic cost of coastal work in Central America at $1.75 per ton. Even if the increase in price level from 1971 to 1974 is 40 per cent, the resulting cost will be $2.45 ($1.75

x 1.4). This is about 30 per cent less than the $3, set as the basic figure for this financial analysis.

(Note 3) This value is also considerably different from that of lighterage oriented ports. The labor & operation cost, excluding depreciation, estimated from the income statement of the Port Champerico for 1973 was $5.5 per ton, which is considerably higher than the cost level of the new port, showing clearly the capital intensive nature of the new port.

(4) Maintenance Cost

Here, maintenance cost refers mainly to dredging cost for removing sand drift and maintaining enough depth for the port, and quay wall repair cost.

The natural condition of the Pacific coast of Guatemala is very different from that of Acajutla. The common setback of the former is the piling up of sand drift. However, the new port is fortified with a strong basic design against sand drift and waves, and sand flowing into the port from rivers is expected to be small. It is therefore expected that maintenance of the channel by grab dredger would require only minimum costs. In the standard case, maintenance cost is estimated at $18,000 a year.

(5) General Administration Cost

There seem to be considerable differences in general administration costs (personnel cost and operation cost) per ton according to the scale of the port.

In 1973, the personnel cost in Acajutla, with 905,000 tons of cargo handled per annum, was $0.35 per ton as against a higher level of $0.94 per ton of Champerico, with 116,000 tons of cargo handled per annum.

The new port should be managed by individuals of high administrative capacity and competence, who of course should be rewarded with high remuneration. At the same time, however, it will be necessary to abandon honorary and nominal posts and endeavor to withhold general administration costs at an adequate level.

The amount of cargo that the new port aims to handle per annum is inbetween those of Acajutla and Champerico. Of the general administration cost of this new port, the initial personnel cost is set at a level of $0.5 per ton or $175,000 total.

Similarly, the operation cost in 1973 in Acajutla was $0.27 per ton, and in Champerico, $1.25 per ton.

In the standard case, the initial value of the new port is set at $0.4 per ton or $140,000. As a result, the total general administration cost becomes $0.9 per ton or $315;000 in initial values. (Note 4)

The general administration cost is generally regarded as fixed cost. But when looked at from a long term viewpoint, it has many variable factors. This is reflected in this financial forecasting program. It rather arbitrarily sets 30 per cent of the increase in the amount of cargo handled in port as the variable increase in general administration costs. (Note 5)

(Note 4) In the previously mentioned Central American Ports Study, the total amount of management, supervision, and service operation costs was set at $0.75 per ton (1975).

(Note 5) In other words, of the general administration cost, 70 per cent is considered to be fixed cost and 30 per cent variable cost.

(6) Interest on loan and repayment schedule

The amount of interest on loan is greatly affected by the project's dependence on loan (ratio of government's equity investment) and conditions of loan (interest rate, grace period, and repayment schedule). In the standard case, as shown later, the ratio of loan dependence is set at 50 per cent, interest rate at 5 per cent, 5 years of grace period and 20 years repayment period.

Government subsidy (free of interest) is relied on in case of fund shortage during financial calculation. The maximum annual government subsidy (flow) and the maximum accumulated government subsidy (stock) will serve as effective indicators to show financial feasibility of this project.

(7) Inflation

In the standard case, computation for the whole period was made on the price level of 1974. Analysis with inflation taken into account is shown in Section 5 Item 8.

(8) Other assumptions

Other assumptions are as follows. (In this connection, references were made to the 1973 year end balance sheet of Port of Acajutla.)

i) Ratio of current assets to sales ... 24.8%
(The ratio of that of Acajutla excluding deposits)

ii) Ratio of current liabilities to sales ... 4.7%
(The ratio of that of Acajutla excluding debt repayment to be made within a year)

iii) Ratio of deferred assets to sales ... 0.8%
(The ratio of that of Acajutla excluding discount on bond)

13-3-2 Examination of Decision Factors ... Harbor Tariff

As main decision factors, there is the harbor tariff and the ratio of government's equity investment. Of the latter, the ratio is tentatively set at 50 per cent in the standard model. As for harbor tariff, although it must ultimately consider trial results for its decision, it is possible to confine the range of decision within certain limits by examining the port's competitive conditions.

Port of Acajutla is an example of a modern port, aimed at by the new port, and it had $7.1 revenue per ton in 1973. Revenue contents are shown below. Revenue from user service accounts for 73 per cent of it, and from vessels service, 19 per cent. (Table 13-1)

In the case of Acajutla, bulk cargo constitutes more than 60 per cent of the total amount of cargo handled. In the case of the new port, it is estimated to be divided roughly into 60 per cent general cargo, 35 per cent bulk cargo, and 5 per cent liquid cargo.

Thus, even if revenue levels per ton of these respective cargo in the new port are the same as in the case of Acajutla, user service revenue of the new port will be $6.6 per ton, a level 26 per cent higher than that ($5.2 per ton) of Port of Acajutla.

When vessels revenue is set at $1.3 per ton, as in the case of Port of Acajutla, and other revenues at $0.2 per ton (after deducting the amount equivalent to interest revenue of Port of Acajutla), the total competitive minimum tariff will be $8.1, as shown in Table-13.2, left column.

On the other hand, it may be possible to interpret competitive conditions in a broader sense, when the large depreciation burden of the new port is taken into consideration. In Port of Acajutla, WITASS, a league of shipping companies, now imposes a congestion surcharge of $2.15 per ton on ships. Since this is a burden wholly borne by users of the Port of Acajutla, port's competitiveness may be regarded as maintained even if such money is added to the user service revenue of the new port.

Also, at present, a considerable amount of cargo that should be handled in Guatemalan ports are handled in Acajutla, due to their poor accommodations and relative inefficiency. If considerations are made solely to secure such cargo to the new port, users may not be concerned with a disparity in tariff that is less than the difference of cargo transport costs (approximately $2.8).

As for vessels service revenue, construction of a new port with complete facilities will greatly benefit shipping companies, who will be able to see dramatic reduction of berthing time of their ships. The vessels service revenue of Port of Acajutra is set at a very low level of one quarter of its user service revenue, probably in an attempt to induce shipping companies to the port. However, it is doubtful whether the merits of such a system is greater than the demerits of reduced revenue and possible financial deterioration.

Considering all these points, the range of tariff per ton of the new port is calculated at approximately \$8 to \$15 as shown in Table 13-2 In the standard model, it is set at \$12 for convenience's sake. The Table 13-3 is summarizing the values and assumptions of main factors in the standard case.

13-4 Examination of the Project's Financial Feasibility

On the basis of the examinations of various factors and their standard values set out in the preceding section, computation for the standard case of this project were conducted for 25 years after its operation in 1980. (Note 6)

(Note 6) As stated in the preceding section, the first stage investment is arranged for 1978, two years prior to the opening(1980.) If a part of the first stage investment is financed by loan, there will be, as a matter of course, interest to be paid before the opening. However, this was put outside consideration in the standard case. Please refer to Section 5 Item 6 of this chapter for the case with this interest before opening added on to investment.

The results, analysed from two points of view, i.e. profitability, and governmental burden, are as follows.

13-4-1 Profitability... Refer to Exhibit 3 and Exhibit 4

The Table 13-4 shows the net profit to sales ratio (1), calculated throughout the period, as 21.7 per cent, indicating a respectable profitability. (Table 13-4)

However, return on total assets (2) is at a low level of 2.7 per cent. This is because the turn-over ratio of total assets is extremely low(0.09 in the initial year), a common phenomenon in projects of this kind. The financial internal rate of return (3) is 3.7 per cent, which cannot be considered high.

Even if the hurdle rate is set at a somewhat low level of 4 per cent (Profitability Index , k = 4 % , (4)), the ratio of the present value of the net cash flow and the present value of total investment is 0.96, just failing to meet the 4 per cent figure, provisionally set as the required rate of return of this project.

However, this project is a typical infrastructure investment, and maximization of profit from the onset is not its ultimate objective.

The decision of whether or not implementing the project should be made on the basis of economic analysis which identifies costs and benefits from a wider point of view.

These profitability indicators based on generally accepted accounting principles, cannot be simply ignored, however. International financial institutions and latent investors respect the principle as an effective criteria for investment. Efforts for increase in profitability should be made energetically so far as it will not produce a great conflict with benefits for the national economy.

13-4-2 Burden Imposed upon the Government

The Guatemalan Government's burden with this project might be divided into two stages.

The first is when part of investment for this project is made in the form of a loan from abroad. In this case, the Guatemalan Government will be responsible for guaranteeing repayment of the principal and payment of its interest.

The second is the burden of equity investment, and governmental subsidy in the port authority to urge repayment of loan and payment of interest.

Since it would be inevitable for the government to make complete execution of the former, whether or not the governmental burden in the latter case, after meeting the requirements of the former, can be kept below the appropriate level, will decide the financial feasibility of the project.

Government's equity investment to the project and cash surplus (negative governmental subsidy), are summed up at an interval of 5 years in Table 13-5 and in Exhibit 5, Funds Statement.

Governmental investment made in the form of capital will reach $71 million in 25 years. But the project will bring forth cash surplus amounting to some $69 million, making the government's net burden only about $2 million in the period of 25 years.

Of course, much of governmental investment is made during the first half of the forecasting period, while cash surplus will be made mostly during the second half. Therefore, when we consider "time value of money," the sum of $2 million cannot be accepted at face value. However, this much of a sum will be said well worth the burden, in view of the project's contribution to the national economy.

On the other hand, it is necessary for judgement of financial solvency of the project itself, to distinguish clearly between government's equity investment, capital, and government subsidy, or short term debt (or cash surplus, when the case is reverse). In this standard case, however, cash surplus is consistently generated throughout the forecasting period, and there seems to be no need of government subsidy. (Fig. 13-2)

Therefore, if the government is willing to make 50 per cent equity investment, the financial soundness of the project would be maintained almost completely. (Note 6)

(Note 6) We cannot ignore the cyclical nature of cargo handling activity. So, generated cash surplus as shown in Fig.13-2 does not assure perfect financial autonomy of the port. The government's back-up will be indispensable in this regard, at least 10 years after the start of the project.

13-5 Examinations of the Project under Various Conditions

13-5-1 Ratio of Government's Equity Investment and Government Subsidy

In the standard case, the ratio of government's equity investment has been set at 50 per cent. How does change in the ratio of government's equity investment affect subsequent government subsidy requirements?

To illustrate this relationship, Fig. 13-3 takes the ratio of government's equity investment on the horizontal axis, and maximum annual government subsidy (max. FLOW subsidy) on the vertical axis.

When revenue per ton is set at $12, and the ratio of government's equity investment at 50 per cent (the standard case), maximum annual government subsidy is zero. However, the smaller the ratio of government's equity investment, the greater the maximum annual subsidy becomes. And, when the ratio of government's equity investment is reduced to 33.3 per cent, max. FLOW subsidy amount to a little more than $1.4 million.

If we make a similar analysis with regard to maximum accumulated government subsidy (max. STOCK subsidy), the relationship can be illustrated as Fig. 13-4. (Note 7)

(Note 7) Accumulated government subsidy is an accumulation of annual government subsidy. Therefore, if cash surplus is generated in the initial stage of a project, it will be accumulated as minus government subsidy (you may call it "accumulated cash surplus"). If annual government subsidy becomes necessary thereafter, the accumulated cash surplus will decrease by that amount.

By the way, the word "maximum" signifies the maximum value during the forecasting period (25 years).

Whether to take FLOW or STOCK as the basis for deciding upon the ratio of government's equity investment, will be left to the discretion of the decision maker. From the standpoint of creditors or investors to the project, however, these are indices to show whether or not the project is financially sound. Therefore, the project administrator must cautiously decide on the initial ratio of government's equity investment, which could place these government subsidies within reasonable limits. (Note 8)

(Note 8) For further discussion of the government's 33% equity investment case, see Exhibit 9.

13-5-2 Reexamination of Revenue per Ton

In section 3 of this chapter, an examination was made on revenue per ton, a decision factor, mainly from the point of competitive conditions. Here, its sensitivity analysis on the project's profitability and financial soundness is attempted.

If in the standard case, revenue per ton is reduced from basic $12 to $10, the internal rate of return drops from 3.7 per cent to 2.3 per cent, and the profit to sales ratio from 21.7 per cent to 6 per cent.

Their effects on financial soundness are shown in Fig.13-3 and 13-4 of the preceding section. If revenue per ton is reduced from $12 to $10, the FLOW subsidy will increase by more than $1 million, even if the ratio of government's equity investment stays the same (50%). (Fig.-13.3)

Furthermore, even in the case of 50 per cent government's equity investment, the STOCK subsidy will reach $3.8 million, and in the 33.3 per cent case, more than $28 million (Fig. 13-4).

The study above shows that if other conditions are the same, the reduction of revenue per ton to $10 level badly aggravates the project's financial soundness.

13-5-3 Change in Loan Conditions and Governmental Burden

(1) Loan repayment term and required government subsidy

In the standard case, the term of loan is set at 20 years, after a 5 year period of grace. But what differences will changes in the term of loan produce in government subsidy requirements (both the FLOW and STOCK)?

Exhibit 7-1 shows the repayment term on the vertical axis, and on the horizontal axis, the maximum FLOW subsidy (upper scale) and the maximum STOCK subsidy (lower scale).

The exhibit illustrates that the FLOW subsidy amount can be drastically reduced from a level of nearly $9 million a year to almost zero, in accord to the extension of the repayment term from 10 years to 20 years.

But the exhibit also makes clear that an extension of the repayment term to more than 21 years is meaningless as far as reduction in the FLOW is concerned.

Similarly, the maximum STOCK subsidy will decrease rapidly, up to the repayment term of 16 years, after which an extension will be ineffective, since the maximum STOCK subsidy remains zero.

As in the case of selecting the ratio of government's equity investment, it will be up to the decision maker whether to eye FLOW or STOCK as the more important criterion. However, let us choose as an example FLOW as a decision criterion, to compare with the government's ordinary expenditures.

If its (the FLOW) limit is set at $2 million, the loan repayment term must be at least 14 years.

The examinations made above are of the case when the ratio of government's investment is set at 50 per cent. When only 33.3 per cent government participation is available, a longer repayment term is necessary to maintain the project's financial soundness. (See Exhibit 7-2)

The shortest required repayment time calculated, given specific ratios of government's equity investment and amounts of maximum FLOW subsidy, is shown in Table 13-6.

(2) Reduction of loan interest rate

When the interest rate is 4 per cent instead of 5 per cent, calculations show that the profit to sales ratio rises considerably, from 21.7 per cent (the standard case) to 25.4 per cent, even though the internal rate of return does not change, by definition.

No government subsidy is necessary as in the standard case, while the cash surplus during the forecasting period will be increased from $69 million of the standard case to $78 million, slightly alleviating the governmental burden.

As can be understood from Exhibit 4, effects of a reduction in load interest rate are especially great in the first half of the project.

13-5-4 Increase and Decrease in Labor and Operation Cost

In the standard case, the labor and operation cost is dealt with as a variable cost, and is set at $3.1 per ton. Trials on effects of its 10 per cent increase or decrease on the total picture are given in Table 13-7.

The table shows that any 10 per cent increase or decrease of labor and operation cost brings up and down the internal rate of return by some 0.2 per cent. However, the impact on project's financial feasibility, from a change in labor and operation cost, is relatively small, as long as other conditions remain the same.

13-5-5 Rise in Investment Amount

The Table 13-8 is a comparison of the project's financial conditions and that of the standard case, first when the total investment amount rises by 5 per cent, and second by 10 per cent.

A 5 per cent rise in the investment amount results in a 0.2 to 0.3 per cent drop in the internal rate of return. But if the ratio of government's equity investment is fixed (at 50 %) as in these cases, a rise in the investment amount, up to about 10 per cent, would not necessitate a large increase of government subsidy.

Meanwhile, governmental burden invitable increases, as can be seen in the bottom column of Table 13-8.

Judging from the importance of capital cost (loan interest and depreciation cost) depicted in Exhibit 4, it is almost self-evident how great the impact of rise in the investment amount is.

13-5-6 Inclusion of Interest before Opening

In the standard case, interest before opening, of the first stage investment (about $3 million), has been excluded in the calculations.

When interest is added to first stage investment for calculation, both the internal rate of return and the profit to sales ratio register a slight decrease, the former from 3.7 per cent to 3.6 per cent, and the latter from 21.7 per cent to 20.5 per cent. But practically no government subsidy is needed.

13-5-7 Increase and Decrease in the Amount of Cargo Handled in the New Port

In the standard case, the amount of cargo to be handled in the port in 1980 (the opening year) is set at 427,000 tons, and its subsequent growth rate at 5 per cent per year.

The results of calculations for different cargo handling scenarios are shown in Table 13-9.

If we are to assume that the second and third stage investments are timed to absorb growth in cargo handling, the impact of change in the level of cargo handling on financial feasibility (the size of government subsidy) can be considered not great.

Meanwhile, differences in the generation of cash surplus creates great differences in total governmental burdens.

13-5-8 Impact of Inflation

It is almost impossible to predict inflation rates, both in and out of Guatemala, for all individual items during the forecasting period. It might be somewhat arbitrary, but two inflation rates were supposed here to analyze the impact of inflation on the financial feasibility of the project, as shown in Table 13-10.

In Inflation (1), a common inflation rate is applied to all items of revenue and cost. In this case, impacts on the project are clearly favorable, since the burden of fixed cost would be greatly reduced.

But in reality, it will be extremely difficult to shift the increase in cost completely on to the tariff (revenue per ton), considering competitiveness and national economy.

Therefore, Inflation (2), in which the growth rate of revenue per ton is set rather low, may be more adequate to show a future picture of the project.

When this case is compared with the standard case, the internal rate of return decreases only slightly (0.4 per cent), while the profit to sales ratio decreases noticeably, by one-half. The governmental burden increases by a large amount, even when price levels are the same.

13-6 Conclusion

From the standard case analysis and the subsequent sensitivity analysis carried out in the report, the following conclusions were drawn on the financial feasibility of the project.

The profitability of this project cannot be called sufficient, were it an ordinary industrial project. But the project is a typical infrastructure investment. Thus, taking into consideration the non-financial benefits produced by the project, its financial profitability can be considered passable.

As for financial soundness, most important in this kind of a project, if the government agrees to invest more than one half of the total investment amount, and sets the repayment period of loan, that is to cover the rest of the investment, for more than 20 years (after 5 years of grace), subsequent government subsidy becomes basically unnecessary.

However, the source of revenue, or the amount of cargo handled, tends to be affected easily by short-term change, and the cash surplus generated by the project cannot be called sufficient to cover the loss in revenue. Governmental support, at least for 10 years after the opening, will be indispensable.

The need for government subsidy increases as the ratio of government's equity investment decreases. If the government can invest no more than 33 per cent, the maximum annual government subsidy will total some $1.5 million and its accumulated amount will reach $5.5 million.

In the standard case, revenue per ton is set at $12. However this figure is near the maximum value in the range conceived under competitive conditions.

If revenue per ton is only $10, the financial solvency of this project will be greatly jeopardized.

Considering the benefits brought about by the new port, a large part of increase in revenue per ton is expected to come as increased revenue from shipping companies. This could be realized only when supported by superb, outstanding services.

In order to induce shipping companies to the new port, efforts should be made in effective advertising and promotion. It will be necessary to find men of excellent administrative and executive ability for the management of the new port.

Lastly, an alleviation in borrowing conditions will greatly reduce the governmental burden. However lending institutions have their own rules, and it might be very difficult for them to give preferential lending conditions to the project.

Fig. 13-1 Cargo handling activity and the capacity of each investment stage (standard case)

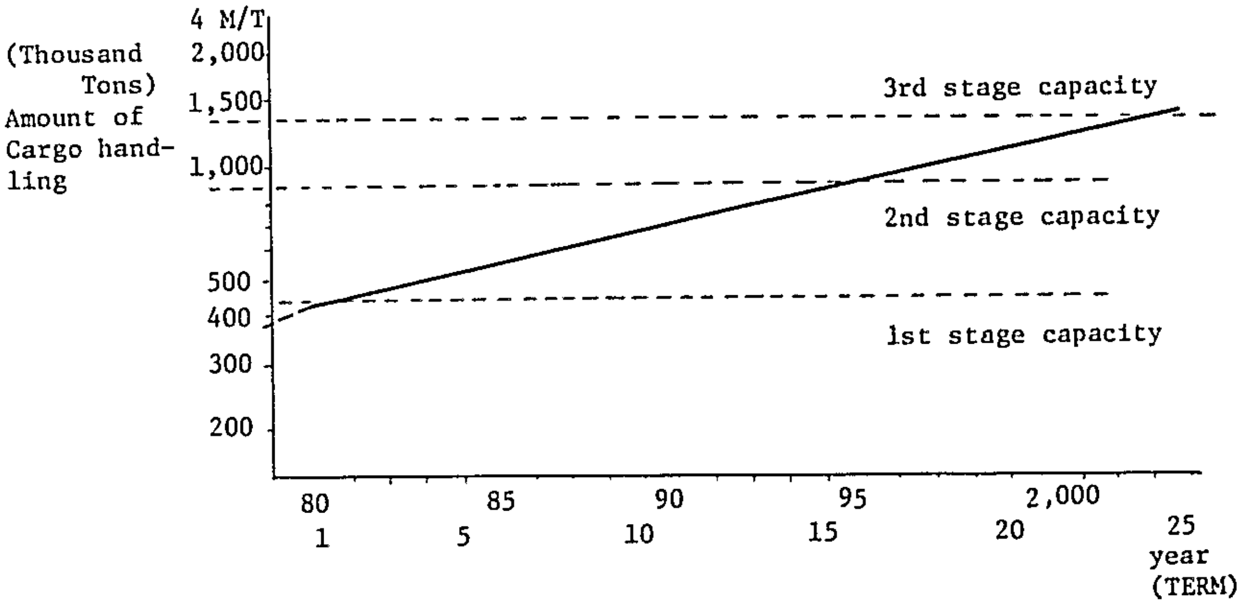


Table 13-1 Per ton Revenue Structure of Port of Acajutla in 1973

* Cargoes handled in 1973 (Thousand Tons)

- Total Revenue $ 7.1
  - User Service Revenue $ 5.2
    - General cargo $8.6 (286)
    - Bulky cargo $3.9 (563)
    - Liquid cargo $1.3 (56)
  - Vessels Service Revenue $ 1.3 (905)
  - Other Revenues (40% interest revenue) $ 0.56

(Note) Conversion rate US$1 = ¢2.5

Table 13 - 2 Competitive Range of Harbor Tariff of the New Port

Criteria for competitiveness / Tariff Item	(1) Same level as that of Acajutla	(2) Consideration given to congestion surcharge imposed on Acajutra	(3) Consideration given to the difference of transportation cost	(4) Increase of vessels service revenue	(2)+(4)	(3)+(4)	(2)+(3)+(4)
Users Service Revenue	$ 6.6	$8.75 ($6.6+$2.15)	$ 9.4 ($6.6+$2.8)	$6.6	$8.75	$9.4	$11.55
Vessels Service Revenue	$ 1.3	$1.3	$ 1.3	$3.3 (a half of user service revenue)	$3.3	$3.3	$3.3
Other Revenue	$ 0.2	$0.2	$ 0.2	$0.2	$0.2	$0.2	$0.2
Total	$ 8.1	$10.3	$10.9	$10.1	$12.3	$12.9	$15.1

Table 13 - 3 Major Assumptions of Standard case

	Assumption / Major Factors	Initial year's value (1980)	Remarks
Decision Factors	Harbor Tariff (Revenue per Ton)	$12	Competitive range $ 8 - $13
	Ratio of Government's Equity Investment	50%	Common to three stages of investment
Event Factors	Amount of Cargoes handled	557,000 tons	Assumes 5% per year increase after 1980
	Amount of Investment	1st stage investment $57,900,000 (1978)	2nd stage $41,808,000 (1981) 3rd stage $41,807,000 (1995)
	Labor cost (per ton)	$2.5	Assumes as 100% variable
	Operation cost (per ton)	$0.6	
	Cost of maintenance	$18,000	30% variable
	General Administration expense	$315,000 ($0.9/ton)	
	Decreciation cost	$1,505.4	Straight line method (refer to Exhibit 2)
	Loan	Interest 5%, 5 years grace period, 20 years repayment	
	Inflation	-	Assumes price level of 1974

Table 13 - 4 Standard Case : Profitability Indicators

Type of Indicators	Value	Remarks
(1) Net profit to sales ratio	21.7 %	Σ Net profit ÷ Σsales
(2) Return on total assets	2.7 %	Σ Net profit ÷ Σtotal assets
(3) Interval rate of return	3.7 %	Net present value of Investment =Net present value of profit before depreciation and interest (IRR is the discount rate which satisfy the above equation.)
(4) Profitability Index		
When k = 0%	1.68	Ratio between present value of profit before depreciation and interest (A), and present value of investment (B) : (A) / (B), when discount rate is k %.
4	0.96	
8	0.58	
10	0.47	
15	0.29	
(5) Payback period	27 years	Cash flow of 25th year is assumed to continue thereafter.

Table 13 - 5 Governmental Burden in the Standard case

(Unit: thousand dollars)

Item \ Terms (year)	1-5	6-10	11-15	16-20	21-25	Total
Government's Equity Investment	49,854	0	0	20,904	0	70,758
Cash Surplus	4,279	2,601	8,785	12,715	40,481	68,861
Total	45,575	2,601	8,785	8,189	40,481	1,897 *

* The calculation of governmental burden above, disregards "time value of money".

If we discount the government's equity investments and cash surpluses at 5%, the net present value of the governmental burden amounts to approximately 29 million.

Fig. 13-2 Generation of cash surplus revenue per ton: 12

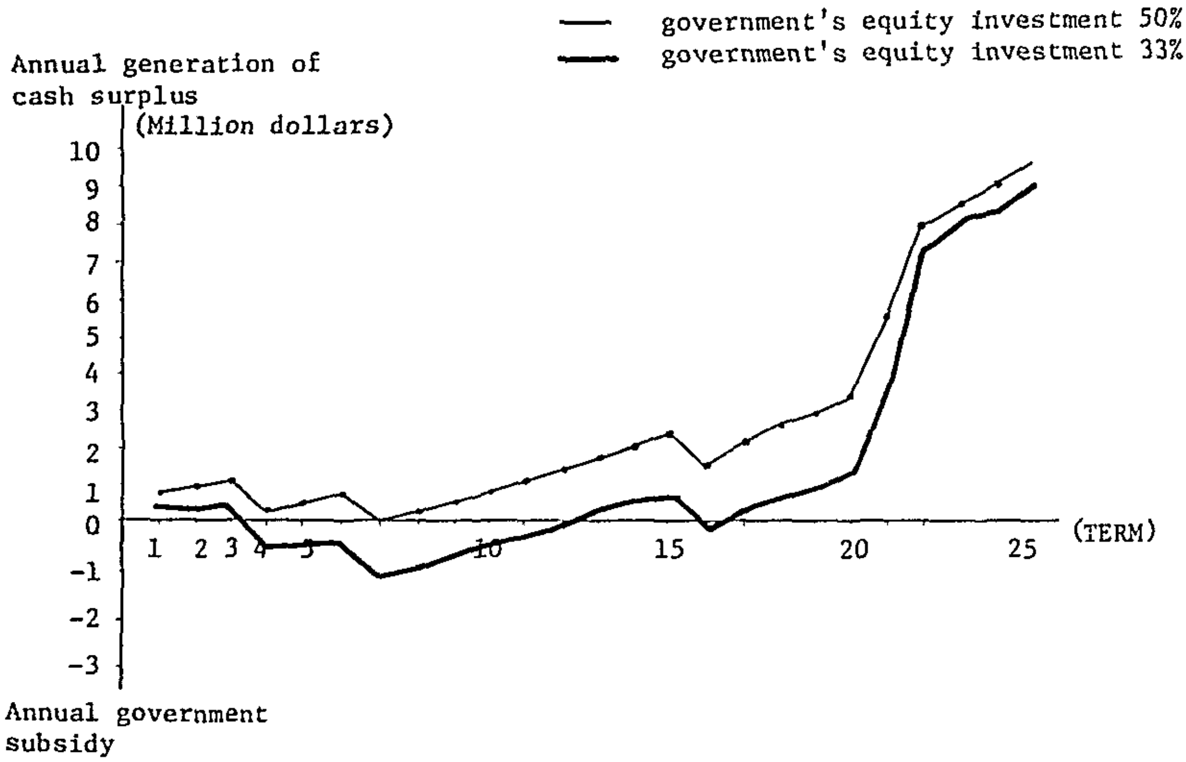


Fig. 13-3 Relation between government's equity investment and maximum annual government subsidy (flow)

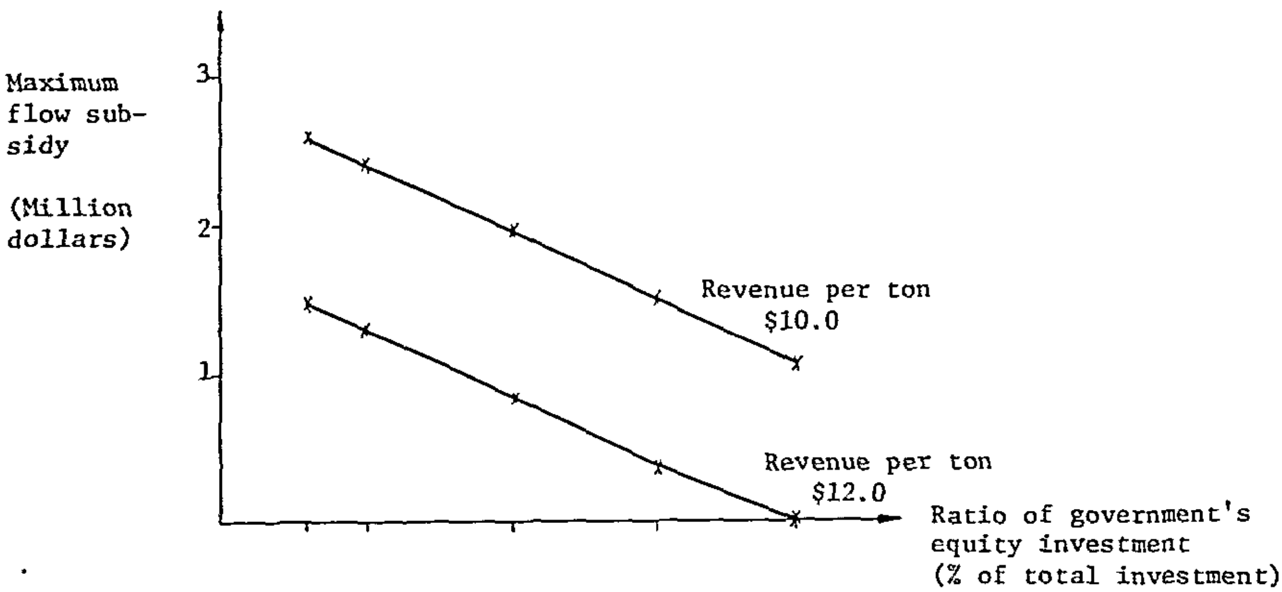


Fig. 13-4 Relation between government's equity investment and maximum accumulated government subsidy (stock)

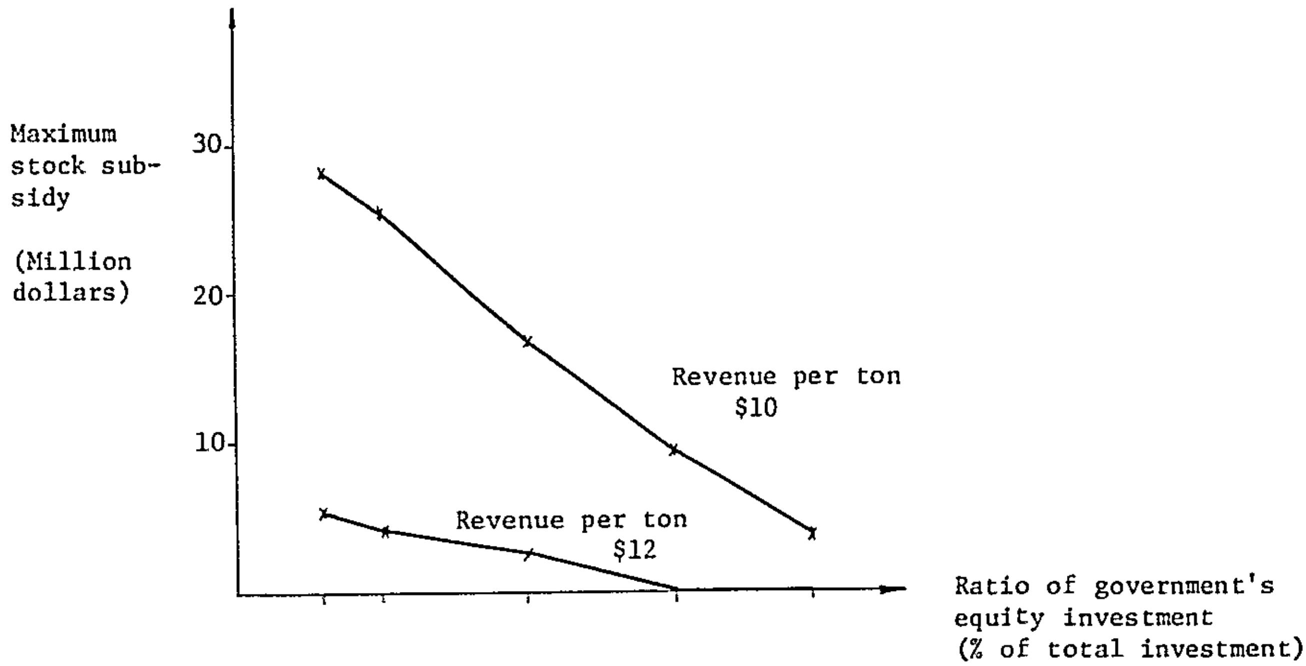


Table 13 - 6 Minimum Required Years for Repayment of Debt, Given the Ratio of Government Equity Investment and Annual Subsidy Ceiling.

Ratio of Government Equity Investment \ Flow Maximum Subsidy Amount (Million dollars)	0	1	2	3	4
	years	years	years	years	years
33%	29	22	18	16	14
40%	24	20	16	14	13
45%	22	18	15	13	12
50%	21	16	14	12	11

Table 13 - 7 Impact of change in Labor and Operation Cost (per ton)

Items \ Case		Standard Case	10% Increase	10% decrease
Labor and Operation Cost Per Ton		$ 3.1	$ 3.41	$ 2.79
Results of Calculation	IRR	3.7%	3.5%	3.9%
	Net profit to Sales Ratio	21.7%	19.1%	24.3%
	Maximum annual government subsidy (Flow)	0	109 (Thousand dollars)	0
	Maximum accumulated government subsidy (Stock)	0	0	0
	Accumulated Amounts of cash surplus (25 yrs)	68,861 (Thousand dollars)	62,557 (Thousand dollars)	75,164 (Thousand dollars)

Table 13 - 8 Impact of Increase in the Amount of Investment

Summary of Calculation Results \ Cases	Standard Case	5% increase of investment	10% increase of investment
Internal rate of return	3.7%	3.4%	3.2%
Net profit to sales ratio	21.7%	19.3%	16.8%
Maximum annual government subsidy (Flow)	0	161 (Thousand dollars)	390 (Thousand dollars)
Maximum accumulated government subsidy (Stock)	0	0	0
(A) Total Government's equity Investment	70,758 (Thousand dollars)	74,296 (Thousand dollars)	77,833 (Thousand dollars)
(B) Total Cash Surpluses(net)	68,861 (")	63,926 (")	58,990 (")
(A)-(B) Governmental Burden	1,897 (")	10,370 (")	18,843 (")

Table 13 - 9 Impact of the level of cargo handling *

Assumption and the result of calculation			Standard	High Growth	Low Growth
Major Assumptions	Amount of cargo handling in 1980		426,000 Ton	426,000 Ton	370,000 Ton
	Growth rate after 1980		5% p.a.	~81 5% p.a. 81~ 7% p.a.	3% p.a.
	Amount and timing of investment	1st stage	1978 57,900 (Thousand dollars)	1978 57,900 (Thousand dollars)	1978 57,900 (Thousand dollars)
		2nd stage	1981 41,808	1981 41,800	1987 41,800
		3rd stage	1995 41,807	1990 81,614	Not necessary during calculation period
Results of calculation	Internal rate of return		3.7%	3.8	2.9
	Net profit to sales ratio		21.7%	22.0	12.6
	Maximum annual government subsidy (Flow)		0	0	294 (Stock) (Thousand dollars)
	Maximum accumu lated government subsidy (Stock)		0	0	0
	(A) Total Government's equity investment		70,758 (Thousand dollars)	90,661 (Thousand dollars)	49,854 (Thousand dollars)
	(B) Total cash Surpluses(net)		68,861	86,522	29,845
	(A)-(B) Governmental Burden		1,897	4,139	20,009

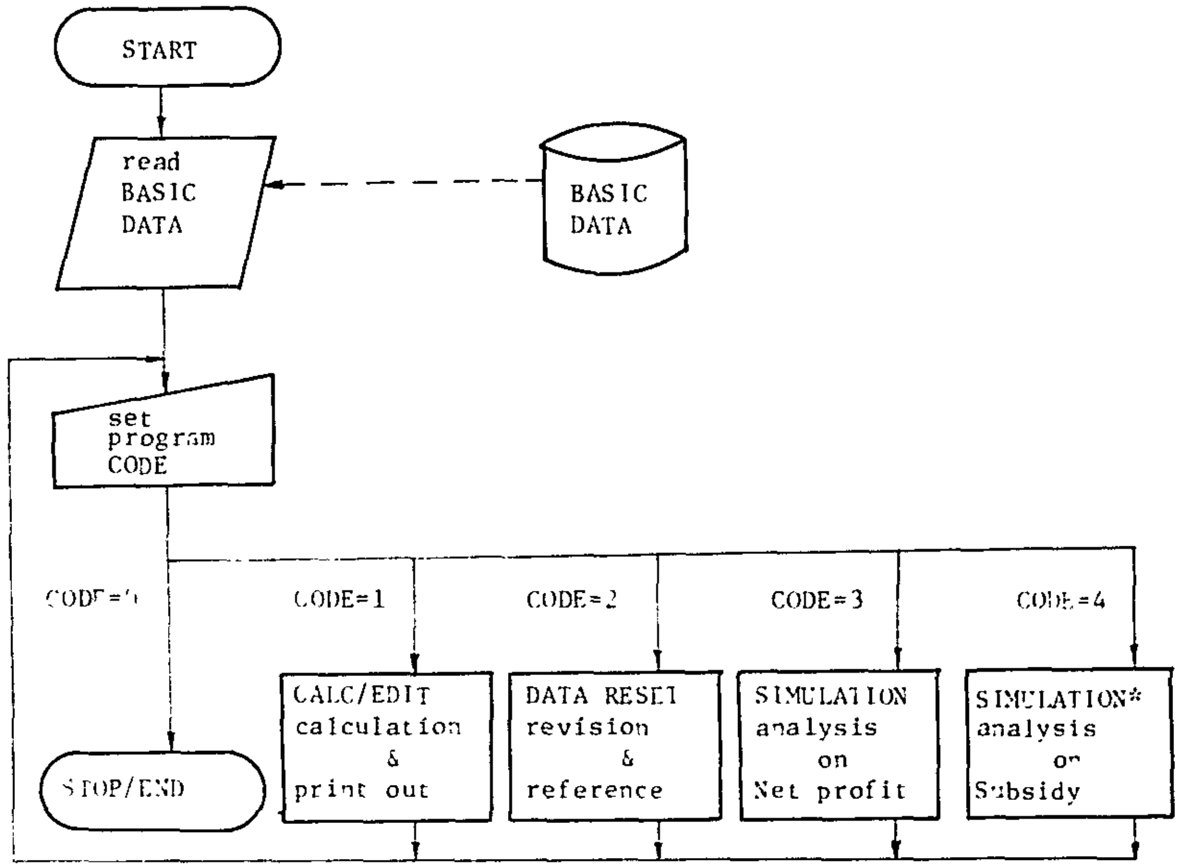
* Refer to Exhibit 8

Table 13 - 10 Impact of Inflation

Cases / Assumptions and the result of calculation		Standard Case	Inflation (1)	Inflation (2)
Assumptions about inflation		assumes 1974 Price level	Assumes 8% p.a. (74-78) and 5% p.a (78-) price level change for all revenue and costs items	Assumes 8% p.a. (74-78) 5% p.a. (78-80) and 2% p.a. (80-) price level change for revenue per ton. Price level assumptions as to other costs are same as Inflation (1)
Results of Calculation	Internal rate of return	3.7%	7.5%	3.3%
	Net profit annual government subsidy (Flow)	21.7%	44.1%	11.0%
	Government aid Flow Stock	Not necessary	Not necessary	Not necessary
	(A) Total government's equity investment	70,758 (Thousand dollars)	(70,758) 137,493 (Thousand dollars)	(70,758) 137,493 (Thousand dollars)
	(B) Total cash Surpluses (net)	68,861	(103,964) 365,921	(26,110) 83,228
	(A)-(B) Governmental Burden	1,897	(33,206) 228,428	(44,648) 54,265

* The parentheses signify the value of 1974 price level.

Exhibit 1-1 Framework of Computer Program



This program is built on MARK-III, the Time Sharing System of G.E. with international network, so that it can be handled easily by everybody. Utilizing properties of Time Sharing System, all the operations were planned to be done in conversational mode. You can enjoy the functions of this program, only by your answers to the questions computer asks.

Now we have prepared four functions in this program, but it is not so difficult to add more functions, or to revise the current ones.

Program size: 1500 steps, 24k-words (96k-bytes) at load module.

Processing time: 9 units per one case (at the standard)

Exhibit 1-2 Message and Function

Our system gets the control from O/S (OPERATIONAL SYSTEM), BASIC DATA are stored normally, and you get message at first as follows.

....

START OF JOB GUPORT/REV. 30/JY/74

....

Next, program station asks you about

'Control CODE'

PROGRAM OPTION

(0) STOP/END

(1) CALC./EDIT

(2) RESET

(3) SIMULATION 1

(4) SIMULATION 2

.... TYPE IN A PROGRAM CODE

With your type-in of CODE corresponding to the upper question, you can enjoy the function prepared as follows, as you like it.

CODE	FUNCTION
1	.... Financial items computed, you'll get SUMMARY of results. Furthermore, you can get the financial statements or the financial graph at your option.
2	.... You can change the assumed conditions with revision of INPUT DATA on the core.
3	.... You can activate the SIMULATION on the net profit, assuming the cargo in every year.
4	.... You can activate the SIMULATION* (type 2) on the subsidy, assuming the terms about borrowing.
0	.... Program STOPs/ENDs normally

Exhibit 1-3 Input Items List

(TIME SERIES DATA)

(1) Cargoes

(2) Revenue per M/T

(3) Labor cost per M/T

(4) Operation cost per M/T

(5) Maintenance cost

(6) Salaries & Wages in Fixed costs

(7) Operation cost in Fixed costs

(8) Depreciation

(9) Investment

(10) Increase of Capital equity

(11) Increase of Long-term bollowing

(SCALER DATA)

$\overline{1}$ Turnover of Current assets

$\overline{2}$ Turnover of Current liabilities

$\overline{3}$ Turnover of Deffered charges

$\overline{4}$ Averaged rate on Long-term bollowings

$\overline{5}$ Deferment term for Initial investment

$\overline{6}$ Deferment term for other investments

$\overline{7}$ Repayment term for Initial investment

$\overline{8}$ Repayment term for other investments

$\overline{9}$ Variable ratio of Administrative costs to increase of Cargoes

Exhibit 1-4

OUTPUT ITEMS LIST (1) / PROFIT & LOSS STATEMENT

(1)	Revenue	$(1)*(2)$
(2)	Costs & Expence of Operation	$(3)+(4)+(5)+(6)$
(3)	Salaries & Wages	$(1)*(3)$
(4)	Operation cost	$(1)*(4)$
(5)	Maintenance cost	(5)
(6)	Depreciation	(8)
(7)	Gross Profit	$(1)-(2)$
(8)	General & Administrative expenses	$(9)+(10)$
(9)	Salaries & Wages	$((9)_{t-1}*\bar{9}*((1)_t/(1)_{t-1}-1)+(9)_{t-1})*(1+(7)):\ t=1 \ldots (6)_1$
(10)	Operation costs	$((10)_{t-1}*\bar{9}*((1)_t/(1)_{t-1}-1)+(10)_{t-1})*(1+(7)):\ t=1 \ldots (7)_1$
(11)	Profit before Interest expenses	$(7)-(8)$
(12)	Interest expenses	Combined amount of each year's loan repayment and interest payment is assumed to be constant.
(13)	Net Profit	$(11)-(12)$
(37)*	Net Profit to Sales	$(13)/(1)$
(38)*	Net Profit to Total Assets	$(13)/(19)$
(39)*	Return on Total Capital	$(11)/((24)+(22))$
(40)*	Return on Equity	$(13)/(24)$
(49)*	Debt-service coverage	$((11)+(6))$/REPAYMENT incl. INTEREST
(41)*	Internal Rate of Return	r such as $0=\text{Sigma}\ ((11)_i+(6)_i-(9)_{i+1})/(1+r)^i$
(42)*	Profitability Index	$\text{Sigma}\ ((11)+(6))/(1+k)^i/\text{Sigma}(9)/(1+k)^{i-1}$
(43)*	Pay-back period	Min.(n:Sigma ((13)+(6)) greater than Sigma (9( )

N.B. Sigma means summation from 1 to n

OUTPUT ITEMS (2) / B/S FINANCIAL STATEMENT

(14)	Current assets	$(1)*\bar{1}$
(15)	Net fixed assets	$(16)-(17)$
(16)	Fixed assets (Gross)	Sigma (9); (from 1st to t-th)
(17)	Allowance for Depreciation	Sigma (5); (from 1st to t-th)
(18)	Deferred charges	$(1)*\bar{3}$
(19)	Total Assets	$(14)+(15)+(18)$
(20)	Current liabilities	$(1)*\bar{2}$
(21)	Short term debt	$(19)-((20)+(22)+(23))$
(22)	Long term debt	Sigma (11) − REPAYMENT (from 1st to t-th)
(23)	Share holder's equity	$(24)+(25)$
(24)	Common stock	Sigma (10); (from 1st to t-th)
(25)	Retained earnings	Sigma (13), (from 1st to t-th)
(26)	Total Liabilities	(19)
(44)*	Long term debt to Equity	(22) : (23) (22)+(23) regarded as 100
(45)*	Total Debt to Equity	((21)+(22)) : (23) (21)+(22)+(23) regarded as 100
(46)*	Total Assets turnover	$(1)/(26)$
(48)*	Max. Accumulated Subsidy	Max. $(21)_t$ every 5 ranges

OUTPUT ITEMS LIST (3) / APPLICATIONS & SOURCES OF FUNDS

(27)	Increase of Fixed Assets	$(16)_t-(16)_{t-1}$
(28)	Increase of Working Capital	$((14)-(20))_t-((14)-(20))_{t-1}$
(29)	Increase of Differed Charges	$(18)_t-(18)_{t-1}$
(30)	APPLICATIONS OF FUNDS	$(27)+(28)+(29)$
(31)	Net Profit	(13)
(32)	Depreciation	(6)
(33)	Increase of Common Stock	$(24)_t-(24)_{t-1}$
(34)	Increase of Long term Debt	$(22)_t-(22)_{t-1}$
(35)	Increase of Short term Debt	$(21)_t-(21)_{t-1}$
(36)	SOURCES OF FUNDS	$(33)+(34)+(35)+(31)+(32)$
(47)*	Max. Annual Subsidy	Max. $(35)_t$ every 5 ranges
(50)*	Subsidy & Increase of Short term Debt	$(33)+(35)$

Exhibit 2 Lives of fixed assets assumed for depreciation

Straight line method has been used for depreciation.
Lives of fixed assets related to first stage investment are assumed as below. Residual values are assumed zero.

Consequently, annual amount of depreciation amounts to approximately 2.6% of the first stage investment. This rate of annual depreciation has been also adopted for the second and the third stage investment.

Type of assets	Assumed lives of assets (years)	First stage investment (thousand dollars)
Breakwater	50	18,900
Quaywall	50	6,580
Dredging	50	13,970
Shore Protection	30	2,060
Transit Shed	20	2,720
Warehouse	20	1,820
Tug boat	15	1,620
Temporary Breakwater	30	930
Engineering & Supervision	15	670
Dock Road	50	1,380
Cargo handling equip.	25	1,460
Open Storage Yard	50	910
Admini. buildings and installations	50	500
Drinking water supply	50	500
Sewer System	30	600
Installations	20	160

Exhibit 3

PROFIT & LOSS STATEMENT

```
IRR =  3.73 %            (INTERNAL RATE OF RETURN)
PI  =  1.68 (K= 0.%)     (PROFITABILITY INDEX)
       0.96 (K= 4.%)
       0.58 (K= 8.%)
       0.47 (K=10.%)
       0.29 (K=15.%)
       0.19 (K=20.%)
N   =   27 YEARS         (PAYBACK PERIOD)
```

(thouand dollars)

	1	2	3	4	5	6	7	8	9	10	15	20	25	TOTAL
REVENUE	5112.	5368.	5636.	5918.	6214.	6524.	6851.	7193.	7553.	7930.	10121.	12918.	16487.	243981.
COSTS OF OPERATION	2844.	3997.	4066.	4139.	4215.	4295.	4380.	4468.	4561.	4659.	5225.	7034.	7956.	138061.
SALA. & WAGES	1065.	1118.	1174.	1233.	1295.	1359.	1427.	1499.	1573.	1652.	2109.	2691.	3435.	50829.
OPERATION COST	256.	268.	282.	296.	311.	326.	343.	360.	378.	397.	506.	646.	824.	12199.
MAINT. COST	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	450.
DEPRECIATION	1505.	2592.	2592.	2592.	2592.	2952.	2592.	2592.	2592.	2592.	2592.	3679.	3679.	74583.
GROSS PROFIT	2268.	1371.	1570.	1779.	1998.	2229.	2471.	2725.	2992.	3272.	4897.	5884.	8531.	105920.
ADMINI. EXPENSES	315.	320.	325.	329.	334.	339.	344.	350.	355.	360.	388.	418.	450.	9470.
SALA. & WAGES	175.	178.	180.	183.	186.	189.	191.	194.	197.	200.	216.	232.	250.	5261.
OPERATION COST	140.	142.	144.	146.	149.	151.	153.	155.	158.	160.	172.	186.	200.	4209.
PROFIT BFR INTEREST	1953.	1051.	1245.	1450.	1664.	1890.	2126.	2375.	2637.	2912.	4589.	5466.	8080.	96450.
INTEREST EXPENSES	1448.	2493.	2493.	2493.	2437.	2378.	2316.	2203.	2084.	1959.	1234.	1355.	836.	43519.
NET PROFIT	506.	-1441.	-1247.	-1043.	-773.	-488.	-190.	172.	553.	953.	3274.	4111.	7244.	52930.
N.PRO./SALES	9.9	-26.9	-22.1	-17.6	-12.4	-7.5	-2.8	2.4	7.3	12.0	32.4	31.8	43.9	21.7
N.PRO./ASSETS	0.9	-1.5	-1.3	-1.1	-0.9	-0.6	-0.2	0.2	0.7	1.2	5.1	4.6	10.2	2.7
***RET.ON CAPITAL**	3.4	1.1	1.2	1.5	1.7	2.0	2.3	2.6	3.0	3.4	6.3	5.8	9.4	4.4
RET.ON EQUITY	1.7	-2.9	-2.5	-2.1	-1.5	-1.0	-0.4	0.3	1.1	1.9	6.6	5.8	10.2	3.2
COVERAGE	0.	0.	0.	157.4	165.7	174.5	103.0	108.4	114.1	120.1	155.0	199.6	583.9	

Exhibit 4

Cost structure of standard case

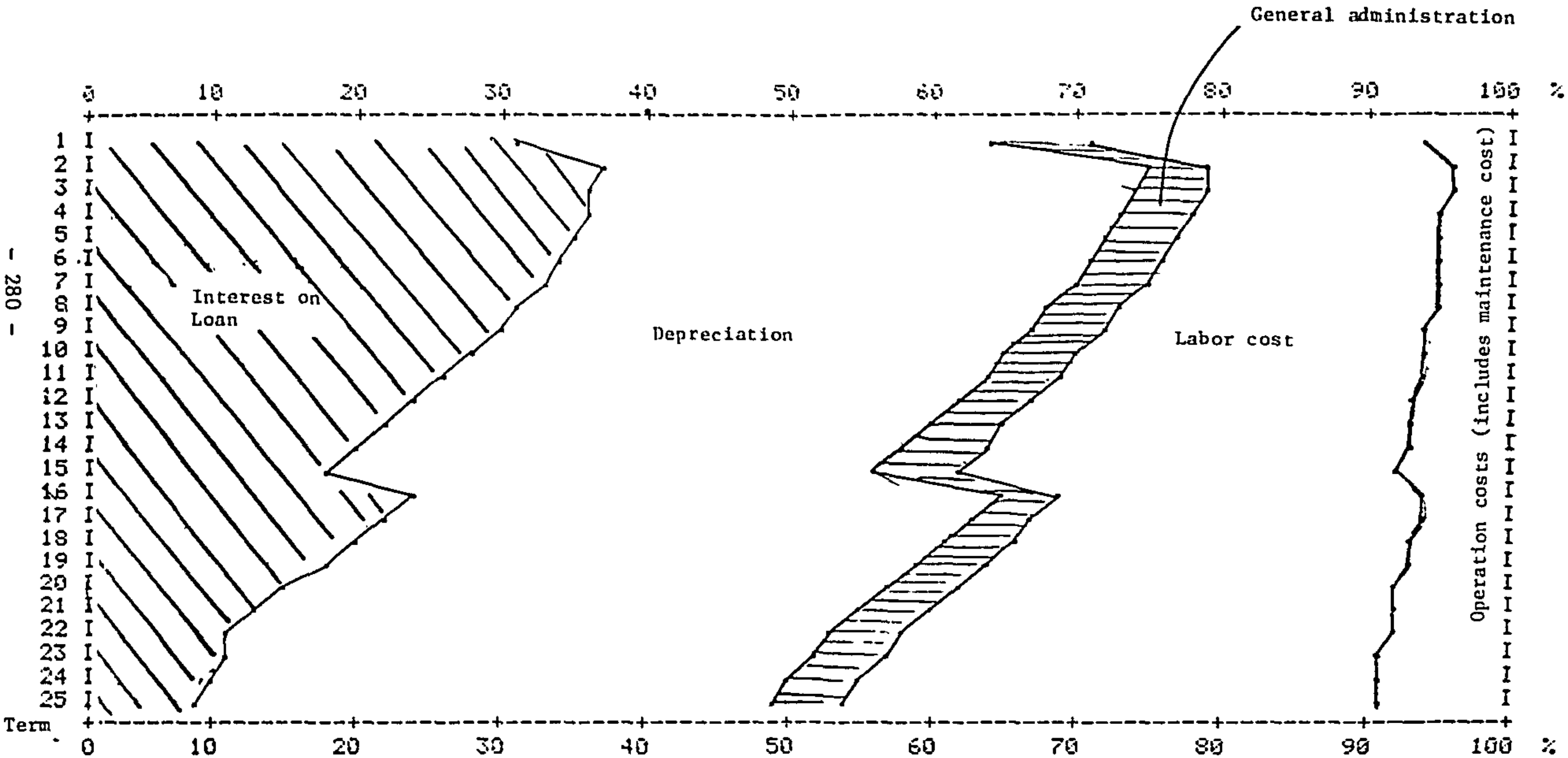


Exhibit 5

Applications & sources of funds
(Standard Case)

APPLICATIONS & SOURCES OF FUNDS

(thousand dollars)

***MAX.ANNUAL SUB.** 0. OPEN

	1-5	6-10	11-15	16-20	21-25
FIXED ASSETS *	99708.	0.	0.	41807.	0.
WORKING CAPITAL *	1249.	345.	440.	562.	717.
DEFERR. CHARGES *	50.	14.	18.	22.	29.
APRIL. OF FUNDS	101007.	359.	458.	42391.	746.
NET PROFIT	-3998.	1000.	11500.	14326.	30103.
DEPRECIATION	11873.	12960.	12960.	18395.	18395.
COMMON STOCK *	49854.	0.	0.	20904.	0.
LONG-T.DEBT *	47557.	-11001.	-15217.	1481.	-7271.
GOV. SUBSIDY *	-4279.	-2601.	-8785.	-12715.	-40481.
SOURCES OF FUNDS	101007.	359.	458.	42391.	746.
***MAX.ANNUAL SUB.**	0.	0.	0.	0.	0.
GOV.SUB. + C/S	45575.	-2601.	-8785.	8189.	-40481.

Exhibit 6-1

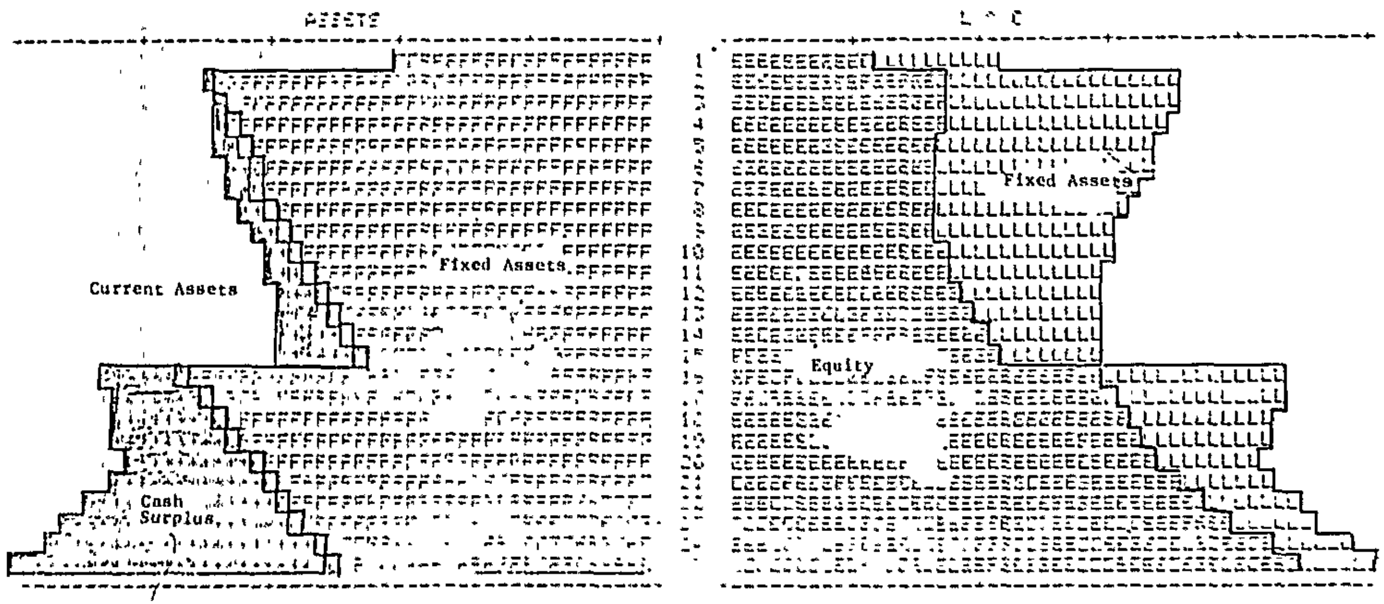
Pro-Forma Balance Sheet of Standard Case

(thousand dollar)

	1	2	3	4	5	10	15	20	25
CURRENT ASSETS	1268.	1331.	1398.	1468.	1541.	1967.	2510.	3204.	4089.
NET FIXED ASSETS	56395.	95611.	93019.	90427.	87835.	74875.	61915.	85327.	66932.
F.ASSETS(GROSS)	57900.	99708.	99708.	99708.	99708.	99708.	99708.	141515.	141515.
DEPRE.(ALLOWANCE)	1505.	4097.	6689.	9281.	11873.	24833.	37793.	56188.	74583.
DEFERRED CHARGES	41.	43.	45.	47.	50.	63.	81.	103.	132.
TOTAL ASSETS	57704.	96985.	94462.	91942.	89426.	76905.	64506.	88634.	71153.
CURRENT LIABILITIES	240.	252.	265.	278.	292.	373.	476.	607.	775.
GOV. SUBSIDY	-942.	-2040.	-3328.	-3698.	-4279.	-6880.	-15665.	-28380.	-68861.
LONG-TERM DEBT	28950.	49854.	49854.	48734.	47557.	36557.	21340.	22821.	15550.
OWNER'S EQUITY	29456.	48918.	47671.	46628.	45856.	46856.	58356.	93586.	123688.
COMMON STOCK	28950.	49854.	49854.	49854.	49854.	49854.	49854.	70785.	70758.
RETAINED EARNINGS	506.	-936.	-2183.	-3226.	-3998.	-2998.	8502.	22828.	52930.
TOTAL LIABILITIES	57704.	96985.	94462.	91942.	89426.	76905.	64506.	88634.	71153.
L.DEBT/EQUITY	50.: 50	50.: 50.	51.: 49.	51.: 49.	51.: 49.	44.: 56.	27.: 73.	20.: 80.	11.: 89.
T.DEBT/EQUITY	49.: 51	49.: 51.	49.: 51.	49.: 51.	51.: 49.	39.: 61.	9.: 91.	0.:100.	0.:100.
***T.ASSETS/T'OVER**	8.9	5.5	6.0	6.4	6.9	10.3	15.7	14.6	23.2
MAX.ACCU.SUB.					0.	0.	0.	0.	0.

Exhibit 6-2

Illustration of standered case balance sheet



Note: F... Fixed assets
C... Current assets

E... Owner's eqity
L... Long term debt
C... Current liabilitiee
*... Government subsidy (when listed on credit side)
Cash acquired through operation (when listed on debit side)

Exhibit 7-1

Loan maturity and Government subsidy required ......(1)

Maximum annual government subsidy (flow)
Maximum accumulated government subsidy (stock)

Rate of governments equity investment 50%
Revenue per ton $ 12

Maturity of the loan (after
5 years grace period

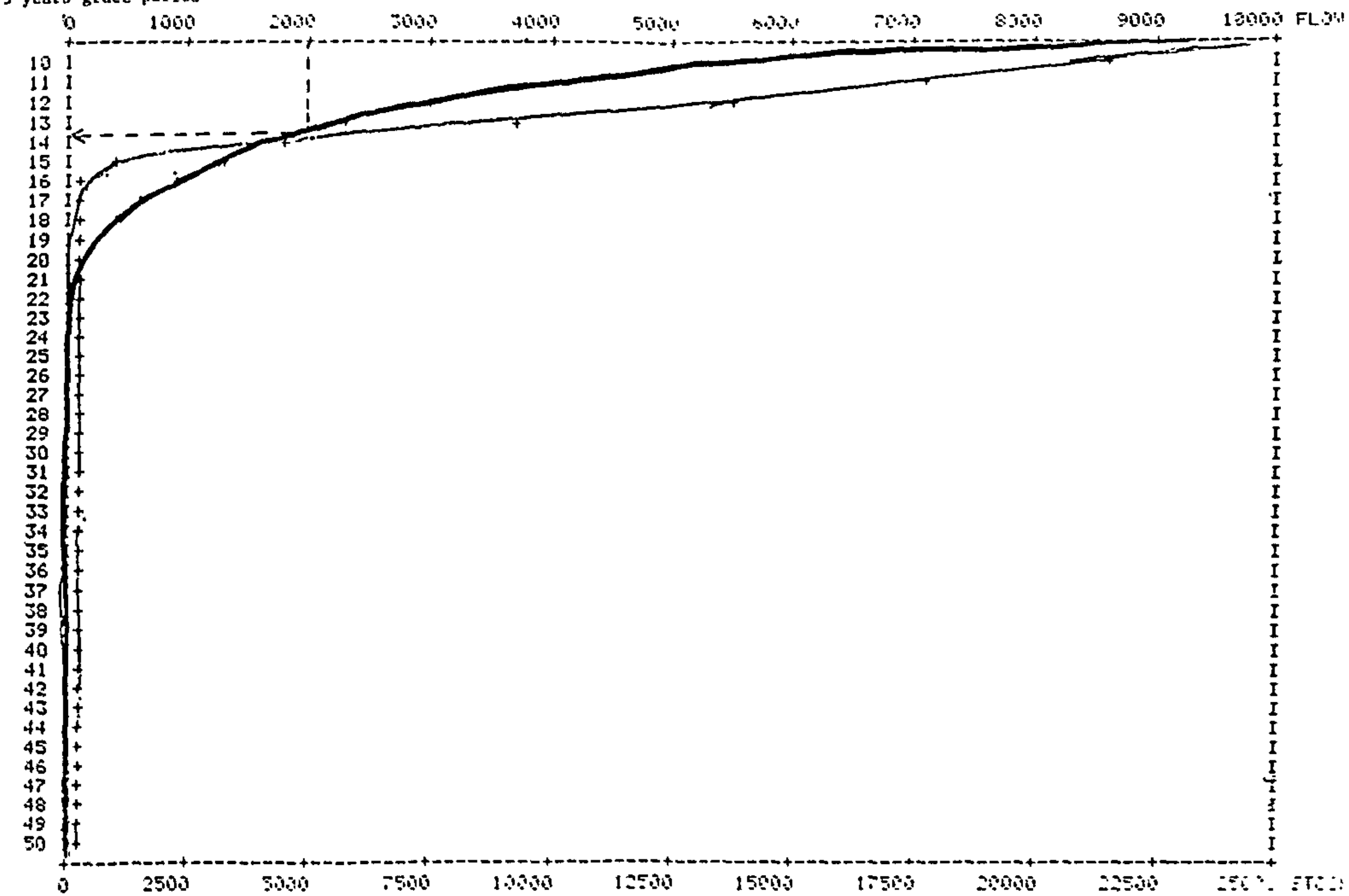


Exhibit 7-2

Loan maturity and Government subsidy required (2)

Maximum annual government subsidy (flow)

Maximum accumulated government subsidy (stock)

Rate of government equity investment 33.3%

Revenue per ton $ 12

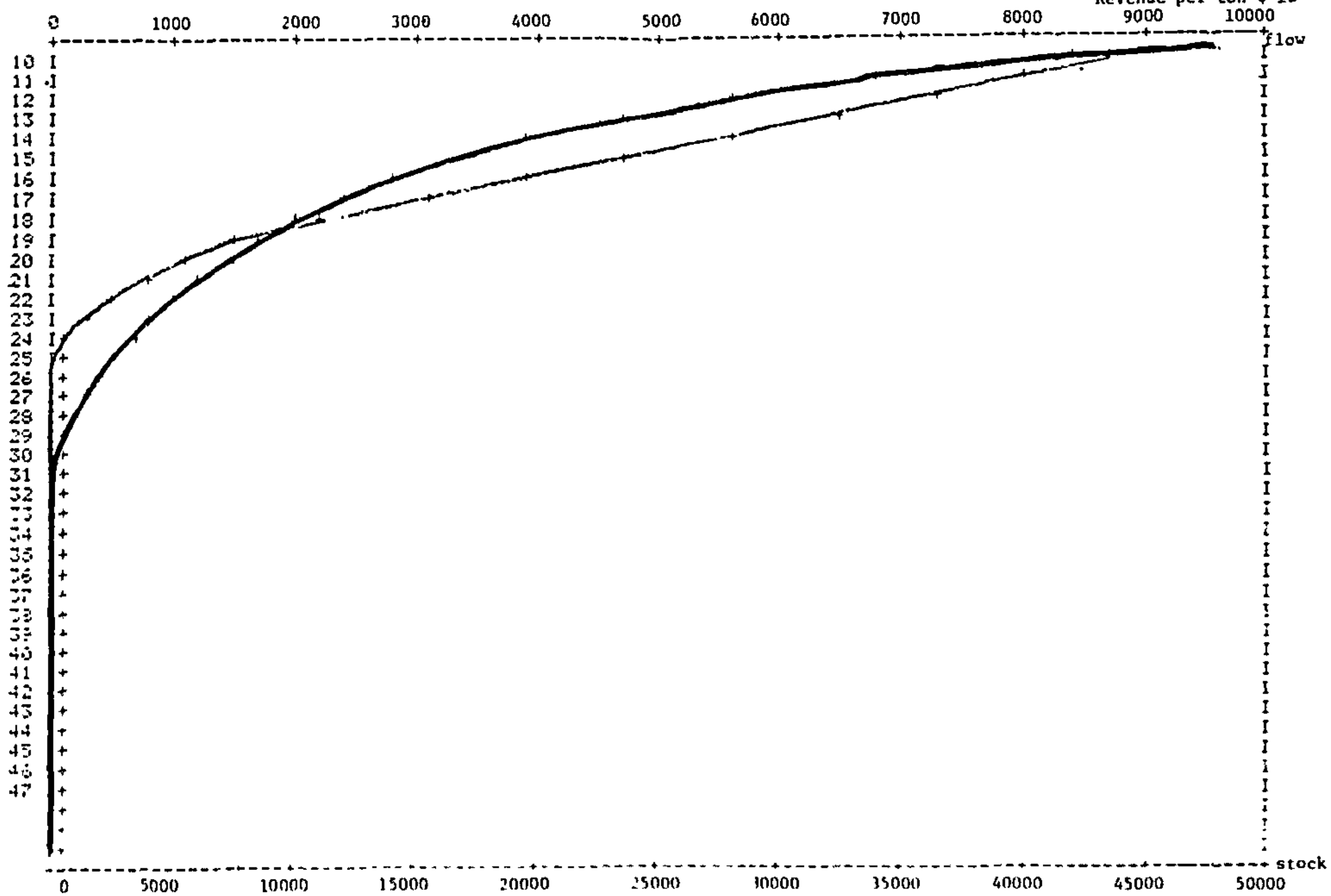


Exhibit 8 Various growth estimate of cargo handling activity and need for capacity increase

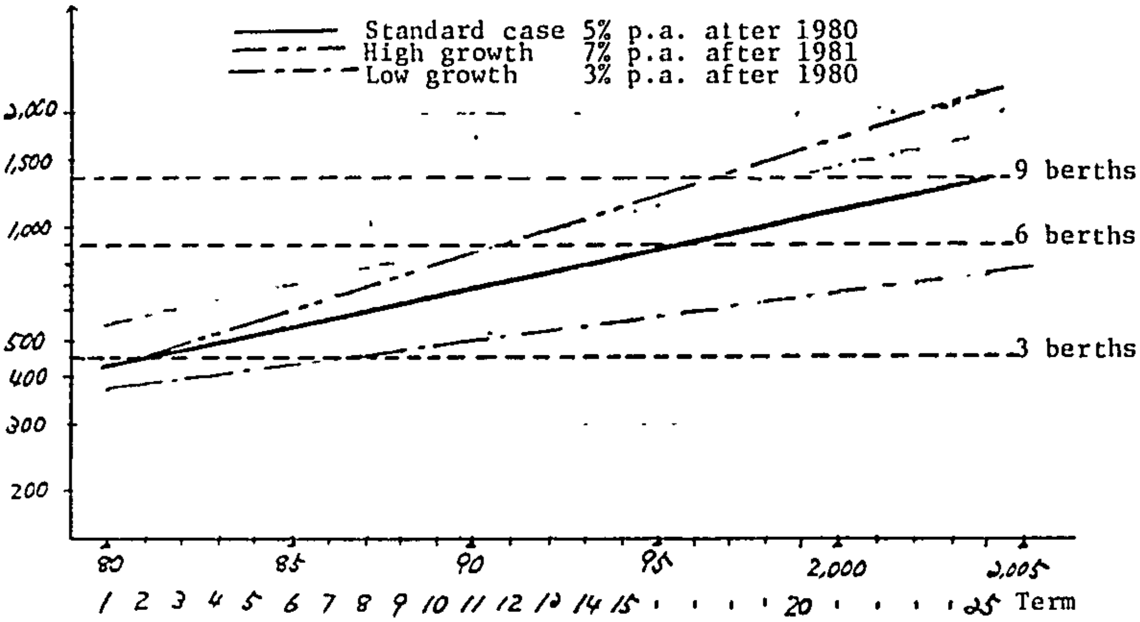


Exhibit 9 Financial conditions of the project when government's equity investment is 33%

Case A: Revenue per ton is assumed as $10

Case B: Revenue per ton is assumed as $12

Each case shows the following summarys and analyses.

(1) Financial ratios for Sensitivity Analysis

(2) Investment Pattern

(3) Government subsidy (annual)

(4) Pro Forma Income Statement
(Profit and Loss Statement)

(5) Pro Forma Balance Sheet

(6) Pro Forma Funds Statement
(Applications & Sources of Funds)

(7) Loan Maturity and Government Subsidy required
[Case A only. Case B's is shown in Exhibit 7-2.]

Exhibit - 9 (Case A) (1) FINANCIAL RATIOS FOR S/A

** NET PROFIT	
1	-829.
2	-3164.
3	-3014.
4	-2857.
5	-2617.
6	-2365.
7	-2100.
8	-1758.
9	-1398.
10	-1020.
15	1178.
20	1507.
25	4217.
TOTAL	-2198.

** NET PROFIT TO SALES	-1.1 %
** NET PROFIT TO TOTAL ASSETS	0.0 %
** INTERNAL RATE OF RETURN	2.3 %
** PROFITABILITY INDEX (4%)	0.78
(8%)	0.46
** MAX. ANNUAL SUBSIDY	7th year $2,583M
** MAX. ACCUMULATED SUBISDY	20th year $28,187M

(2) INVESTMENT PATTERN

(thousand dollars)

TERM	1	2	16
TOTAL INVESTMENT	57900.	41808.	41807.
INCREASE OF CAPITAL	19300.	13936.	13936.
LONG TERM DEBT	38600.	27812.	27871.

(3) GOVERNMENT SUBSIDY

(thousand dollars)

1	214.	676.	469.	1808.	1645.
6	1474.	2583.	2394.	2196.	1987.
11	1768.	1537.	1295.	1041.	773.
16	1886.	1591.	1281.	955.	612.
21	-1880.	-4937.	-5334.	-5751.	-6190.

(4) PROFIT & LOSS STATEMENT

```
IRR =  2.26 %          (INTERNAL RATE OF RETURN)
PI  =  1.39 (K= 0.%)   (PROFITABILITY INDEX)
       0.78 (K= 4.%)
       0.46 (K= 8.%)
       0.37 (K=10.%)
       0.22 (K=15.%)
       0.15 (K=20.%)
N   =  34 YEARS        (PAYBACK PERIOD)
```

(thousand dollars)

	1	2	3	4	5	6	7	8	9	10	15	20	25	TOTAL
REVENUE	4260.	4473.	4697.	4931.	5178.	5437.	5709.	5994.	6294.	6609.	8435.	10765.	13739.	203317.
COSTS OF OPERATION	2844.	3997.	4066.	4139.	4215.	4295.	4380.	4468.	4561.	4659.	5225.	7034.	7956.	138061.
SALA. & WAGES	1065.	1118.	1174.	1233.	1295.	1359.	1427.	1499.	1573.	1652.	2109.	2691.	3435.	50829.
OPERATION COST	256.	268.	282.	296.	311.	326.	343.	360.	378.	397.	506.	646.	824.	12199.
MAINT. COST	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	450.
DEPRECIATION	1505.	2592.	2592.	2592.	2592.	2592.	2592.	2592.	2592.	2592.	2592.	3679.	3679.	74583.
GROSS PROFIT	1416.	476.	631.	793.	963.	1142.	1329.	1526.	1733.	1950.	3210.	3731.	5783.	65256.
ADMINI.EXPENSES	315.	320.	325.	329.	334.	339.	344.	350.	355.	360.	388.	418.	450.	9470.
SALA. & WAGES	175.	178.	180.	183.	186.	189.	191.	194.	197.	200.	216.	232.	250.	5261.
OPERATION COST	140.	142.	144.	146.	149.	151.	153.	155.	158.	160.	172.	186.	200.	4209.
PROFIT BFR INTEREST	1101.	157.	306.	463.	629.	802.	985.	1176.	1378.	1590.	2822.	3313.	5333.	55786.
INTEREST EXPENSES	1930.	3321.	3321.	3321.	3246.	3167.	3085.	2934.	2776.	2609.	1644.	1806.	1115.	57984.
NET PROFIT	-829.	-3164.	-3014.	-2857.	-2617.	-2365.	-2100.	-1758.	-1398.	-1020.	1178.	1507.	4217.	-2198.
N.PRO./SALES	-19.5	-70.7	-64.2	-57.9	-50.5	-43.5	-36.8	-29.3	-22.2	-15.4	14.0	14.0	30.7	-1.1
N.PRO./ASSETS	-1.4	-3.3	-3.2	-3.1	-2.9	-2.7	-2.5	-2.2	-1.8	-1.3	1.8	1.7	6.0	0.0
***RET.ON CAPITAL**	1.9	0.2	0.3	0.5	0.7	0.8	1.1	1.3	1.6	1.9	4.6	4.3	7.9	3.0
RET.ON EQUITY	-4.3	-9.5	-9.1	-8.6	-7.9	-7.1	-6.3	-5.3	-4.2	-3.1	3.5	3.2	8.9	-1.0
COVERAGE	0.	0.	0.	89.2	94.1	99.1	58.6	61.7	65.0	68.5	88.7	114.6	335.6	

(5) B/S FINANCIAL STATEMENT

(thousand dollars)

	1	2	3	4	5	10	15	20	25
CURRENT ASSETS	1056.	1109.	1165.	1223.	1284.	1639.	2092.	2670.	3407.
NET FIXED ASSETS	56395.	95611.	93019.	90427.	87835.	74875.	61915.	85327.	66932.
F.ASSETS(GROSS)	57900.	99708..	99708.	99708.	99708.	99708.	99708.	141515.	141515.
DEPRE.(ALLOWANCE)	1505.	4097.	6689.	9281.	11873.	24833.	37793.	56188.	74583.
DEFERRED CHARGES	34.	36.	38.	39.	41.	53.	67.	86.	110.
TOTAL ASSETS	57486.	96756.	94221.	91689.	89161.	76567.	64074.	88083.	70449.
CURRENT LIABILITIES	200.	210.	221.	232.	243.	311.	396.	506.	646.
GOV. SUBSIDY	214.	890.	1360.	3168.	4813.	15449.	21863.	28187.	4095.
LONG-TERM DEBT	38600.	66412.	66412.	64918.	63350.	48694.	28423.	30423.	20734.
OWNER'S EQUITY	18471.	29243.	26229.	23372.	20754.	12113.	13391.	28966.	44974.
COMMON STOCK	19300.	33236.	33236.	33236.	33236.	33236.	33236.	47172.	47172.
RETAINED EARNINGS	-829.	-3993.	-7007.	-9864.	-12482.	-21123.	-19845.	-18206.	-2198.
TOTAL LIABILITIES	57486.	96756.	94221.	91689.	89161.	76567.	64074.	88083.	70449.
L.DEBT /EQUITY	68.: 32.	69.: 31.	72.: 28.	74.: 26.	75.: 25.	80.: 20.	68.: 32.	51.: 49.	32.: 68.
T.DEBT /EQUITY	68.: 32.	70.: 30.	72.: 28.	74.: 26.	77.: 23.	84.: 16.	79.: 21.	67.: 33.	36.: 64.
***T.ASSETS/T'OVER**	7.4	4.6	5.0	5.4	5.8	8.6	13.2	12.2	19.5
MAX.ACCU.SUB.					4813.	15449.	21863.	28187.	26308.

(6) APPLICATIONS & SOURCES OF FUNDS

***MAX.ANNUAL SUB.** 2583. 7th year

	1-5	6-10	11-15	16-20	21-25
FIXED ASSETS *	99708.	0.	0.	41807.	0.
WORKING CAPITAL *	1041.	288.	367.	468.	598.
DEFERR. CHARGES *	41.	11.	15.	19.	24.
APPLI. OF FUNDS	100790.	299.	382.	42294.	622.
NET PROFIT	-12482.	-8641.	1278.	1639.	16008.
DEPRECIATION	11873.	12960.	12960.	18395.	18395.
COMMON STOCK *	33236.	0.	0.	13936.	0.
LONG-T.DEBT *	63350.	-14655.	-20271.	1999.	-9689.
GOV. SUBSIDY *	4813.	10635.	6415.	6324.	-24092.
SOURCES OF FUNDS	100790.	299.	382.	42294.	622.
***MAX.ANNUAL SUB.::	1808.	2583.	1768.	1886.	0.
GOV. SUB. + C/S	38049.	10635.	6415.	20260.	-24092.

(7) LOAN MATURY AND GOVERNMENT SUBSIDY REQUIRED

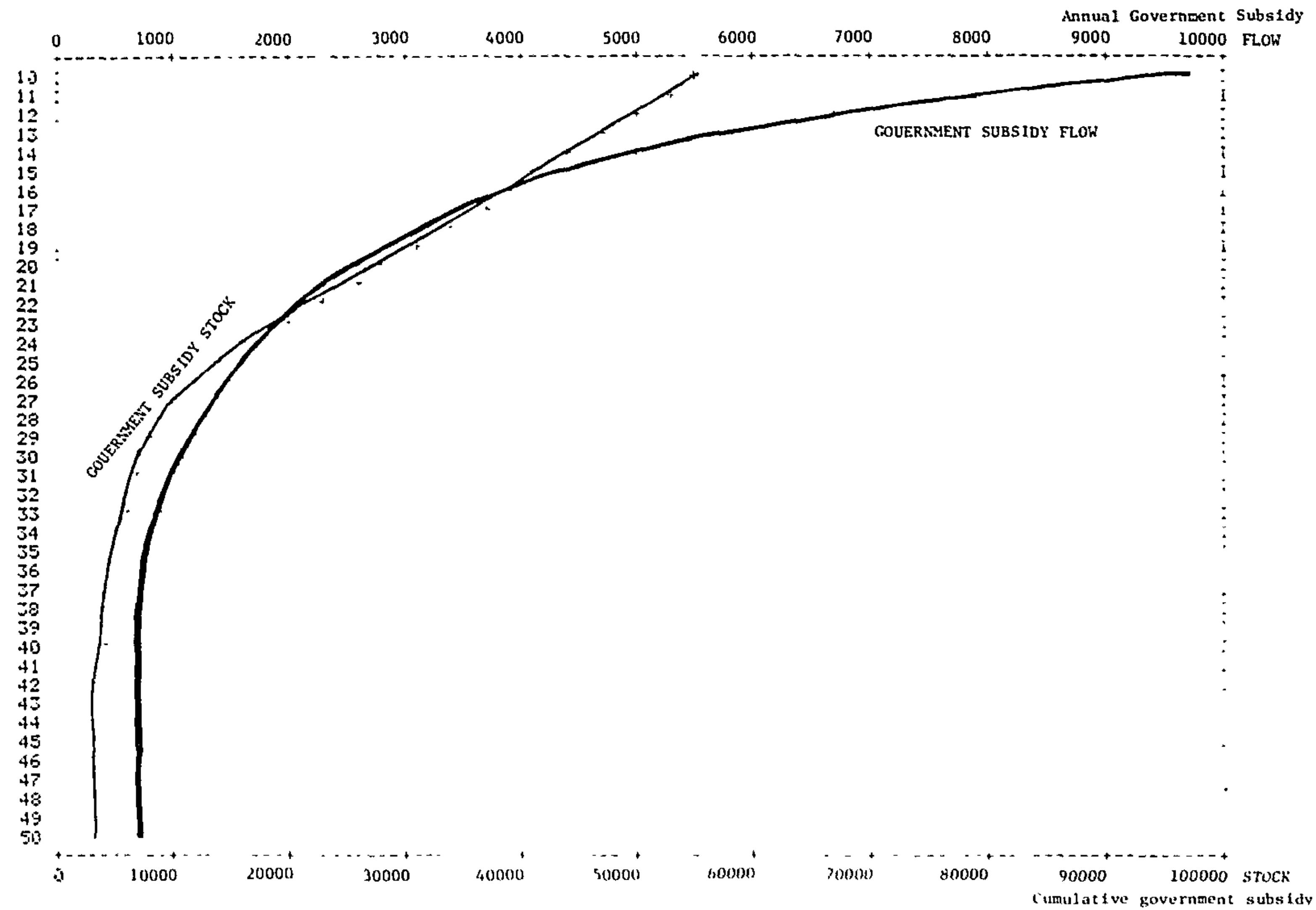


Exhibit - 9 (Case B) (1) FINANCIAL RATIOS FOR S/A

(thousand dollars)

** NET PROFIT	
1	23.
2	-2269.
3	-2075.
4	-1871.
5	-1582.
6	-1278.
7	-959.
8	-559.
9	-139.
10	302.
15	2865.
20	3660.
25	6965.
TOTAL	38466.

** NET PROFIT TO SALES	15.8%
** NET PROFIT TO TOTAL ASSETS	2.0%
** INTERNAL RATE OF RETURN	3.7%
** PROFITABTLITY INDEX (4%)	0.96
(8%)	0.58
** MAX. ANNUAL SUBSIDY	7th year $1,453M
** MAX. ACCUMULATED SUBISDY	12th year $5,497M

(2) INVESTMENT PATTERN

(thousand dollars)

TERM	1	2	16
TOTAL INVESTMENT	57900.	41808.	41807.
INCREASE OF CAPITAL	19300.	13936.	13936.
LONG TERM DEBT	38600.	27812.	27871.

(3) GOVERNMENT SUBSIDY (ANNUAL)

GOVERNMENT SUBSIDY

(thousand dollars)

1	-460.	-209.	-461.	832.	620.
6	398.	1453.	1208.	950.	679.
11	394.	95.	-220.	-550.	-897.
16	132.	-251.	-653.	-1075.	-1519.
21	-4118.	-7287.	-7802.	-8342.	-8910.

(4) PROFIT & LOSS STATEMENT

```
IRR = 3.73%              (INTERNAL RATE OF RETURN)
PI  = 1.68 (K= 0.%)      (PROFITABILITY INDEX)
      0.96 (K= 4.%)
      0.58 (K= 8.%)
      0.47 (K=10.%)
      0.29 (K=15.%)
      0.19 (K=20.%)
N   =  28  YEARS         (PAYBACK PERIOD)
```

(thousand dollars)

	1	2	3	4	5	6	7	8	9	10	15	20	25	TOTAL
REVENUE	5112.	5368.	5636.	5918.	6214.	6524.	6851.	7193.	7553.	7930.	10121.	12918.	16487.	243981.
COSTS OF OPERATION	2844.	3997.	4066.	4139.	4215.	4295.	4380.	4468.	4561.	4659.	5225.	7034.	7956.	138061.
SALA. & WAGES	1065.	1118.	1174.	1233.	1295.	1359.	1427.	1499.	1573.	1652.	2109.	2691.	3435.	50829.
OPERATION COST	256.	268.	282.	296.	311.	326.	343.	360.	378.	397.	506.	646.	824.	12199.
MAINT. COST	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	450.
DEPRECIATION	1505.	2592.	2592.	2592.	2592.	2592.	2592.	2592.	2592.	2592.	2592.	3679.	3679.	74583.
GROSS PROFIT	2268.	1371.	1570.	1779.	1998.	2229.	2471.	2725.	2992.	3272.	4897.	5884.	8531.	105920.
ADMINI. EXPENSES	315.	320.	325.	329.	334.	339.	344.	350.	355.	360.	388.	418.	450.	9470.
SALA. & WAGES	175.	178.	180.	183.	186.	189.	191.	194.	197.	200.	216.	232.	250.	5261.
OPERATION COST	140.	142.	144.	146.	149.	151.	153.	155.	158.	160.	172.	186.	200.	4209.
PROFIT BFR INTEREST	1953.	105.	1245.	1450.	1664.	1890.	2126.	2375.	2637.	2912.	4509.	5466.	8080.	96450.
INTEREST EXPENSES	1930.	3321.	3321.	3321.	3246.	3167.	3085.	2934.	2776.	2609.	1644.	1806.	1115.	57984.
NET PROFIT	23.	-2269.	-2075.	-1871.	-1582.	-1278.	-959.	-559.	-139.	302.	2865.	3660.	6965.	38466.
N.PRO./SALES	0.5	-42.3	-36.8	-31.6	-25.5	-19.6	-14.0	-7.8	-1.8	3.8	28.3	28.3	42.2	15.8
N.PRO./ASSETS	0.0	-2.3	-2.2	-2.0	-1.8	-1.5	-1.1	-0.7	-0.2	0.4	4.4	4.1	9.8	2.0
***RET.ON CAPITAL**	3.4	1.1	1.2	1.5	1.7	2.0	2.3	2.7	3.1	3.6	7.3	7.0	11.9	5.1
RET.ON EQUITY	0.1	-6.8	-6.2	-5.6	-4.8	-3.8	-2.9	-1.7	-0.4	0.9	8.6	7.8	14.8	3.2
COVERAGE	0.	0.	0.	118.0	124.3	130.9	77.3	81.4	85.7	90.2	116.3	149.8	437.9	

(5) B/S FINANCIAL STATEMENT

	1	2	3	4	5	10	15	20	25
CURRENT ASSETS	1268.	1331.	1398.	1468.	1541.	1967.	2510.	3204.	4089.
NET FIXED ASSETS	56395.	95611.	93019.	90427.	87835.	74875.	61915.	85327.	66932.
F.ASSETS(GROSS)	57900.	99708.	99708.	99708.	99708.	99708.	99708.	141515.	141515.
DEPRE.(ALLOWANCE)	1505.	4097.	6689.	9281.	11873.	24833.	37793.	56188.	74583.
DEFERRED CHARGES	41.	43.	45.	47.	50.	63.	81.	103.	132.
TOTAL ASSETS	57704.	96985.	94462.	91942.	89426.	76905.	64506.	88634.	71153.
CURRENT LIABILITIES	240.	252.	265.	278.	292.	373.	476.	607.	775.
GOV. SUBSIDY	-460.	-669.	-1130.	-298.	322.	5008.	3831.	465.	-35994.
LONG-TERM DEBT	38600.	66412.	66412.	64918.	63350.	48694.	28423.	30423.	20734.
OWNER'S EQUITY	19323.	30990.	28915.	27044.	25462.	22830.	31776.	57139.	85638.
COMMON STOCK	19300.	33236.	33236.	33236.	33236.	33236.	33236.	47172.	47172.
RETAINED EARNINGS	23.	-2246.	-4321.	-6192.	-7774.	-10406.	-1460.	9967.	38466.
TOTAL LIABILITIES	57704.	96985.	94462.	91942.	89426.	76905.	64506.	88634.	71153.
L.DEBT /EQUITY	67.: 33.	68.: 32.	70.: 30.	71.: 29.	71.: 29.	68.: 32.	47.: 53.	35.: 65.	19.: 81.
T.DEBT /EQUITY	66.: 34.	68.: 32.	69.: 31.	70.: 30.	71.: 29.	70.: 30.	50.: 50.	35.: 65.	0.:100.
***T.ASSETS/T'OVER**	8.9	5.5	6.0	6.4	6.9	10.3	15.7	14.6	23.2
MAX.ACCU.SUB.					322.	5008.	5497.	3963.	0.

(6) APPLICATIONS & SOURCES OF FUNDS

***MAX. ANNUAL SUB.** 1453. 7th year

		1- 5	6-10	11-15	16-20	21-25
FIXED ASSETS	*	99708.	0.	0.	41807.	0.
WORKING CAPITAL	*	1249.	345.	440.	562.	717.
DEFERR. CHARGES	*	50.	14.	18.	22.	29.
APPLI. OF FUNDS		101007.	359.	458.	42391.	746.
NET PROFIT		-7774.	-2633.	8946.	11427.	28499.
DEPRECIATION		11873.	12960.	12960.	18395.	18395.
COMMON STOCK	*	33236.	0.	0.	13936.	0.
LONG-T. DEBT	*	63350.	-14655.	-20271.	1999.	-9689.
GOV. SUBSIDY	*	322.	4687.	-1177.	-3366.	-36459.
SOURCES OF FUNDS		101007.	359.	458.	42391.	746.
***MAX. ANNUAL SUB. **		832.	1453.	394.	132.	0.
GOV.SUB. + C/S		33558.	4687.	-1177.	10570.	-36459.

CHAPTER 14. FUTURE VIEW

Chapter 14. Future View

14-1 Sipacate in the Year of 2000

14-1-1 New Port in 2000

As for new port in 2000, it is conceived that the port will become a main port in the Pacific Coast area of Guatemala by the first term project, which is to complete the port facilities and promote its activities. It also may be imagined that in 2000 the existing ports, both San José and Champerico won't be any more usable, judging from the damage seen at present, as the port will be 100 years old in that year. In new port will be concentrated the functions as a foreign trade port, a fishing base, an industrial base and an ocean-type recreation base, on the Pacific coast. Also, a modern Sipacate new town will be completed in the behind of port, with development of new port.

Construction of the new port will bring forth:

-- Encouragement of agriculture through smooth exports of agricultural products produced in abundance in the lower area of the Pacific side. Expansion of the agricultural products output by imports of fertilizer.

-- Acceleration of economic independence of Guatemala by switch of the cargo from Acajutla to the new port.

-- Saving in the transportation cost of cargo and stable supply and price-cutdown of commodities by diminishing damage on cargo during transit.

-- Acceralation of modernization such as introduction of container and roll-on-roll-off transportation system for the mode of transportation, etc. Rapid expansion of industry and commerce with modernization of the port. Therefore, increase of employment chance.

As mentioned above, centering around the new port area, the whole Guatemala will be greatly developed.

According to the forecast on change in transportation formation of exports and imports cargo centering around the new port, the change is limited to reorganization and modernization of cargo flow in the Pacific coast ports only in the first term project. However in the second and following terms the development will be on a full-scale and will exercise influence on cargo transportation of foreign trade in the whole country. For instance, in trade with Japan or far east, there will be saving of about 4 quetzals per toñ in case of using the new port instead of Santo

Tomas or Puerto Barrios in the Atlantic coast. Also, in case the agricultural products in the Pacific coast are exported to Europe, there will be saving of about 8 quetzals by routing via the new port instead of a port in the Atlantic coast even if the toll via Panama canal is paid, as in this instance the distance in inland transportation is shortened.

Naturally the network in the sea transportation is not decided upon only by the freight difference, which however has a great effect trampers. It is highly probable that by this factor mainly new routes are opened. Moreover, the opening of new routes will accelerate merchandising domestic products, which have not been exported to foreign markets, and also formation of a new industrial zone.

(1) *Scale of new port*

The new port seems to be remarkably developed, in the year of 2000. According to assumption made regarding the economic and social trend of Guatemala and the new port's hinterland and the scale of new port, it is estimated that the volume of cargo handled at the new port will be 1.5 million to 2.0 million tons. To cope with this cargo volume, the scale of new port facilities is as below:

Facilities	Scale	Remarks
Breakwaters	1,990 m	
Quay - 12 meters quay - 10 " " - 5 " "	 1 berth 9 berths 550 meters	 Fishing port facilities
Channel & Mooring basin	Depth of water -5.0 to -12m.	Main channel: -12m depth 250m width
Cargo-handling equipment	2 sets	Gantry crane
Transit shed	9	
Warehouse	6	
Land reclamation	824,000m^2	Not including land for industry and city

With consideration that the container transportation as mentioned in 14-2 will be put into practice, it is planned to construct a large berth of -12m water depth. Also, according to the plan, as for the usual liner wharf, 3 berths will be increased to 9 berths. As its result, the channel will be made minus 12 meters in depth of water and 250 meters in width, with consideration that full container ship will enter the port.

Also, with enlargement of the channel width, the breakwater will be extended and one part of breakwater must be removed. Regarding the extent of calmness of mooring basin, the same idea as shown in Chapter 6 is applied.

(2) Investment Scale of New Port (1975 ~ 2000)

The scale of investment amount required for constructing various facilities as mentioned in (1) from 1975 to 2000 is as shown in the Table-14.1. The amount is based on prices in 1975 and is in total 127 million quetzals.

Moreover in the Table-14.1 are not included the construction cost of railroad and marina and cost for adjustment of the road between Sipacate and Escuintla. As for the railroad, when the container transportation among three countries is materialized, it will become necessary to construct a railroad to be a land-bridge. Furthermore it will be indispensable to construct a marina to accomodate pleasure boats cruising in the Pacific coast from the West coast of North America to the West coast of South America and also motor boats utilizing Chiquimulilla canal as mentioned in Chapter 6, with increase in tourits who gather to buy duty-free goods available at the port as a result of making the new port the free port.

Regarding the shape of new port in the year of 2000, please refer to a map illustrating the port in that year.

14-1-2 Industrial Development of Areas Surrounding the New Port.

The present situation of industry of Guatemala, as explained in Chapter 1, indicates noticeable lag. It is the present situation that the country is only exporting agricultural products produced in abundance, especially cotton, while clothing as a industrial product is being re-imported. Under the circumstances, it is impending necessity to develop the industries, such as cotton mills, fabrics, clothing, leather, cattle feeds, flour mills, oil manufacture, etc. which are directly related to the agriculture in the hinterland. Also, it is neccessary to transform the present industries to metal and machinery industry gradually by enchancing industrial technique.

As for the scale of industrial development in the areas surrounding the new port in the year of 2000, it is expected that the industries centering around those mentioned above are arranged in the scales mentioned below.

Table-14.1 Rough Estimation of Construction Cost (1975 - 2000)

Item	Quantity	Cost(Q.1,000)
Breakwater construction deconstruction	1,990m 150m	27,560 350
Quaywall	2,930m	23,880
Dredging	12,360,000m^3	35,600
Shore protection facility	3 x 150m	2,060
Dock road	309,000m^2	4,120
Cargo handling equipment	2	3,000
Transit shed	9	8,190
Warehouse	6	5,460
Tug boat	2	1,620
Fishing facility	1	700
Temporary breakwater	100m	930
Engineering & Supervision	1	830
Land reclamation (Excluding industry & urban area)	824,000m^2	820
Pavement	390,000m^2	5,190
SUBTOTAL		119,510
Administration buildings and Installations		500
Drinking water supply system		700
Sewer system, drainage and treatment plant		600
Installations: electric, telephone, security		200
SUBTOTAL		2,500
Contingency		4,990
GRAND TOTAL		127,000

(Administration buildings and Installations, Drinking water supply system, Sewer system, drainage and treatment plant, Installations: electric, telephone, security) } This is the cost only for new port.

Kind of manufacture	Dimension of land used (unit: ha)	Amount of manufactures' shipments (unit: Million Quetzals)	Population of employes (persons)
Flour mill and oil manufacture	16	18.0	240
Cattle feeds	8	9.3	120
Cotton mills, fabrics and clothing	40	13.7	1,470
Leather	8	3.6	290
Metal products and machinery	24	14.3	1,030
Total	96	59.2	3,150

Beside the above, it is possible to bring in industries of high productivity, if improvement of technique justifies it. As the land for such industries can be formed in the low and humid area of hinterland, it is thinkable that there exists possibility of further increase in the amount of manufacturing shipments.

For development of these industries, system is now being studied, by which in the new port is set up the free zone as a free port and duty-free raw materials and semi-finished products are brought in this zone to process for exports. Now this plan is examined as follows.

While it is a merit of the free zone to earn the foreign currency by industrial activities in the zone and also increase the employment, as another merit it can be pointed out that the foreign currency is earned by depositing temporarily the goods transported among the three countries by port and inland transportation or the income of tourist industry is increased by attracting tourists who visit the port for shopping duty-free merchandise as well as tour.

As a prerequisit of being the free zone, the place for setting up the zone should be a place for transit or distribution of the country's own goods as well as those transported among three countries. In other words the free zone should be connected with the world principal routes. Moreover, regarding the industries in the free zone, the industrialization in the country and also countries in the Central America and their competing position with the industries there should be carefully studied. Accordingly, while it is no problem to pick up the construction of free zone as one of future plans, it is necessary to study in advance various matters, such as improvement of Pan American Highway and Santo Tomoas port, etc.

14-1-3 Construction of Fishing Port and Promotion of Fishing Industry.

Regarding the construction of fishing port, in the year of 2000, the mooring basin will be made minus 5.0 meters deep for fishing boats and carrier boats of 200 G.T. class and the quay will be minus 5.0 meters deep and 550 meters long. By this construction of fishing port, it is expected that the catch will be drastically increased from the level of 8,900 tons in the year of 1980. At present it is estimated that the catch will be 30,000 to 40,000 tons in the year of 2000, which is based on the following reasons.

First of all, existence of excellent fishing grounds of tuna off the Pacific coast has been confirmed. It is imaginable that the catch of high-class fish will increase by development of the fishing grounds.

Followingly, as for the present shrimp fishing, its drastic increase cannot be expected. As small fishing boats are used in the present fishing method, shrimps only are caught and a large volume of simultaneously caught are cast away into the sea. Under this circumstances, there arises necessity of making carrier boats provided with refrigerators, which go around catcher-boats to collect miscellaneous fishes and carry to a processing plant. While the miscellaneous fishes will find ready markets as a fish-meal, it is desired that the miscellaneous fishes is used as an animal protein taking place of meat to improve the people's diet of this country.

Moreover, as a result of construction of the new port, it will be the mother port for fishing boats, conducting a very small scale fishing at present in the canal and the new port will permit these small boats to conduct fishing in the canal as well as the coast facing to the ocean, which will probably increase the catch of snappers, perches, etc.

As mentioned above, it is expected that the construction of new port will exercise various influence on the fishermen in the Pacific coast or existing fishing enterprises to bring forth development of new coastal fishing and off-shore fishing. However, as the measures for this expected development are not well prepared yet, it is necessary to establish a plan for encouraging the fishing industry as early as possible. In this plan should be included various projects, such as a subsidy scheme for building fishing boats (including carrier boats), constructing cold storages, building various processing plants, etc., improvement of distribution channels of marine products, a plan to diffuse the new fishing industry energetically by establishing an organization for fishing education and an institute for scientific research behind of the new port to aim at modernization of the fishing industry of this country. It is important to set up an official organization as early as possible and put these plans into practice smoothly and without delay.

For information, in the fishing port area of new port are secured lands for fish market, freezing and cold storages, processing plants and institutes for education and research.

14-1-4 Sipacate New City

As a result of expansion of activities and various development of new port, the population will inevitably increase and it will be necessary to build a city with modern facilities beside present Sipacate town. The minimum scale of the new city to accomodate newly increased population may be considered as below. And layout of new port and new town land utilization refer to figure at the end of this report.

(1) Population of the new city.

	Population	Remarks
Population to be planned	20,000	
Population with job	6,700	Employment rate 1/3
Industry	3,150	Ref. to 14-1-2
Commerce	750	
Fishing industry	800	
Port	2,000	Including employes of custom house, etc.

(2) The number of houses to be planned.

5,000 houses (Each house comprising 4 members of family)

(3) Plan of land utilization.

	Dimension	Remarks
Land for industry	100 ha.	Refer to 14-1-2
Residential area	350 ha.	(100%)
Housing site	200	(57%)
Park	20	(6%)
Road	70	(20%)
Site for school etc.	40	(11%)
Land for commerce, etc.	20	(6%)

(4) Water supply system.

Average volume of water-supply per day (250ℓ/day/head)	5,000m^3/day
Maximum water-supply per day (350ℓ/day/head)	7,000 "
Volume of water for fire fighting (8 hours or 1/3 of maximum water-supply per day)	2,500 "
Volume of water for industry	3,000 "

From the above estimate, the volume of water-supply is planned to be 10,000m^3/day. For the required volume, 10 to 20 wells, each capable of supplying volume of water, 500 to 1,000m^3/day, are to be sunk.

(5) Sewer system.

The confluence system is employed for the sewer. The land for sewer facilities is about 1 ha. wide. The density of drainage is kept below 200ppm for BOD and about 300ppm for suspended materials. It is necessary to prepare the drainage plan for flood outflow from the hinterland, by making use of the existing canal, to prevent the port area from the flood outflow and lessen the effect on the new port.

(6) Electric power.

As for the power required for the new city, 8,500KW is for home use and 4,500KW, for industry and other business (including offices related to port activities, cranes, etc.). For immediate use, a power station of 15,000KW class is enough. However, in view of scale merits, it is also necessary to consider a large scale power station, which can supply power to neighboring cities.

14-2 Policy for Containerization and Landbridge Plan

Among the government officials of Guatemala is now being contemplated a plan to attract the container cargoes transported among the three countries by materializing the so-called "landbridge system" through completing facilities exclusively for containers and also a broad gauge express railway between the new port and Santo Tomas de Castillo.

This project is worthy of serious study, in consideration of increasing demand for development of new routes on account of expansion of international marine transportation flow and plans for development of containerization, etc. However, it is a fact that there are various problems to se-tle before realization of the project, as explained in details below.

Under the circumstances, it seems to be a most appropriate policy at present to treat the present project as one of future plans of the new port and conduct careful analysis of the situation and close study of problems regarding future trend of international marine transportation, and formation of inland freight transportation systems, etc.

At the same time, it is important as a step for materilization of landbridge in future and as a realistic policy against the situation in the near future to prepare a system to permit the new port to complete container handling facilities ahead of other Central and South American countries to cope with containerization of cargo transported in the Pacific coast of Central America.

14-2-1 Conditions for Forming Landbridge System.

While the landbridge system is related to a plan of free zone as mentioned in 14-1, as merits of the landbridge plan are pointed out foreign currency earned by the port and railroad by attracting cargo transported among the three countries, increase in employment, completion of domestic railroad facilities to be planned by income of foreign currency, etc. However, feasibility of this project depends on whether the environment conditions as mentioned below can be arranged.

1) The mode of transportation between Far East and Japan/ Mexico, Central America and Caribbean sea and North America Pacific coast/Mexico, Central America and Caribbean sea is containerized. Even in case of break-bulk cargo, it is possible that in some special cases transportation among the three countries is made by intermediation of railway. But in general, in case of break-bulk cargo, the transportation among the three countries cannot compete with the route via Panama canal, in respects of handling cost, damage on cargo, etc. Accordingly, it may be said that without containerization the landbridge is not materialized.

2) Even in case the containerization is materialized, the landbridge should be able to compete with the route via Panama canal or other area.

3) The feeder service between Santo Tomas de Castillo and major ports in the Caribbean sea and also the same service by truck between the new port and important producing and consuming areas in the Central America are to be completed.

14-2-2 Present Situation of Transportation via Other Area.

The present situation of transportation via other area, which will compete with this landbridge plan, is as mentioned below.

1) Via Panama canal.

As for the capacity of Panama canal, at present there occurs in the canal congestion temporarily. But the congestion does not exist always. It is therefore not imaginable for the time being that the function of the canal is paralized. On the other hand, to cope with increase in the number of boats passing the canal in future, as an idea it is considered to build the second Panama canal or expand the present canal. But at present no concrete move is seen. Also there is an idea that a container terminal is built in the Critobal area to cope with containerization in future. In any case, in the trade between Far East & Japan and Caribbean sea the route via Panama canal remains to be most important in future too.

For information, the toll of Panama canal is as mentioned below and, when computed on basis of freight ton, is approximately US$1.00.

US$1.08 per net ton for laden vessel
US$0.86 per net ton for vessels in bullast

plus US$1,200 per ship for tug boat charge and other miscellaneous charge.

2) The landbridge between Pacific coast of North America and Gulf area of North America

The marine transportation between Japan and Pacific coast of North America has been completely containerized. On the other hand, there exists flow of cargo of about half million freight tons per year at present from Far East, Japan to Gulf ports of North America, which are being carried by conventional type of boats or semi-container boats via Panama canal. Moreover, beside the route via Panama canal, about 150 thousands tons of container cargo are being transported by landbridge system to Gulf area of North America via Pacific coast of North America. It is foreseen that the share of this transportation via landbridge will increase every year. Also, the cargo of about same volume is being transported from Gulf Area of North America to Japan or Far East by containers landbridge system, which comprises mainly cotton.

In case of these routes of transportation, the rail freight rate is about US$300. for a twenty-foot container and US$550. for a forty-foot container (excluding handling charge, miscellaneous expenses at the terminal).

However, at present there does not exist such a case as containers, transported from the Pacific coast to Gulf area of North America via landbridge, are shipped again and sent by sea to major ports in Caribbean sea. All the marine transportation from Far East and Japan to Caribbean sea is now via Panama canal.

3) Other areas

While in neighboring countries of Guatemala are also being studied the landbridge plans similar to Guatemala's as mentioned below, the plans are not at a concrete stage yet in all these countries.

x Mexico --- Salina Cruz-railway-Coatzacoallos.

x Elsalvador and Guatemala --- Acajutla-highway-Snato Tomas de Catillo.

x Honduras --- San Lorenzo-highway-Puerto Cortes.

14-2-3 Outlook of Containerization

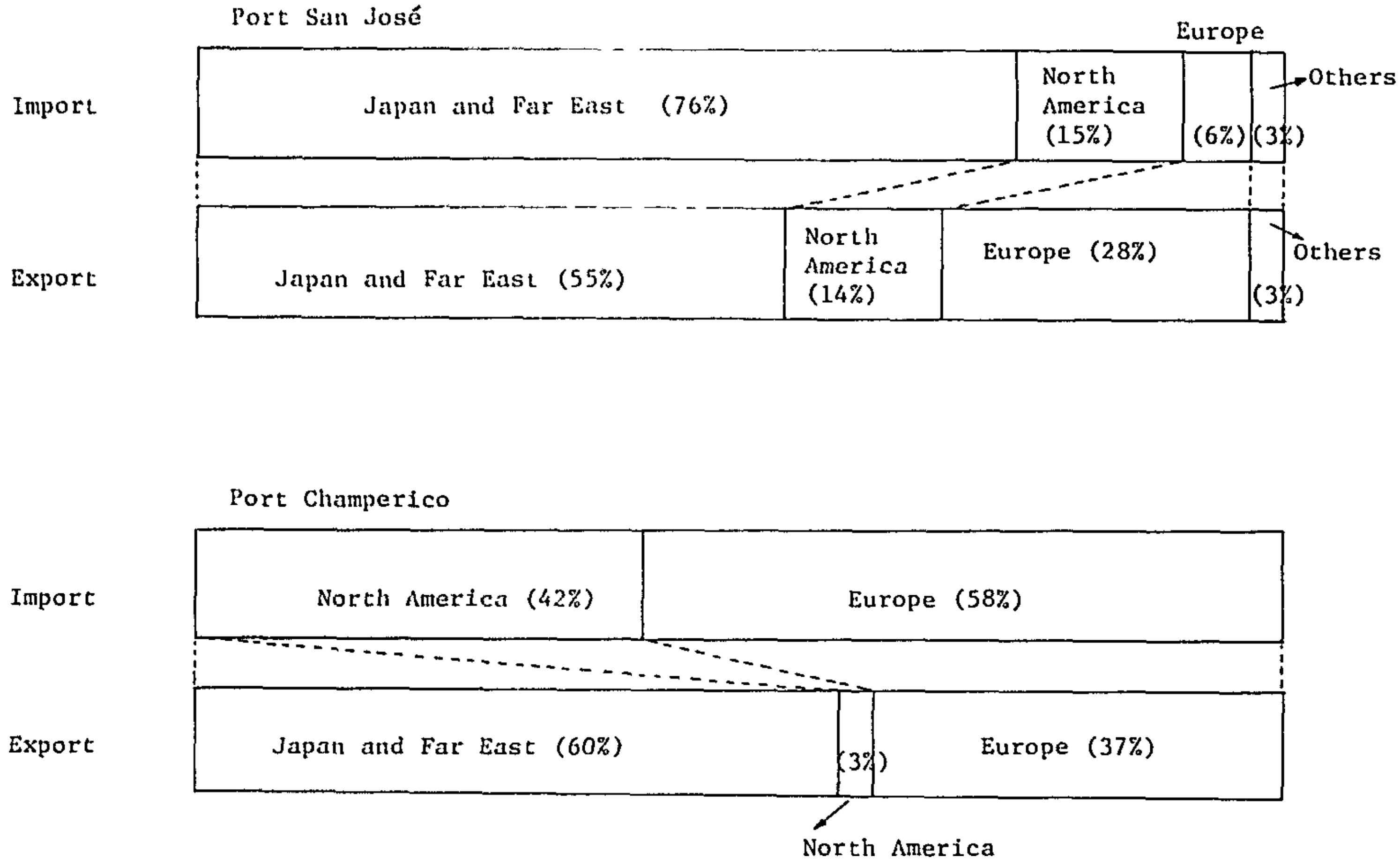
1) In analyzing the cargo handled at present at existing ports, San Jose and Champerico, according to the destination and origin, it has been found out that the trade with Japan and Far East is most important as shown in Fig.-14.1. The trade with North America and Europe follows. Therefore, in studying completion of facilities to handle containers at the new port and the landbridge plan, it is important to grasp fully the trend of changing marine transportation mode in the trade with Japan and Far East. Accordingly, comments are made on the outlook of containerization in the trade with Japan and Far East only as follows.

As for the trade with the origin of Japan, in 1968 the trade between Japan and Pacific coast of North America was containerized and as of today the containerization has been extended to the trade with Australia, Europe and Atlantic coast of North America. The containerization in the trade between Japan and developing countries is a problem of future. On the other hand, the trend of containerization in the world indicates that, while trade among developed countries in the main has been containerized, the marine transportation is still made mainly by conventional ships in the trade among developing countries and the same between developed and developing countries. As a reason for the situation, the problems of port facilities, conditions of inland transportation, etc. are pointed out. Another reason is that the exports from developing countries comprise various natural resources, agricultural products, etc., mainly, which are in the cargo shape not suitable for container transportation. In other words, the kind of cargo is an important factor in containerization. However, developing countries are rapidly transforming themselves to be an exporting country of finished or semi-finished products by industrialization. It is therefore foreseen that containerization will extend to the trade concerning developing countries with change in type of cargo. The same trend is applied to the trade between Japan and Mexico and Central America and the same between Japan and Caribbean area. Kinds and volume of cargo in these trades, related to the plan of landbridge, are analyzed below.

2) Trade between Japan and Mexico and Central America.

Annually about 600 thousands freight tons of cargo (mainly steel mill products, automobiles and general goods) are being exported from Japan to Mexico and Central American countries, while from Mexico and Central America to Japan are being exported about a million bales (about 250 thousands freight tons) of cotton, a certain quantity of coffee, cotton seed, linter, etc. However, though cotton and coffee are a primary product, they may be considered to form favorable cargo in containerization, as they can be carried by containers. It is also convenient for containeriza-

Fig.-14.1 The Origin and Destination of Foreign Trade through Port San José and Champerico



tion that cotton of Central America origin is shipped for a period of December to March and the same of Mexican origin is shipped for a period of June to November, which spreads out the time of shipment in the year.

3) Trade between Japan and Caribbean sea.

From Japan to Caribbean sea (excluding Gulf of North America and Puerto Rico of the US territory) about 1.2 million freight tons of cargo are being transported by sea, 80% of which are occupied by steel mill products and automobiles, not suitable for containerization in the type of cargo. On the other hand, from Caribbean sea to Japan there exists no cargo suitable for containerization and the trade between the two areas is in less favorable conditions than the trade between Japan and Mexico and Central America for containerization. As mentioned already, since feasibility of landbridge depends on whether or not this trade is containerized, it is in a remote future that the conditions are completed to permit formation of landbridge.

4) However, even if the composition of cargo is appropriate for containerization, in the marine transportation the switch to containerization requires investment of huge sum of capital for construction of container ships, a problem of finding a new route for conventional ships after replacement, construction of port facilities for container, etc. Therefore, in deciding upon the switch to containerization, it goes without saying that it is a prerequisite to confirm that the project will pay when comparison is made between the investment in these facilities and productivity improvement by containerization.

It is very difficult at present to forecast when the marine transportation between Japan and Mexico and Central America and the same between Japan and Caribbean sea will be containerized. But it is foreseen that the containerization is materialized at earliest in 1980 or later and it is started with semi-container ships loaded with consolidated cargo of container and non-container. Then the containerization will be developed to the full extent, with a result that non-container cargo such as steel mill products, motor cars, etc. will be carried by ships for exclusive use of each cargo for rationalization of transportation. As for the mode of service, between Japan and Mexico and Central America the shuttle container service route is presumed. But according to circumstances, it is also imaginable that the feeder service route would be newly established between the container base in the Pacific coast of North America and Mexico or Central America, by making use of existing container service route between Japan and Pacific coast of North America. In any case, it is highly probable that as the base for containers on the side of Mexico and Central America one or tow ports in Mexico and one or two ports in Central America are chosen and the net work of inland feeder service by trucks will be completed between these ports and each consuming and producing place. In other words, from the standpoint of inland transportation the truck transportation of container as feeder service making use of the Pan American Highway will be relatively easy, as in the Central American countries in general the capital as well as densely populated areas or producing and consuming places are on the Pacific side from the central Madre mountains.

On the other hand, in general the coastal service by sea as the feeder service within the Central American area does not seem to be not materialized, as the loading cost, cost for transferring to trucks, etc. are estimated to be high.

Meanwhile, as the container service route between Japan and Caribbean sea is considered the shuttle service in the route of Japan/Panama canal area/Caribbean Sea/Gulf area of North America. In this case, it is foreseen that in the Panama Canal area and Caribbean sea, two or three container bases are built, from where the network of feeder service by small boats to the main Caribbean ports is completed.

5) For information, as the system of marine transportation by container there are such systems as lift-on-lift-off, roll-on-roll-off and lash boats, etc. In the world major trade and the trade of Japanese origin also, the lift-on-lift-off system is most commonly employed. On the other hand, the roll-on-roll-off system has merits that the investment in port facilities required is relatively small and the system is suitable to such a case as a producing place is situated relatively deep in the inland as seen in the exports of agricultural products. In the marine transportation system for exporting frozen meat to Miami by reefer containers also, which is the only container transportation from Guatemala, this roll-on-roll-off system is adopted. However, it is impossible at present to forecast what system should be employed for the marine transportation to Mexico, Central America and Caribbean sea, when containerized.

In any event, it is important to pay watchful attention to the trend in the marine transportation as explained above, in proceeding to prepare the plan for completion of the container handling facilities and the landbridge plan as the second term plan of the new port.

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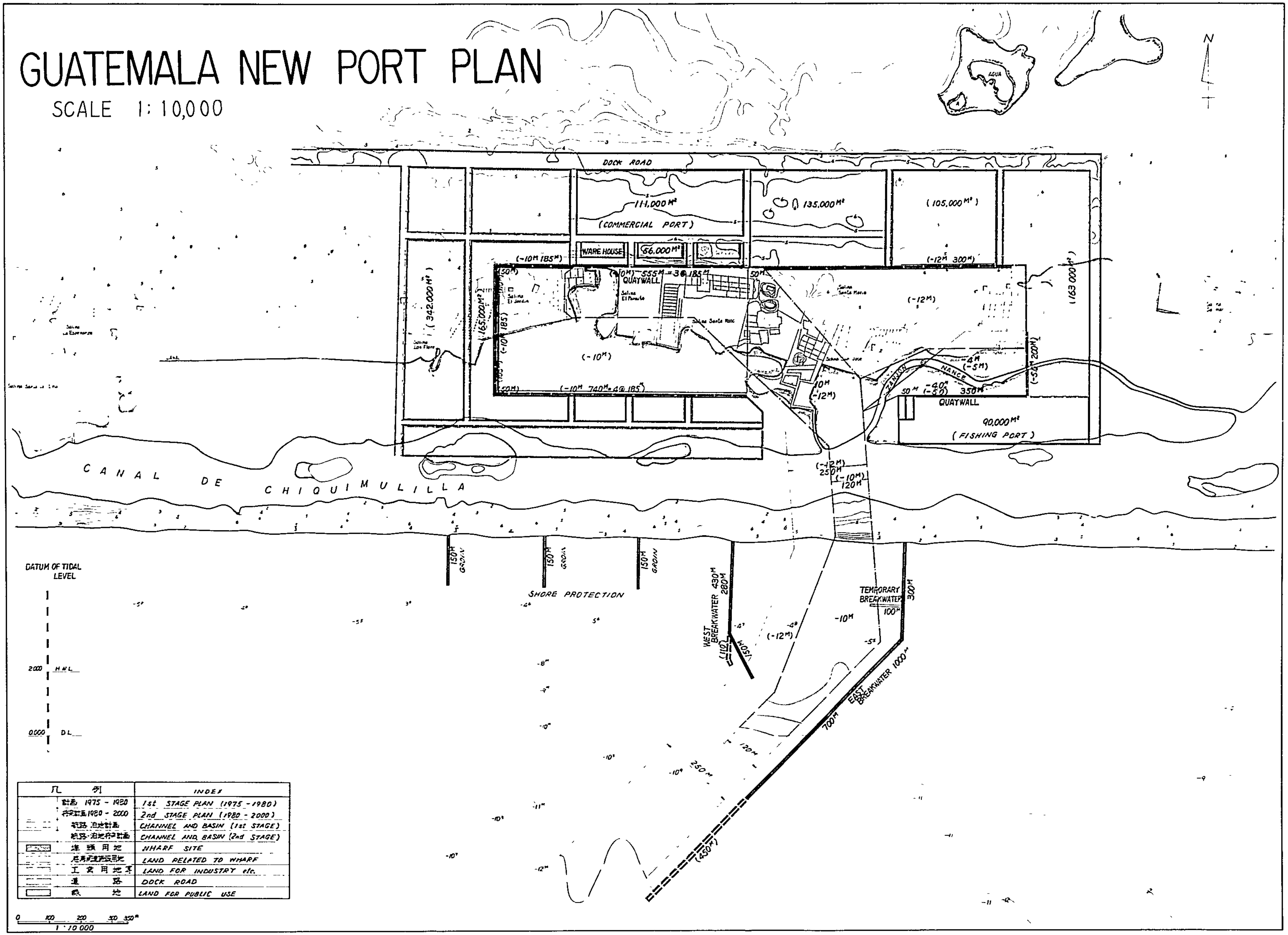
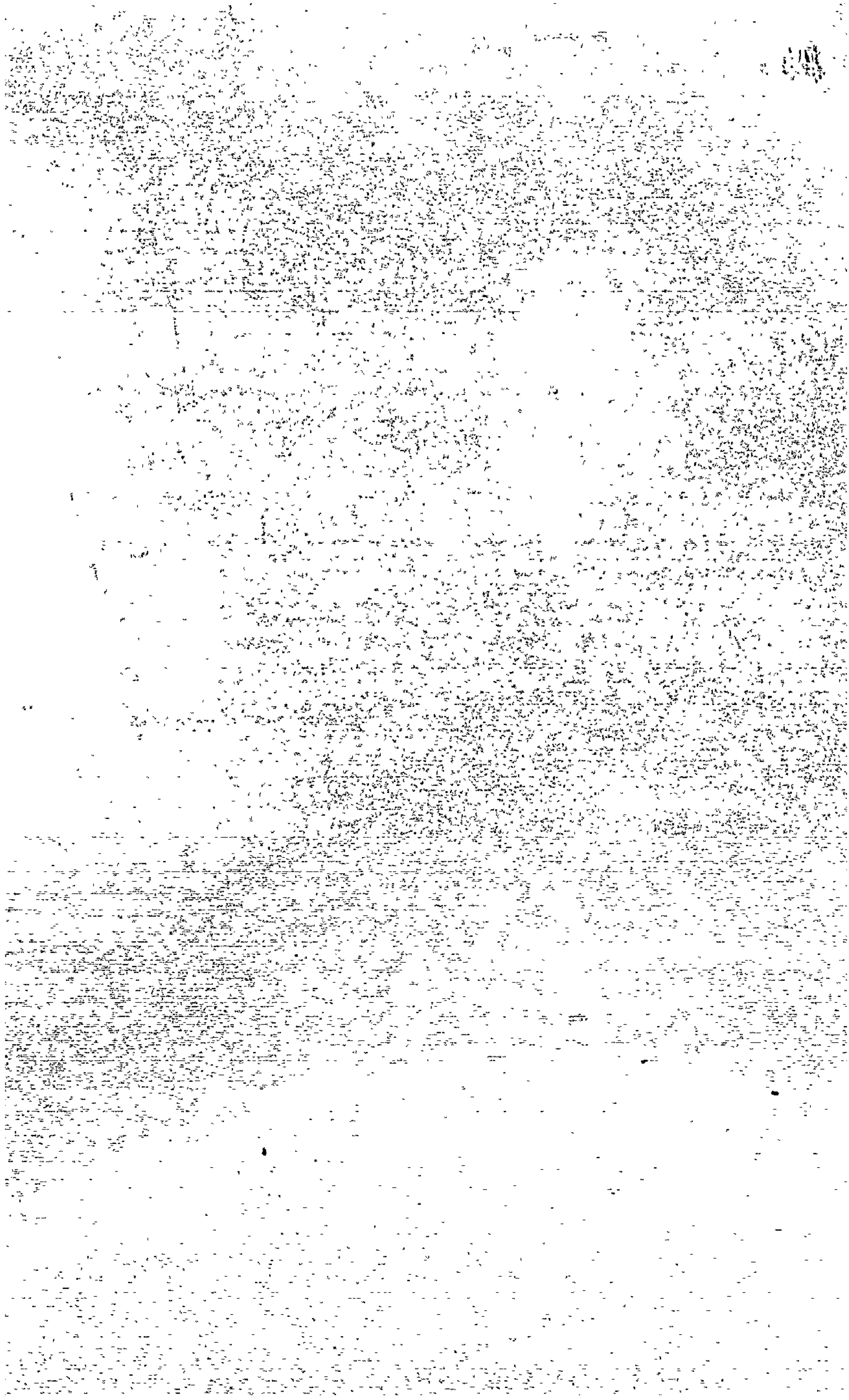
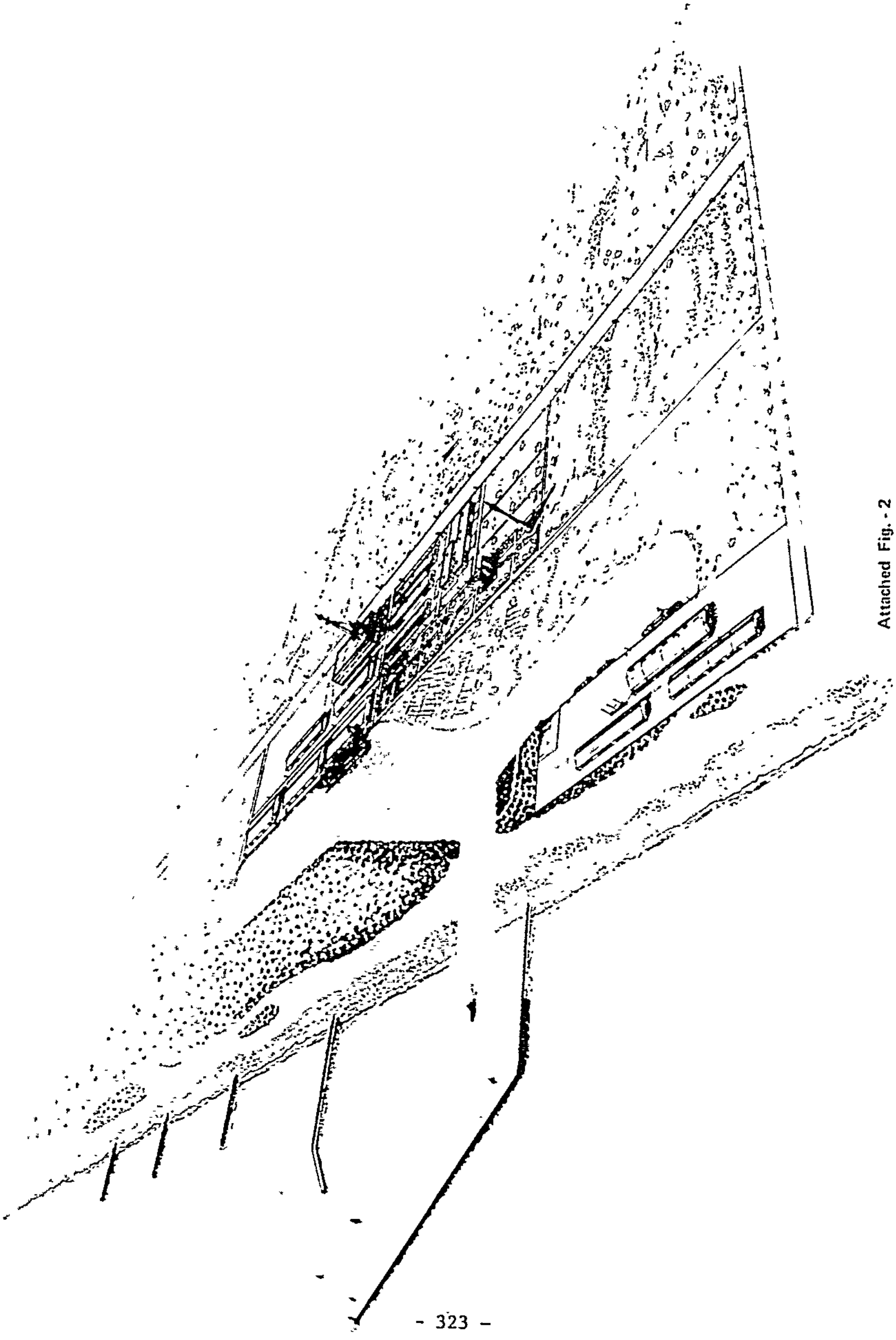
GUATEMALA NEW PORT PLAN

SCALE 1:10,000







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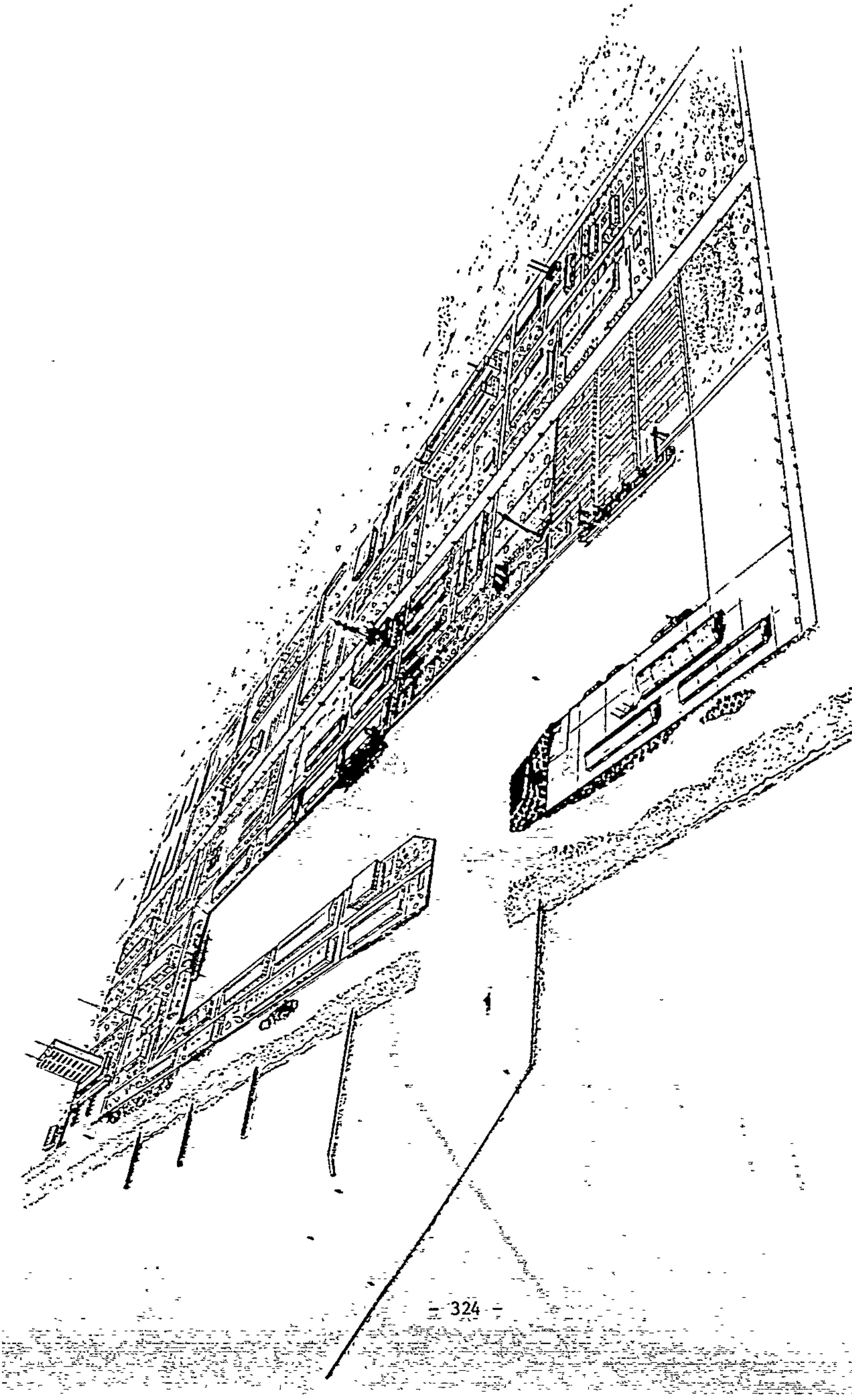

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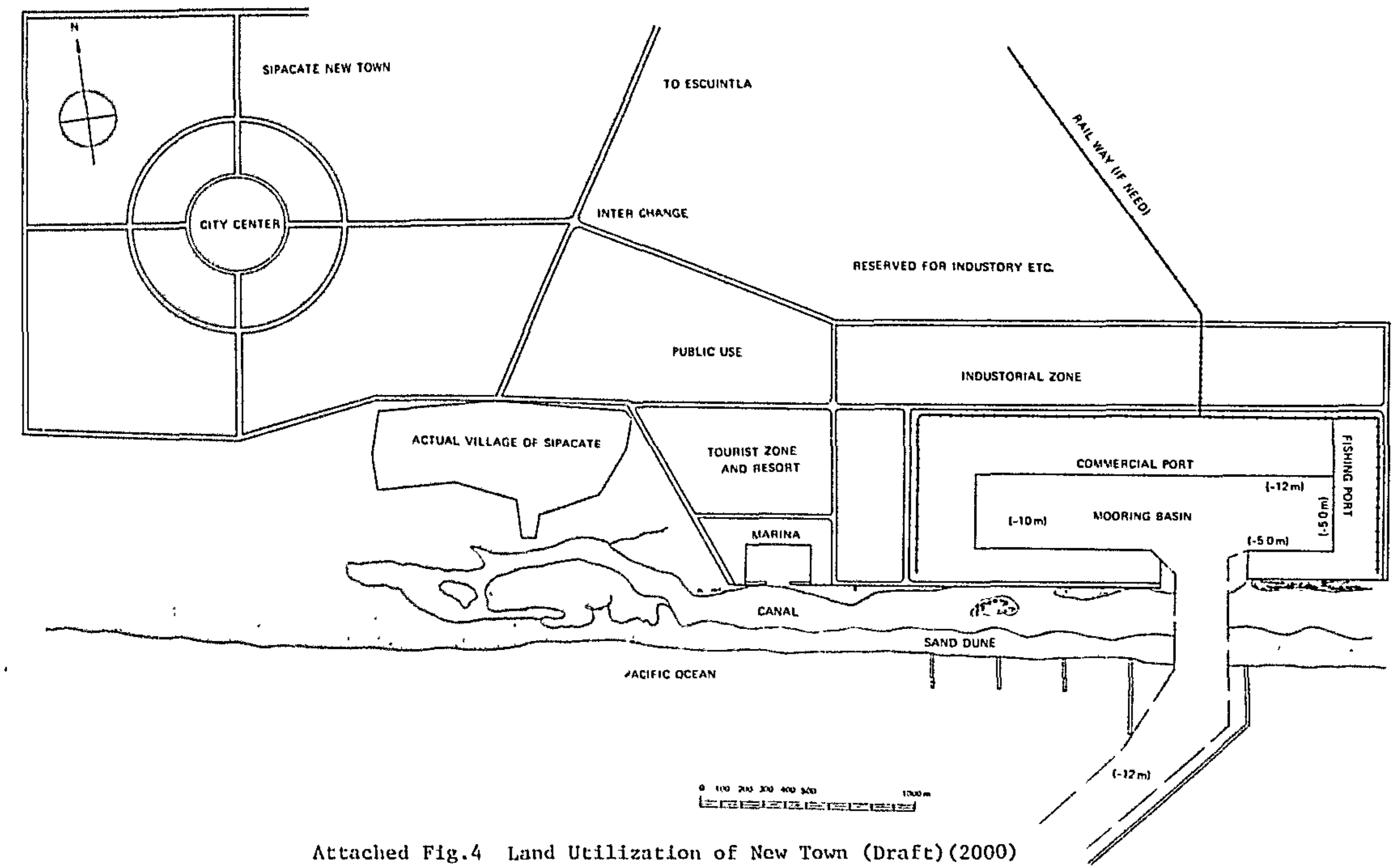

Attached Fig.4 Land Utilization of New Town (Draft)(2000)