MALAYSIA

KUANTAN PORT CONSTRUCTION PROJECT

FEASIBILITY REPORT

MARCH 1971

OVERSEAS TECHNICAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

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PREFACE

The Government of Japan, in response to the request of the Government of Malaysia, undertook to conduct a survey for the development of a new port incorporating a commercial port project in the Kuantan Fishing Port Project in West Malaysia, which the Japanese Government had been pushing forward since 1968 as part of its overseas economic and technical assistance program, and entrusted the execution of the survey to the Overseas Technical Cooperation Agency, an executing organization of the Japanese Government.

Upon this, the Agency sent a seven-member survey team, headed by Mr. Junichi Itao, former Director of the 2nd Port and Harbour Construction Bureau, Ministry of Transportation to West Malaysia over a period from September 1 to October 3, 1970 to undertake a feasible study for the above-mentioned port project.

The survey team promptly summarized the findings of the survey into an initial report and submitted it to the Government of Malaysia during its stay in West Malaysia. After its return to Japan the team prepared an interim report and sent it the Malaysian Government at the end of December 1970. Thereafter, the team made various studies and analyses on the basis of the findings of the survey and has recently completed the final report, which is now ready for presentation to the Malaysian Government.

I sincerely hope that the report will contribute to the promotion of foreign trade, regional development and fishing industry in West Malaysia and will also help promote friendly relations between Malaysia and Japan.

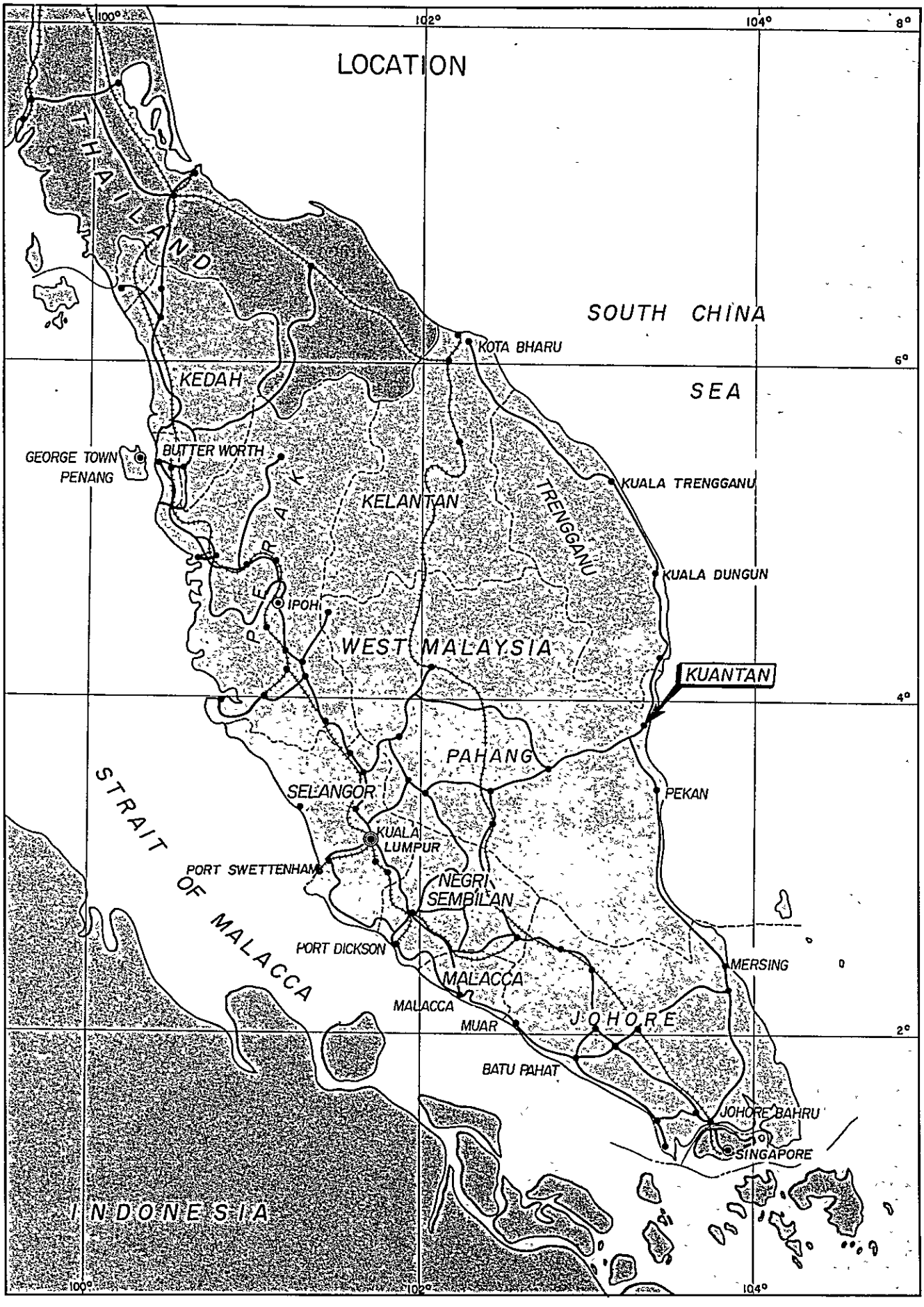
Finally, I wish to take the opportunity to express my sincere appreciation and gratitude to officials of the Malaysian Government for their unlimited support and cooperation in the execution of the survey.

February 1971

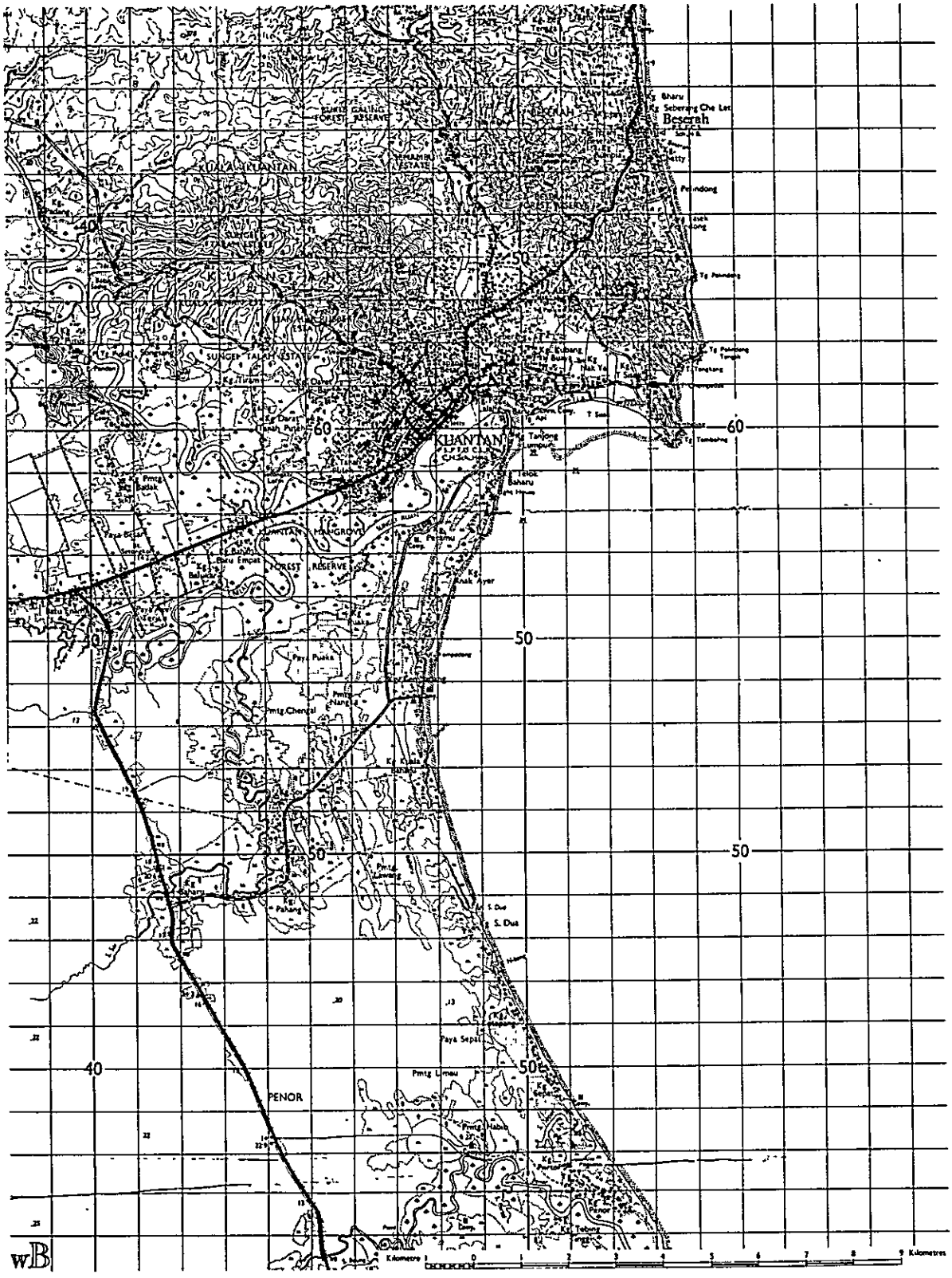
Keiichi Tatsuke

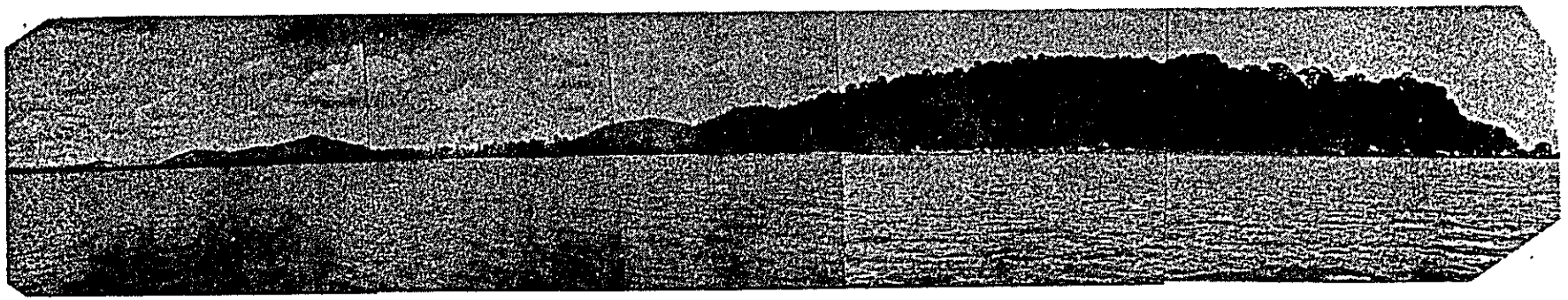
Director General

Overseas Technical Cooperation Agency


LOCATION
100°
102°
104°
8°
6°
4°
2°
THAILAND
SOUTH CHINA
SEA
KOTA BHARU
KEDAH
GEORGE TOWN
PENANG
BUTTER WORTH
KELANTAN
TRENGGANU
KUALA TRENGGANU
KUALA DUNGUN
PERAK
IPOH
WEST MALAYSIA
KUANTAN
PAHANG
PEKAN
SELANGOR
KUALA
LUMPUR
PORT SWETTENHAM
NEGRI
SEMBILAN
STRAIT OF MALACCA
PORT DICKSON
MALACCA
MALACCA
MUAR
JOHORE
MERSING
BATU PAHAT
JOHORE BAHRU
SINGAPORE
INDONESIA

Topographical Map of Kuantan and Surrounding Area





A Panoramic View of Project Area (Sea area)

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INTRODUCTION

1. Background of Survey

The Government of Japan, in response to the request of the Government of Malaysia, dispatched a survey team to that country in January 1969 to conduct a preliminary survey in Kuala Besut, Kuala Tregganu, Kuantan and Mersing on the east coast of West Malaysia, the sites selected by the Malaysian Government for construction of a fishing port, and submitted a report on the findings of the survey to that government.

The Government of Malaysia, after making various studies on the basis of the report, made a request to the Japanese Government in July 1969 for a feasibility study on the fishing port construction in Kuantan which had been selected from among the above-mentioned four proposed sites.

According to this request, the Government of Japan dispatched a second survey team to West Malaysia in August 1969 to conduct the said feasibility study.

While the survey team was engaged in the preparation of a report on the findings of the survey in Japan after completing the necessary survey in Malaysia in October 1969, the Government of Malaysia made another request to the Japanese Government in December of the same year for a survey on the feasibility of a new port project which envisaged the integration of the Kuantan fishing port project, which had already been in progress, and a commercial port project in relation to the progress of the industrial and natural resources development projects such as the Jengka Triangle Scheme and Pahang Tenggaru Scheme planned for the hinterland of Kuantan Port.

The Government of Japan accepted the request of the Malaysian Government and dispatched a survey team in September 1970 with the primary aim of obtaining necessary information on the above-mentioned commercial port construction project.

The dispatch of the survey teams was commissioned to Overseas Technical Cooperation Agency, an executing organ of the Japanese Government.

2. Purpose and Scope of Survey

The purpose of the recent survey was to make a feasibility study on the new port project in which the Kuantan Fishing Port Project, which had already been promoted vigorously by the Malaysian Government since 1968 as an integral part of the comprehensive development project for the eastern coast of West Malaysia with the cooperation of the Japanese Government, is planned to incorporate a commercial port project in relation to the regional development projects for the hinterland and at the same time, to determine the scale of the proposed port and make an estimate on the cost of construction.

In order to achieve the above-mentioned purpose, the survey was made with emphasis placed on the following points.

1) Social, economic and transport conditions in the hinterland

2) Physical conditions of Kuantan Port (Supplementary survey of the previous survey team for the Fishing Port Project)

3) Present state of Kuantan Port and related ports (Port Swettenham)

4) Port planning (Types of vessels, cargoes to be handled, scale of port, target year for completion of port construction, layout of facilities, preliminary design, cost estimation, preparation and review of alternative plans)

5) Port management (Economic benefit, operation and maintenance of port facilities)

6) Review of the subjects to be given further studies in the future

3. Organization of Survey Team

Name	Assignment	Occupation
Chief ITAO, Junichi	Overall responsibility	Member of the Board of Trustees, Japan Port and Harbor Association. (Former Director, 2nd District Port Construction Bureau, Ministry of Transportation)
Member NISHIMURA, Kazuo	Port planning	Chief, Niigata Design and Research Office, 1st District Port Construction Bureau, M.T.
Member ARAKI, Ichiro	Natural conditions	Deputy Chief, Yokohama Design and Research Office, 2nd District Port Construction Bureau, M.T.
Member SOMEYA, Akio	Socio-economic conditions	Planning Division, Port & Harbor Bureau, M.T.
Member SAITO, Akio	Port planning	Fishing Port Division, Fisheries Agency, Ministry of Agriculture and Forestry
Member FUJITA, Kenji	Port facility design	3rd Design Section, Japan Port Consultants Ltd.
Member HASHIURA, Hiroshi	Coordination	Development Surveys Department, Overseas Technical Cooperation Agency

4. Itinerary of Survey Team

The survey covered a period from September 1 to October 3, 1970 during which data and materials were collected, field investigations were conducted and consultations with the Malaysian counterparts were held, and an initial report was submitted to the Malaysian Government.

An outline of the itinerary of the survey team is as follows.

Date	Activities
Sep. 1, 1970 (Tue)	Departure from Tokyo and arrival in Kuala Lumpur.
Sep. 2, (Wed)	Paid a courtesy call on the Japanese Embassy in Kuala Lumpur and prepared a questionnaire to be delivered to the Malaysian side and a list of data and materials to be furnished by the Malaysian side, in consultation with the Embassy secretaries in charge.
Sep. 3, (Thu)	After presenting a questionnaire and a list of required data to the Malaysian side, had consultations with the Malaysian counterparts at EPU on the details of itinerary and facilities and services to be provided by the Malaysian side.
Sep. 4, (Fri)	Received answers to the questionnaire and exchanged views with the competent Malaysian officials at the Ministry of Transport. Collected data and materials at FENCO.
Sep. 5, (Sat)	Collected data and materials at Continental Oil Co., and the Dept. of Statistics.
Sep. 7, (Mon)	After collecting data and materials at Port Swettenham Authority, made an inspection tour of the entire port facility.
Sep. 8, (Tue)	Collected data and materials at FLDA and Esso. Head ITAO and two other members met with the Director of Fisheries Agency.
Sep. 9, (Wed)	Made a trip from Kuala Lumpur to Kuantan. Made a survey on the progress of the Jengka Triangle Scheme in Temerlah en route to Kuantan.
Sep. 10, (Thu)	Had consultations and exchanged views with the officials of Pahang State Government. Presented a questionnaire and a list of required data to them and requested that the reply be given to the team on September 15.
Sep. 11, (Fri)	Exchanged views with the officials of Pahang State Government and collected data and materials from them.
Sep. 12, (Sat)	Collected data and materials at the detachment of the Marine Dept. in Rompin and made preparations for surveying at Kuantan Port.

Sep. 14,	(Mon)	Summarized and reviewed the collected data and materials and made a survey of the above-mentioned port.
Sep. 15,	(Tue)	The team was divided into two groups for the activities in the following two days. A Group (Head ITAO and two other members) had a second round of consultations with the officials of Pahang State Government, received answers to the questionnaire put forward previously, exchanged views with them, and departed for Trengganu for collection of data and materials. B Group (ARAKI and two other members) remained in Kuantan and completed the marine survey.
Sep. 16,	(Wed)	A Group, after collecting data and materials at Trengganu State Government and other agencies, made a survey of Trengganu Port. B Group, meanwhile, summarized and reviewed the collected data and materials and prepared necessary drawings.
Sep. 17,	(Thu)	A Group, after collecting data and materials at Trengganu, made a survey of Dungun and Kenanan Ports and returned to Kuantan in the afternoon. B Group, after exchanging views with the fisheries officials of Pahang State Government, made a survey of the landing of catches at Kuantan fishing port.
Sep. 18,	(Fri)	A and B Groups merged again and collected supplemental data and materials at Pahang State Government. Made a trip from Kuantan to Kuala Lumpur.
Sep. 19,	(Sat)	Held intra-team discussions on the results of past activities and the schedule for the remaining part of survey period. Summarized and reviewed the collected data and materials.
Sep. 21,	(Mon)	Had consultations with staffs of the Japanese Embassy on the team's future activities and the content of the initial report to be submitted to the Malaysian Government.
Sep. 22,	(Tue)	Attended a coordinating meeting held at EPU, briefed the Malaysian counterparts on the outline of the team's activities, necessary supplemental data to be furnished, the need for various technical surveys prior to the detailed engineering of the Kuantan Port Project and then participated in question and answer sessions.
Sep. 23,	(Wed)	Collected data and materials at FLDA and FAMA. Started the preparation of the initial report at the Japanese Embassy.
Sep. 24,	(Thu)	Continued preparation and translation of the initial report, and preparation of required drawings.
Sep. 25,	(Fri)	Continued the work of the previous day.

Sep. 26,	(Sat)	Completed the preparation of the initial report.
Sep. 28,	(Mon)	Submitted the initial report to the Malaysian side at EPU with necessary explanations, and exchanged views with the Malaysian counterparts. A request was made to the team by the Malaysian side for prompt notification to them of the estimated construction cost of the project in stages and the amount of subsidies to be granted by the Federal Government.
Sep. 29,	(Tue)	Paid a call on the Japanese Embassy and offered farewell greetings to the Minister and other staff. Held a press interview at the conference room of the Embassy.
Sep. 30,	(Wed)	Made a trip from Kuala Lumpur to Singapore. Paid a courtesy call on the Japanese Embassy and then met with Mr. Kato, Director of OTCA Singapore Office, and discussed the future activities of the team.
Oct. 1,	(Thu)	Made a survey of the entire facilities of the Port of Singapore and collected data and materials at the Port of Singapore Authority.
Oct. 2,	(Fri)	After collecting data at the OTCA Singapore Office, made preparations for departure.
Oct. 3,	(Sat)	Departure from Singapore and arrival in Tokyo.

5. Acknowledgement

During the course of the recent survey in West Malaysia, kind cooperation and advices were extended to the survey team from various quarters, particularly by those whose names are given below. To them, the team expresses its gratitude and appreciation.

Deputy Secretary, EPU	Thong Yaw Hong
Assistant Secretary, EPU	Ahmad bin Sidek
Assistant Secretary, Ministry of Transport	Bashah bin Nordin
Assistant Secretary, Ministry of Transport	Ibrahim bin Mohamed
Director of Fisheries	Tengku Ubaidillah
Commissioner of Lands and Mines, Pahang State	Haji Mohamed Jamali
Chief Surveyer, Pahang State	Ho Khye Soa
Fisheries Officer, "	B. Balachandran
Development Officer, "	Moha Tarmizi bin Thahin
State Engineer, P.W.D., Pahang State	Tajul bin Haji Abee
Kuantan Port Officer, Marine Dept.	Ananda Rajah
Assistant Director, Tengka Jengka Project	Isher Singh Sekhon
Japanese Embassy in Malaysia	Ambassador Kojima
"	Minister Maeda
"	Secretary Niwa
"	Secretary Shigeta
"	Secretary Yamakawa
"	Secretary Yamashita
"	Secretary Tanaka
OTCA Singapore Office	Director Kato

Acknowledgement must also be made to the officials of other agencies of the Malaysian Government, who generously extended their cooperation and support to the team in various fields.

Summary and Recommendations

1. Economic Survey

1-1 General Consideration

The east coast of West Malaysia lags far behind the west coast both economically and socially. With regard to ports and harbors, there is not a single modern port on the east coast. The existing ports on the east coast are all estuary ports, which, because of inadequate depth of water, are not capable of accommodating larger ships and have to rely on the off-shore cargo handling. During the North-East monsoon season, therefore, the functions of these ports are brought to virtual suspension due to high waves and at the same time, fishing operation is greatly hampered. For these reasons, the volume of cargo handled by the ports on the east is small coupled with the low tone of economic activities and the fish catch is also lean.

However, various regional development projects are being implemented vigorously or under planning for the east coast. In the State of Pahang, in particular, the Jengka Triangle Scheme, which aims mainly at agricultural development, is now in progress and moreover, the Pahang Tenggana Scheme, far greater than the former in scale, is also under planning. With the growing demand for transportation following the progress of these regional development projects, there will be increasing need for a modern commercial port on the east coast. Construction of a fishing port for expansion of fishing industry will also be an important question for the region.

Under such circumstances, construction of a modern port, a combination of a commercial port and fishing port, in Kuantan situated almost in the center of the east coast and also occupying the strategic point of land transport will greatly contribute to the development of the east coast and help increase national income in the long run.

1-2 Forecast of Hinterland for Exports and Imports

In forecasting hinterland of Kuantan Port for exports and imports up to 1985, the survey team concluded that Kuantan Port would not grow to the level of a liner port by that time but remain as a port only for trampers and coastal vessels. For this reason, the hinterland of Kuantan Port for exports and imports by trampers was assumed to embrace the following areas by taking into consideration the possible competition with Port Swettenham, Johore, Malacca, Penang and the Port of Singapore, all of which allow the entry of large ships.

District of Kuantan, State of Pahang
District of Jerantut, "
About 80% of the district of Pahang, State of Pahang
About 50% of the district of Temerloh, "
All of the State of Trengganu

The hinterland of Kuantan Port, therefore, will cover about 75% of the project area of the Pahang Tenggana Scheme and the entire project area under the Jengka Triangle Scheme.

The hinterland of Kuantan Port for exports and imports by coastal

vessels was considered to include the entire area of the district of Kuantan in view of the possible land transport from Port Swettenham and the compound transport by sea and truck from Singapore.

1-3 Estimated Volume of Cargo

The volume of cargo handled by Kuantan Port in 1969 is shown in Table I-25. The majority of cargo which will be handled by Kuantan Port upon completion of its modern facilities are expected to be generated as a result of hinterland development. The volume of cargo generated in the hinterland of Kuantan Port as a result of the development projects is estimated at 1,316,000 tons for 1980 and 1,981,000 tons for 1985, as shown in Table I-25.

In estimating the volume of cargo generated as a result of the development projects, efforts were made to gather as dependable forecast values as possible. However, to forecast the production 15 years hence, there were too many uncertainties as a matter of course. For this reason, daring assumptions had to be made at times in the course of estimate. The most daring assumption was that made for the estimate on the volume of cargo related with the Pahang Tenggana Scheme. On this point, therefore, it will be necessary to make another estimate on the volume of cargo to be handled by Kuantan Port at time when the scheme becomes definite.

1-4 Forecast of Type of Vessels to be Accommodated by the Proposed Port

An accurate forecast of the type of vessels to be accommodated by the proposed port is extremely difficult at present when transport revolution is in progress. Nevertheless, the following forecast was made by taking into account the topography of the sea-bed in the proposed port site, type and volume of cargo expected, relationship between the shipping port and landing port and the possible competition with the neighboring ports.

Ocean-going vessels	15,000 D/T
Coastal vessels	3,000 D/T

1-5 Goal of Fishing Industry

As reported by the fishing port survey team, the goal of fishing industry 10 years hence was set as follows on the condition that appropriate measurements for the development of unexploited marine resources along the east coast of West Malaysia are implemented in an efficient manner.

(1) Type of fishing operations to be expanded as early as possible ----- mainly large scale trawling and large scale purse seine operation.

(2) Number of fishing boats to be maintained ----- 580. Of this number, large fishing boats of more than 30 tons are to be 300.

(3) Haul (Annual) ------- 93,000 tons

2. Survey on Natural Environments

2-1 Topographic Features

Results of topographic surveys and sounding conducted around Tembeling point, which had been selected as the site for construction of Kuantan Port, are

shown in Fig. I-3. As the sounding was performed only for the fishing port project, a more extensive sounding survey and a detailed sounding survey at the port project area should be conducted for the current port project. Also, in order to obtain more definite data on the changes in contour lines of the sea-bed in the project area, it will be necessary to conduct an additional sounding survey on the base line after one monsoon season as a follow-up of the initial survey.

2-2 Climate and Marine Meteorology

As the meteorological observations for the district of Kuantan are being conducted at Kuantan airport, it is necessary to conduct observations on wind direction and velocity at the point not affected by Tembeling point during a North-East monsoon season and compare the results with those obtained at the airport to clarify the correlations between the two observation points. The highest wave in the sea off Kuantan occurs during the North-East monsoon season and the elements of high waves are estimated to be as follows:

Elements of deep water wave:

Wave height	Ho = 2.5 m
Wave period	T = 10.0 seconds
Wave direction	NE

Elements of the wave in the sea in front of the port project area (Depth: - 8.0 m)

Wave height	H = 2.8 m
Wave period	T = 10.0 m
Wave direction	N 65°E

As these figures were estimated from the weather charts and other data, it is necessary to conduct an instrument observation of wave height and period and a visual observation of wave direction at the point about one Km northeast of Tembeling point, where the depth of water is 8 m, during two North-East monsoon seasons to obtain more accurate data.

As no observations of tide current have been made in this area, it is necessary to make an observation of the direction and velocity of the tide current around the shoals at the points about 2 km and 5 km offshore respectively during the North-East monsoon season to obtain accurate data on the tide current around the project area. Since no data is available on the littoral drift, it is advisable to to make a follow-up survey on the movement of fluorescent sand around the shoals during the North-East monsoon season to obtain data on the movement of bottom deposits, particularly the movement of the two shoals.

2-3 Soil Conditions

According to the results of a soil survey conducted by the fishing port survey team, the composition of soils at the sea-bed in the project area is as follows and the foundation in general is not considered satisfactory.

(1) The top layer consists of very loose fine sand containing clay or silts and ranges from 2.0 m to 4.0 m in thickness.

(2) The middle layer comprises highly silty and sandy soft clay in the upper stratum and hard clay irregularly mixed with weathered rocks in the bottom stratum. The layer has a thickness of 4.0 6.0 m.

(3) The bottom layer consists of gravel and extends to a depth of 15 m from the ground surface.

For the design of various structures for the proposed port, it is necessary to conduct an additional earth boring and soil test at several points along the face line and the center line of wharves and breakwaters.

2-4 Expenses of Future Surveys

Technical surveys to be provided for the Kuantan Port Project in the future have already been mentioned. Besides, it is advisable to conduct an experiment on the sheltering effect on the basis of the findings of the sounding survey, wave observations and the design face line and center line. The estimated expense of all these surveys is approximately $189,000.

3. Port Construction Plan

3-1 Selection of Site for Port Construction

If a new port is to be constructed in or around the district of Kuantan, the estuary of the Kuantan River or the coast in the vicinity of the estuary is conceivable as the site of the port judging from the natural environment in these locations and their relation with the hinterland.

As shown in Fig. 1 , the estuary port plan envisages construction of jetty wharves extending from both banks of the river to the sea and reclamation of the sea inside the wharves with soils dredged from the navigation channel to create a new port area. However, because of the slow grade of the sea-bed along the center line of the river, the jetty wharves to be constructed will have to be extended to a greater distance and dredging will also be required to prevent silting-up of the port by sediment load, entailing higher cost of construction and maintenance than the other plan.

If a port is to be constructed on the coast, the shore extending from the estuary of the Kuantan River to Tembeling point is considered most appropriate in view of the sheltering effect it provides against high waves during the North-East monsoon season, slope of the sea-bed and its relation with the hinterland.

As shown in Fig. 2, this plan envisages construction of a breakwater which will extend from the tip of Tembeling point to the south and a groin off the shoreline to shelter the port from high waves and littoral drift and reclamation of the sea with soils dredged from the navigation channel and anchorage to create a new port area. Under this plan the cost of construction is about 2/3 of that under the estuary port plan and there is less liability of fill-up of the port by sediment load of the river, resulting in less maintenance cost. After comparing the two plans, the survey team has adopted the coastal port plan.

3-2 Port Facilities Plan

The size of the new Kuantan Port and the arrangement of facilities were determined as shown in Fig. III-1 (a), based on the following fundamental principle.

(1) The type and volume of cargo to be handled by the commercial port are as described in Section 1-3.

(2) The final objective in determining the size of the fishing port is as described in Section 1-5.

(3) As both the commercial port and the fishing port are expected to expand further even after the target years, necessary steps should be taken to leave room for future extension of facilities.

(4) A clear distinction must be made between the commercial port area and the fishing port area and each port area should have its own facilities except the ones joint use of which is considered definitely advantageous.

(5) Though no special consideration is being given to container cargo at present, allowance should be made for future construction of a container pier and yard.

(6) The pier should be of the type which provides as long a water line as possible in a certain area.

(7) Facilities handling such hazardous materials as petroleum should be isolated from other facilities as practically as possible.

(8) As the seaside near the project area is a resort for the people, port facilities should be provided far from this area and care should be exercised not to alter the existing environments of the area.

(9) In the fishing port area the landing quay, mooring quay and servicing quay should be arranged in that order to ensure smooth movement of fishing boats, and required facilities should be provided in the rear of these quays.

3-3 Construction Schedule

This project is divided into the first phase covering an 8 year period (1972 ~ 1979) and the second phase covering a 2 year period (1980 ~ 1981) because of the target year and accordingly the cost of construction is not balanced between the two phases. However, since the entry of larger ships of the 5,000 T/T class and fishing boats will be possible in 1976, it is also possible to consider that the first phase covers a 5 year period (1972 ~ 1976) and the second phase covers the remaining 5 year period (1977 ~ 1981).

The cost of construction for the new Kuantan Port is estimated at approximately US$42,900,000. There is a possibility, however, that this figure will fluctuate within the range of 50% depending on the results of detailed survey.

4. Economic Analysis for New Port Construction

The proposed Kuantan Port may be divided largely into the commercial port and the fishing port. The econometric analysis made by the survey team was aimed only at the commercial port. The barometers sought in the econometric analysis were the benefit-cost ratio at the discount rate of 10% and the internal rate of return. The project life to be used for the study was determined to be 20 years from 1972 to 1991 for fear that the facilities might become obsolete in this age of technical innovation.

For the benefit derived from the new Kuantan commercial port in the national economic analysis, the reduction in transport cost, resulting from the elimination of land transport by truck in the inland area and the secondary coastal transport, and the net profit of the port, obtained by deducting expenditure from the revenue of Kuantan commercial port, were considered. For the cost, the cost of construction for the commercial port was considered. The benefit-cost ratio thus obtained was 2.23 and the internal rate of return was 24.8%. It may be said, therefore, that the project is fully justifiable from the standpoint of national economy.

On the other hand, however, when the scope of analysis is limited only to the management of Kuantan commercial port, the benefit derived from this project is only the net profit. In this case, the cost used for the analysis was the cost of construction for the commercial port. In this analysis the benefit-cost ratio is 0.97 and the internal rate of return is 9.6%. These results are similar to those of the management by port authority which adopts a self-paying basis. In this case, however, the business of Kuantan commercial port can hardly be maintained. For the project such as this which possesses a high national economic value, it is not always necessary to adopt the self-paying basis for the management. Other conceivable means of port management are the case in which the central government furnishes required facilities and transfer them to the port authority at time when the facilities produce profits and the case in which the central government grant subsidies to the port authority.

If assumption is made that subsidies are granted to the port authority, the benefit in the business analysis of port management will be the net profit plus subsidies. Assuming that subsidies cover construction of east groin, south groin and dredging, the internal rate of return will be 19.3% and the business of the port will be on the paying basis. In this case, the share of subsidies in the total cost of construction is 35.8%.

Figure-1 ESTUARY PORT PLAN

Scale = 1/25,000
UNIT : m

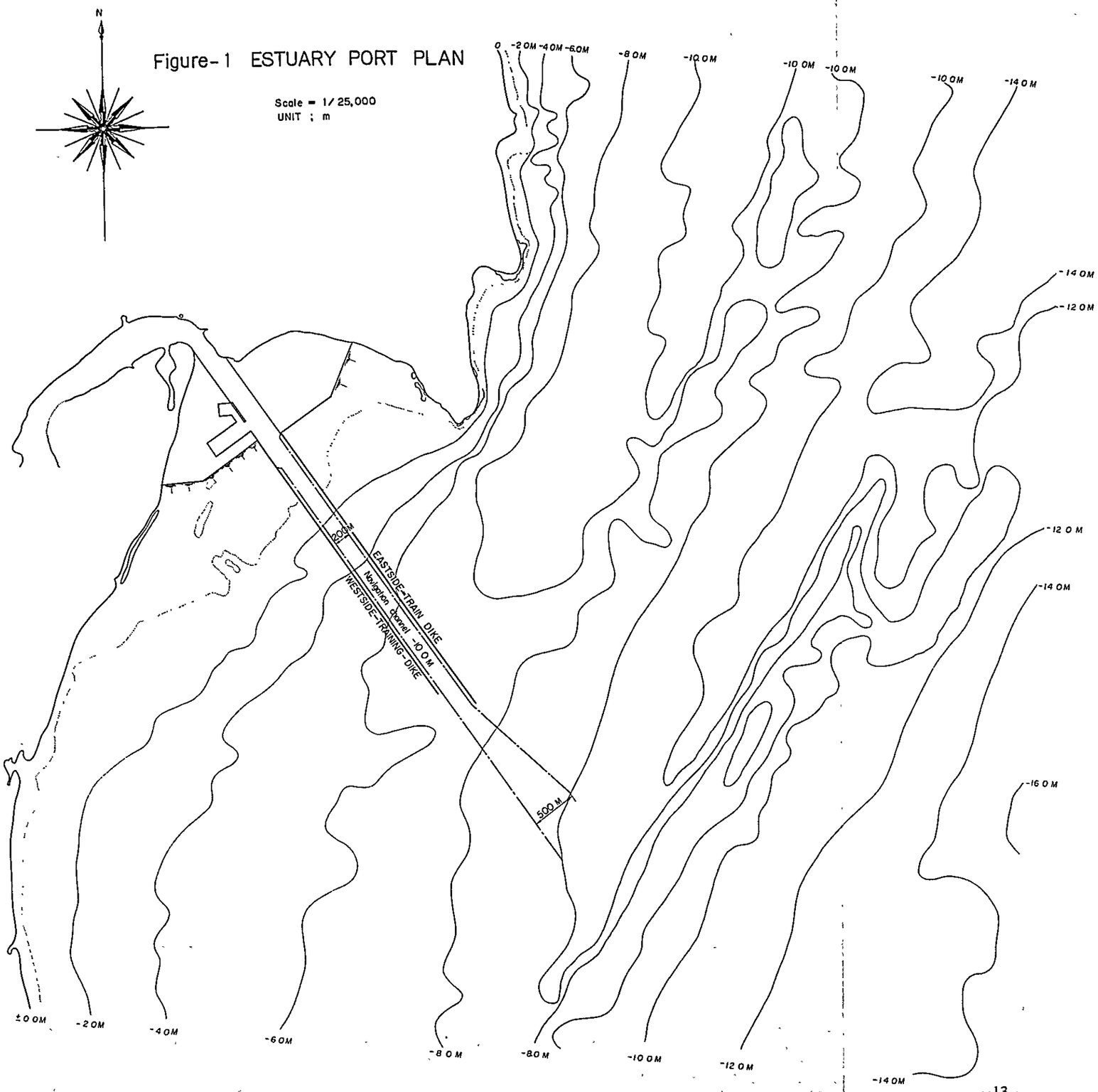
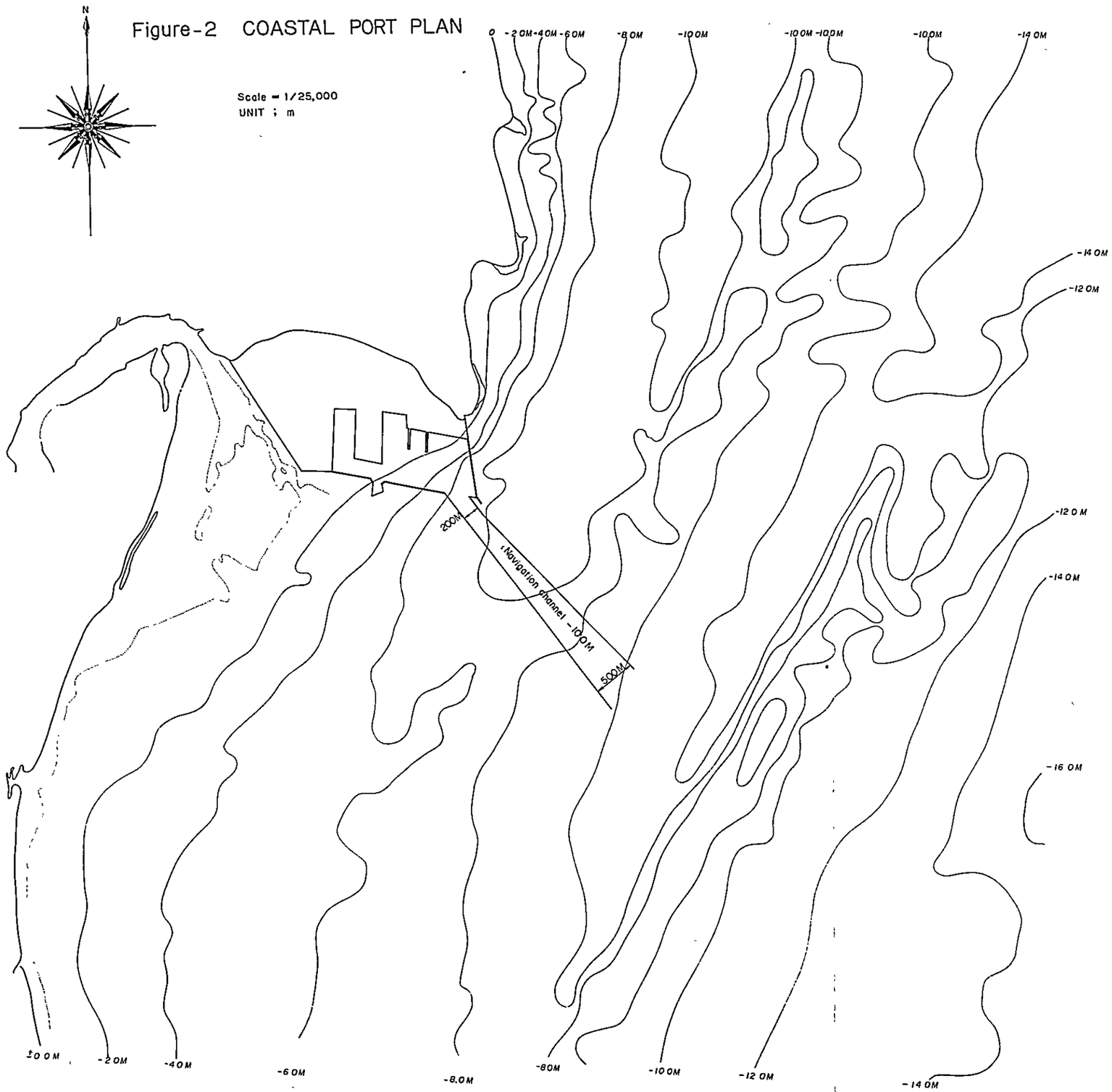
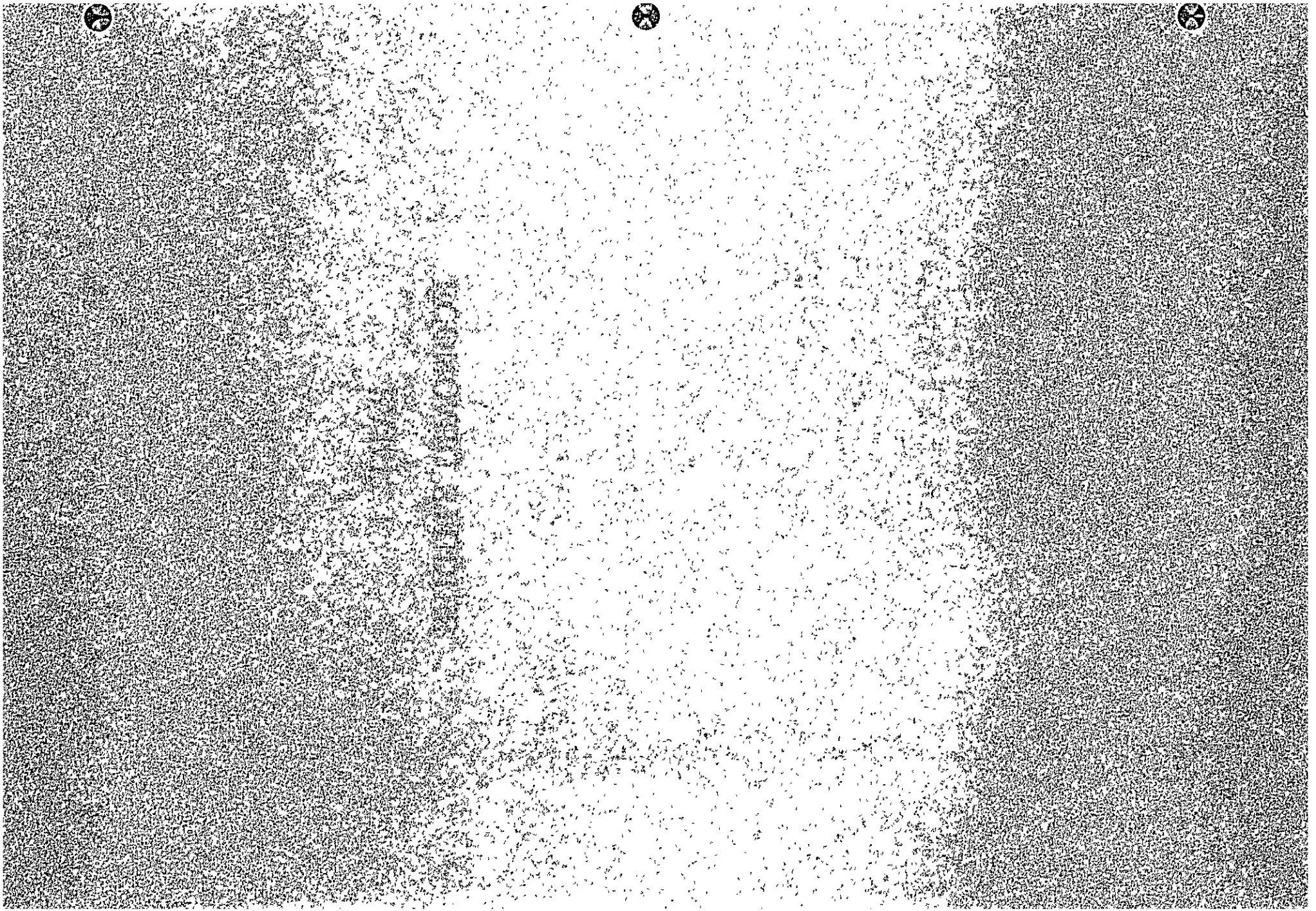


Figure-2 COASTAL PORT PLAN



PART I

ECONOMIC STUDIES



CHAPTER 1. OUTLINE OF WEST MALAYSIA

1.1 Community

The Federation of Malysia was a constitutional monarchy founded in 1963 by the unification of the Federation of Malaysia (Today's West Malaysia), the State of Singapore, British Crown Colony of Sabah and Sarawak (Today's East Malaysia) in Borneo until 1965 when Singapore separated from the Federation and became an independent country.

West Malaysia is situated in the Malay Peninsula, south of 6°N latitude and borders on Thailand in the north and the Republic of Singapore in the south. The total area is 131,600 km^2 and the population is estimated at 8,655,000 as of the end of 1967. The climate changes very little through the year and the temperature in daytime ranges from 73°F to 82°F. Though situated in the tropical zone, the peninsula with a width of only 150 km to 300 km is under the influence of oceanic climate with much precipitation and extensive jungles.

One of the most outstanding features of the community in West Malaysia is the racial composition of its population. As shown in Table I-1, the native Malayan race accounts for merely half of the total population and 1/3 of the population is occupied by Chinese.

Table I-1 Constituent Races of West Malaysia

(In thousand)

Race / Description	Malayan	Chinese	Indian & Pakistani	Others	Total
Population	4,351	3,157	958	189	8,655
Constituent ratio	50.2	36.5	11.1	2.2	100%

Note: Estimate as of the end of 1967
Source: Department of Statistics

Though the absolute number of Chinese in other Southeast Asian countries does not differ greatly from that in Malaysia, its share in the total population is only about 1% in each country and they are absorbed by the principal race as far as community activities are concerned.

In West Malaysia, meanwhile, the number of Chinese accounts for 36.5% of the total population (Nearly the same also in East Malaysia), thus constituting a complete multi-race community. Though there are other cases of multi-race nations, Malaysia may be said to be the only country in the world in which Malayans, Chinese and Indians, who had nothing in common nor had any significant relations between them with respect to tradition, customs, religion, history and culture, are united to form a single nation.

As is evident from the distribution of occupations by race shown in Table I-2, many of Europeans, particularly the British, are the owners of modern enterprises centering on tin and rubber industries.

Table I-2 Constituent Ratio of Employed Population in West Malaysia by Industry

Description \ Race	Malayan	Chinese	Indian	Others	Total
Primary industry	73.21	40.21	55.76	18.74	57.50
Secondary industry	6.10	22.40	10.69	7.18	12.63
Tertiary industry	18.23	24.49	30.95	* 71.15	27.26
Others	2.47	2.90	2.60	2.93	2.62

(Note) 45.41% of the figure * marked are national defence police force.

Malayans, meanwhile, are seen overwhelmingly in the primary industry centering on agriculture and fishery. Chinese constitute the nucleus of the secondary and tertiary industries but at the same time, they are also widely engaged in the primary industry. Indians are engaged mainly in the primary industry, followed by the tertiary industry. Consequently, Malayans are seen mostly in agricultural and fishing areas and Chinese concentrate in cities.

Malayans, even though they account for half of nation's population, are mostly engaged in the primary industry of low productivity and their income is far below that of Europeans and Chinese. Thus, the improvement of economic footing of Malayans is an important problem for the Federal Government to solve. Malayans are given special constitutional privileges over other races for the employment in government offices, ownership of land and in civil rights. Attitude of Malayans toward labor and economy and the restrictions imposed by Islamism, which have been the major obstacle in the improvement of their economic position, are changing gradually with the diffusion of education. Measures are also being taken to promote enterprises owned by Malayans as a means to improve their economic position. As the question of the future, land system reform and improvement of commodity distribution system have been pointed out.

Income level of Chinese is the second highest, only next to that of Europeans. Though they account for 1/3 of the total population and are at advantage over other races in economic position, 80% of them are farmers, fishermen or belong to the propertyless class, and there is a wide disparity in their income. One of the characteristics of Chinese community is the existence of a band uniting the fellow people.

As this band has been established as a means of providing mutual assistance and self-defence for fellow traders, they are in perfect unity within their community but take an extremely exclusive attitude toward the outsider. Because of this, establishment of a system for enormous capital concentration and centralization required for modern and large scale production activities, streamlining of enterprises and improvement of distribution system are greatly obstructed.

In recent years such organized unity is collapsing gradually but still exists steadfastly in Chinese community.

The future growth of Malaysia's economy depends entirely on how

Malayans and Chinese, the two leading races in Malaysia, will solve their internal problems and promote mutual cooperation among themselves.

1-2 Economy

1-2-1 General

In West Malaysia rubber industry and tin mining and related industries have been expanding steadily ever since the colonial day with the investment of British capital with brisk commerce and financial activities centering around the people of Chinese origin. Today, West Malaysia is the most prosperous district in Southeast along with Singapore.

The gross national income of West Malaysia in 1966 was US$2,164 million and the per capita income recorded US$256, ranking third in Asia following Japan (US$791) and Singapore (US$517).

A study on the gross national product by industry shown in Table I-3

Table I-3 Industry-wise Percentages of National Gross Product

(Unit: %)

		Agri-culture	Mining	Manu-facturing	Con-struction	Service	Others
Japan	1966	12	1	28	7	26	26
Malaysia*	1966	28	10	11	4	19	27
Philippine	1967	33	2	18	4	15	28
India	1966	49	2	14	4	15	15
Indonesia	1964	56	0	10	2	19	12
Taiwan	1966	26	4	19	5	31	26
Burma	1967	34	1	9	2	36	17

Source: United Nations Statistical Year Book, 1968
*: Values for East Malaysia inclusive.

indicates that the percentage of the primary industry is considerably high as compared with the secondary industry as with the case of other Southeast Asia countries. It is particularly noteworthy that the mining industry accounts for 10% of the gross national product, which is an overwhelmingly large share as compared with other Southeast Asian countries.

Records on exports and imports shown in Table I-4 indicate that while exports amounted to MS$ 3,203.9 million in 1968, imports remained at MS$2,771.1 million, leaving a favourable balance of MS$432.8 million. Balance of trade has been showing an average annual gain of MS$400 million over the past several years.

Table I-4 Imports, Exports and Balance of Trade (West Malaysia)

(In M$ million)

Year	Imports			Exports			Balance of Trade
	Direct from foreign countries	Via Singapore	Total	Direct to foreign countries	Via Singapore	Total	
1965	1,669.7	938.6	2,608.3	2,209.6	886.2	3,095.8	487.5
1966	1,724.9	907.7	2,632.6	2,164.6	945.9	3,110.5	477.9
1967	1,761.1	824.8	2,585.9	2,067.0	838.9	2,906.8	320.9
1968	1,955.4	815.7	2,771.1	2,331.0	872.9	3,203.9	432.8

Source: Department of Statistics

The fact that the trade with Singapore accounts for 30% of total foreign trades indicates the close economic relations between the two countries. With regard to the item-wise export amount in 1968, rubber and tin held an overwhelmingly large share, as shown in Table I-5. These two items are the chief supporters of the economy of West Malaysia with the share in the total export being 64.8% (39.1% by rubber and 25.7% by tin). This tendency will also continue in the future.

Table I-5 Commodity-wise Export Values of West Malaysia

(Unit: M$ million)

Commodity	Value
Rubber	1,251.8
Tin metal	820.3
Palm oil	116.6
Iron ore	110.3
Sawn timber	106.3
Saw log	75.9
Pine apple	50.2
Coconut oil	36.5
Palm kernel	14.2
Others	621.8
Total	3,203.9

Source: Department of Statistics

The economic activity in West Malaysia leans extremely to the West coast when viewed from a geographical point of view. A comparison of two major industries, rubber and tin, in their production shows that about 85% of rubber and approximately 90% of tin are produced in the western half of the country.

1-2-2 Agriculture and Forestry

(a) Rubber

As stated previously, rubber is a typical agricultural product in Malaysia. According to the 1967 statistics shown in Table I-6, rubber plantation in

Table I-6 Acreage of Agricultural Land by Crops

	(1,000 acres)	(%)
Rubber	4,335	65.5
Rice	904	13.6
Coconut	502	7.6
Oil palm	400	6.0
Fruit	245	3.7
Miscellaneous	242	3.6
Total	6,628	100

Source: Department of Statistics

West Malaysia covers an area of 4.33 million acres, which accounts for 65% of the total erable land in West Malaysia. Rubber production in the same year amounted to 948,000 tons (one million tons including East Malaysia), accounting for about 40% of total rubber production of the world and ranked top outstripping Indonesia whose rubber production was 760,000 tons. Rubber production has been expanding steadily by a few per cent annually as a result of an increase in plantation area and plant breeding and is expected to grow further in the future.

(b) Rice

The crop which follows rubber in the planted area is rice. While rice is a staple food for Malayans, 240,000 tons of rice was imported in 1968 against domestic production of 672,000 tons. In the face of this basic shortage, increased production of rice is one of the most important tasks imposed on agriculture in Malaysia.

(c) Coconut and Oil palm

Both coconut and oil palm produce food oil from their nuts and are the main agricultural products for export following rubber. The oil palm, in particular, has been attracting public attention as an important agricultural product which may substitute rubber and its weight in land use is increasing steadily in various parts of the country. Oil palm production has been expanding by about 20% annually over the past few years and is expected to grow also in the future.

(d) Timber and saw-timber

In the face of world-wide growing demands for timber, export of timber in Malaysia, with its rich forest resources, has grown rapidly. In 1968 1.18 million tons of timber and 700,000 tons of saw-timber were exported

and the export has grown by 25% annually in recent years. In the future, however, export of saw-timber is expected to surpass that of timber in line with the government policy to promote domestic industry.

1-2-3 Fishery

As shown in Table I-7, fishery in West Malaysia has been growing steadily in the past 10 years. The growth of fishing industry after 1966 is particularly remarkable with an annual growth rate of 25 ~30% against an average annual growth rate of 10% recorded prior to 1966. This sharp increase is attributable to the expansion of trawl fishing by large boats in the western coastal area. On the east coast, meanwhile, fishing industry remains stagnant and income gap between the east coast and west coast is expected to widen further. The lag of fishing industry on the east coast is due to the stagnation of general economic activities, but it is also attributable to the fact that the operation has to be curtailed considerably during the North-East monsoon season and that modernization of fishing boats and gear has been making slow progress.

1-2-4 Mining

(a) Tin

The tin deposits are found mostly on the west coast and the majority of ores are refined in West Malaysia. Production of tin in 1967 was 76,000 tons, accounting for 43% of total production in the world (Communist countries excluded) and ranked top in the world far surpassing Thailand whose production was 27,000 tons. Though the production and price of tin have been stable in recent years, exploitation of the existing mines has progressed to a considerable extent. For this reason, exploration of new deposits is hoped for.

(b) Iron ore

The main production areas of iron ore are Pekan, Pahang State and Dungun, Trengganu States. (Production of iron ore in both places in 1965 accounted for 54% of total production in West Malaysia). Production of iron ore in 1968 was 5.1 million tons, most of which was exported to Japan. The production has been declining annually since 1963, the peak year. As Japan is shifting its purchase of iron ore to Australia, any increase in the production of iron ore in West Malaysia is not expected in the future.

1-3 Ports and Harbours

1-3-1 Ports and Harbours in West Malaysia

For the volume of cargo handled in West Malaysia, as shown in Table I-8, petroleum leads other items for landing and iron ore tops the list for loading by a large margin. Petroleum accounts for 60% of the total volume of inbound cargo and 80% of petroleum handled is crude oil, the majority of which is landed at Port Dickson on the west coast. There are two oil refineries at Port Dickson and the crude oil brought to these refineries are transported from Saudi Arabia, Kuwait and Sarawak. Iron ore is shipped to Japan mostly from Port Dungun and Port Rompin on the east coast.

Table I-7 Past Fishing Production in West Malaysia

(Unit: tons)

State \ Year	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Perlis	4,197	4,541	4,614	4,612	3,270	4,184	4,907	5,847	6,462	4,243
Kedah	13,636	10,120	11,728	8,988	19,273	11,056	14,501	33,470	40,639	29,728
Penang	10,002	10,828	12,441	18,120	28,1 6	25,499	30,886	30,094	33,043	37,343
Perak	52,059	50,914	60,754	60,086	66,386	69,506	80,105	104,412	127,954	121,099
Selangor	16,429	19,495	22,421	23,371	18,757	21,090	33,970	50,718	55,583	39,628
Negeri Sembilan	339	309	374	334	365	350	588	511	538	412
Malacca	2,579	2,686	2,646	1,844	1,469	1,449	1,714	1,635	2,077	1,771
Johore-West	4,463	5,294	6,075	5,883	8,822	9,734	12,310	11,280	11,855	9,756
Sub-total	103,704	104,187	125,053	123,238	137,538	142,868	178,978	237,967	278,151	243,980
Johore-East	8,287	9,830	11,282	10,924	16,381	18,076	22,862	28,193	20,623	17,877
Kelantan	4,075	4,996	5,965	6,709	5,616	5,754	6,078	7,023	7,447	5,255
Trengganu	14,540	25,510	26,715	37,849	26,978	26,446	23,362	23,091	25,110	22,710
Pahang	8,863	6,127	5,182	4,916	5,645	6,733	5,327	6,577	8,151	8,378
Sub-total	35,765	46,463	49,154	60,398	54,620	55,509	57,629	64,884	61,331	54,220
Total	139,469	150,650	174,207	183,636	192,158	198,377	236,607	320,851	339,482	298,200

Source: Annual Statistics, Fishery Agency

Table I-8 Cargo Handling Volume in West Malaysia (1968)

(Unit: Thousand tons)

Discharged		Loaded	
Petroleum products	4,710	Iron ore	4,595
Sugar	370	Rubber	892
Iron and steel	255	Timber	707
Rice	247	Ilmenite	185
Fertilizer	157	Latex	184
Other cargo	2,145	Palm oil	180
		Other cargo	2,736
Total	7,884		9,478

Source: Department of Statistics

The typical ports in West Malaysia are Port Penang and Port Swettenham on the west coast and both of them are liner ports. With the exception of the previously mentioned petroleum and iron ore, 60% of export cargoes and 90% of import cargoes are handled by these two ports.

1-3-2 Topography of the East Coast

Most of the coasts are flat and have a simple shoreline. The sea-bed has a slow grade and there is not a single place near the coast that provides a great depth of water in its natural form.

During the South-West monsoon season which covers a period from May to September, the climate is favourable and the sea is generally calm. During this season the winds blow systematically from southeast in the daytime and from southwest at night. The period from the end of October to March is the North-East monsoon season, during which the sea is rough and a long sea surges upon the shore and the estuary. The wave height sometimes reaches 2.5 m in the vicinity of the port entrance. From November to January, heavy rainfalls often cause river floods. When a great flood occurs, the sediment transport sometimes changes the river mouth configuration and river course. During this season strong winds with a velocity of 25 m/sec blow in 3 ~ 6 days and at times the winds with a velocity of 10 ~ 13 m/sec. blow continuously for several days. The tidal current is northward during the South-West monsoon season and southward in the North-East monsoon season.

1-3-3 Ports and Harbours on East Coast

Ports and harbours on the east coast are found mostly at or around the estuary of rivers and many of them have bars at their entrance. These bars are very changeable and sometimes close up the port entrance during the North-East monsoon season.

Major ports on the east coast are Kata Baru, Kuala Trengganu, Dungun, Kuala Kemaman, Kuantan and Rompin. All of them are estuary ports. None of these ports is capable of accommodating ocean-going vessles and cargo handling

for these large ships is being accomplished through the use of barges. Main cargo items are timber and iron ore for ocean-going vessels and petroleum products and general goods for coastal freighters.

Because of the concentration of economic activities on the west coast, the volume of cargo handled is also overwhelmingly large on the west coast.

The typical cargo item handled on the east coast is iron ore, which is shipped exclusively from Port Rompin and Port Dungun. The share of the east coast in West Malaysia's total cargo handling volume is 20%, and with the exception of iron and petroleum, which are the special cargo items, the east coast falls short of 1% of the total volume. The volume of cargo handled at each port is very small except the above-mentioned two items.

The greatest disadvantage of the ports on the east coast is that they become almost inoperative during the North-East monsoon season.

1-3-4 Fishery on East Coast

Main gears used for fishing operation along the east coast are dragnet, drift gill-net, blanket net, hoop net, line and trawl net. Though small trawlers have been in wide use and the haul by this method has increased considerably in recent years, it is still smaller than the catch by other methods except in Johore State.

As for fishing boats, the majority of them are small crafts of less than 30 tons and the only 50 ton class boats are the 15 government owned trawlers.

All fishing boats operate on daily basis. The main bases of fishing operation on the east coast are Kuala Besut, Kuala Trengganu, Kuantan and Mersing.

Table I-9 Fish Catch on East Coast by Port and Gear Group

Gear Groups	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Fishing Stakes (Large)	85	89	98	112	101	118	190	246	272	270	187	86	1,853
Fishing Stakes (Small)	12	16	19	19	20	18	19	20	20	21	19	11	213
Seine Nets	403	674	765	859	932	1,354	1,236	2,283	1,890	1,711	392	208	12,706
Drift Nets	231	424	731	686	722	812	695	889	765	951	313	80	7,498
Lift Nets	787	1,007	783	616	525	956	719	1,107	1,455	1,270	972	259	10,459
Bag Nets	311	217	343	326	338	403	380	406	391	441	353	338	4,247
Hooks and Lines	416	437	389	400	392	352	318	369	429	385	246	258	4,390
Traps and Pots	186	246	275	309	334	329	354	410	384	409	261	217	3,711
Trawl Nets	864	731	690	595	539	490	511	544	723	874	926	878	8,365
The Other	25	53	97	73	51	79	110	80	67	101	26	16	778
Total	3,320	3,894	4,185	3,995	3,954	4,911	4,532	6,354	6,596	6,433	3,695	2,351	54,200

CHAPTER 2. HINTERLAND DEVELOPMENT PROJECTS

2-1 The Jengka Triangle Scheme

This is a regional development scheme worked out in 1965 by the joint efforts of the Federal Land Development Authority (FLDA) and a consultants firm. Its details are contained in a series of "the Jengka Triangle Report".

Description of the planning of Kuantan Port Project contained in the report may be summarized as follows.

The Jengka Triangle is situated in Temerloh county, Pahang State, West Malaysia and covers an area of 163,500 acres. With the addition of 25,500 acres of the existing FLDS project area, the area under this scheme totals 189,000 acres. Also, with the addition of 5,200 acre logging area other than the Development Area, the total logging area reaches 168,700 acres. Details of land use under this scheme are shown in Table I-10.

Table I-10 Land Use

Land Recommended for Agricultural use (gross areas)			Land Planned for Development				Logging Areas		
Description	Area in Acres		Description		Area in Acres		Description	Area in Acres	
Oil Palm	83,000			Oil Palm	65,500				
Rubber	41,000			Rubber	27,500				
		124,000				93,000			
				Village Agricultural	8,400[1]				
				Roads	4,800				
			Rural	Triangle			Rural		
			Areas	Roads	2,600		Areas	114,100	114
				Schools and Factories	600				114,100
				Unusable	4,700				
						21,100			
						114,100			114,100
			Towns		2,700		Towns	2,700	
						2,700			116,800[2]
			Stream Protection		4,100		Streams	4,100	
						4,100			4,100[3]
						120,900			120,900
			Forest						
			Agricultural land under forest		3,100				
Forest	39,500		Forest land		39,500		Forest	42,600	
		39,500				42,600			42,600[3]
Total New Land		163,500				163,500[4]			163,500[5]

1) Includes 6,000 acres available on houselots for secondary crops.
2) Logged 1966 - 1976.
3) Logged 1976 - 1978.
4) Excludes 25,500 acres of existing FLDA schemes, making a total area for development of 189,000 acres.
5) Excludes 5,200 acres of logged area outside the Development Area, a total logged area of 168,700 acres.

This scheme envisages mainly the clearing of forests in the Jengka Triangle and the creation of oil palm and rubber plantations in the cleared area. Under the scheme, the Triangle is to produce 28,000 tons of palm oil, 29,000 tons of palm kernel and 28,000 tons of rubber annually by 1985 to support the live of 105,000 people.

The annual forest clearance programme has been worked out for timber production and the annual planting programme has been established for oil palm and rubber plantation.

Table I-11 Annual Forest Clearance Programme

	1966[1] /7	1967 /8	1968 /9	1969 /70	1970 /1	1971 /2	1972 /3	1973 /4	1974 /5	1975 /6	1976 /7	Total[2] New Land
Project I	4,800	8,600	1,300									14,700
Project II			9,600	6,100	3,600							19,300
Project III				7,700	11,500	3,000						22,200
Project IV						11,800	4,600					16,400
Project V							8,400	4,600	8,600			21,600
Project VI								7,800	2,400	9,700		19,900
Total cleared	4,800	8,600	10,900	13,800	15,100	14,800	13,000	12,400	11,000	9,700		114,100

1) 1st July - 30th June
2) Does not include land added to existing FLDA Schemes (800 acres)

Source: The Jengka Triangle Report

Figure I-1 THE JENGKA TRIANGLE AND THE AREA OF PAHANG TENGGARA SCHEME

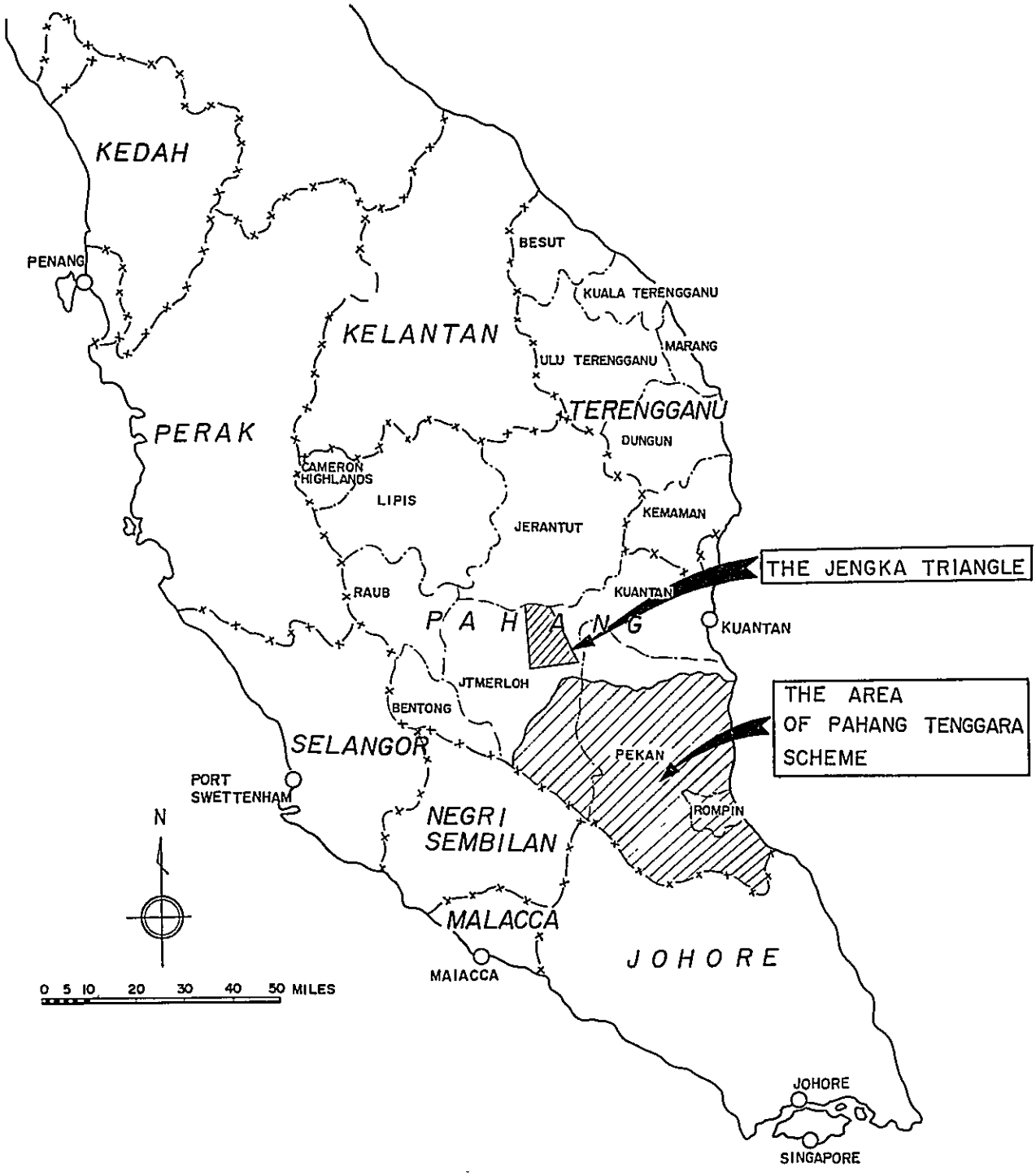


Table I-12 Annual Planting Programme (net acres planted)

	1966/7[1]	1967/7	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	Total New Land	Total FLDA	Total[2] Project
Project I														
Oil Palm		4,000	6,400	1,100								11,500	5,200)	
Rubber			600									600	)	17,300
Project II														
Oil Palm				7,900	2,900							10,800	)	
Rubber					2,000	2,800						4,800	3,800)	19,400
Project III														
Oil Palm					6,300	9,400	700					16,400	)	
Rubber							2,400					2,400	5,600)	24,400
Project IV														
Oil Palm							2,700	3,800				13,500	)	
Rubber												-	3,300)	16,800
Project V														
Oil Palm								6,900				6,900	)	
Rubber									3,600	6,700		10,300	)	17,200
Project VI														
Oil Palm									6,400			6,400	)	
Rubber										1,900	7,500	9,400	)	15,800
Total Oil Palm		4,000	6,400	9,000	9,200	9,400	10,400	10,700	6,400			65,500		
Total Rubber		-	600	-	2,000	2,800	2,400	-	3,600	8,600	7,500	27,500		
Total Planted		4,000	7,000	9,000	11,200	12,200	12,800	10,700	10,000	8,600	7,500	93,000	17,900	110,900

1) (1st July - 30th June)
2) Does not include land added to existing FLDA Schemes (800 acres)

Source : The Jengka Triangle Report

The annual movements of goods expected to be generated in the Triangle are shown in Tables I-13 and I-14.

Table I-13 Primary Goods Movements (tons per year)

Internal-Triangle	1970	1975	1980	1985
Oil Palm (FFB)	55,300	375,000	625,000	640,000
Rubber (Latex)	5,600	23,000	46,000	80,000
Logs [1]	255,000	255,000	255,000 [2]	200,000 [3]
External				
Palm Oil (in bulk)	9,000	69,000	125,000	128,000
Palm Kernels (in sacks)	2,400	17,000	28,000	29,000
Rubber (crates)	2,000	8,000	16,000	28,000
Logs [1]	50,000	50,000	50,000	50,000
Processed Timber	100,000	100,000	100,000	100,000

1) Log tons of 50 cubic feet (Forest Department Measure)
2) Annual volume assumed from Sungai Tekam area 1979-1981 moving to Triangle's Forest Industry
3) Possible annual volume from forest areas outside Triangle and Sungai Tekam, moving to Triangle's forest industry.

Source: The Jengka Triangle Report

Table I-14 Secondary Goods Movement [1] (tons per year)

	1970	1975	1980	1985
Food	9,000	24,000	30,000	30,000
Consumer Goods	9,000	24,000	30,000	50,000
Miscellaneous Goods	6,000	9,000	12,000	15,000
Fuel	6,000	16,000	20,000	20,000
Fertilizer	12,000	31,000	32,000	32,000

1) External only, additional internal movement would be required for local distribution.

Source: The Jengka Triangle Report

2-2 The Pahang Tenggara Scheme

This is a large scale regional development project covering the southern half of Pahang State. The plan of the project is being worked out by FEMCO, a Canadian consultants firm. When the survey team visited the project area the Canadian survey team had been engaged in the survey for only a month and as a result, no definite planning had been made yet.

According to the Canadian survey team, the project area of the Pahang Tenggaru Scheme covers the area south of the Pahang River in Pahang State or the part of Pekan county and Temeloh county. (See Fig. I-1). The only definite information available was that clear cutting will be given to a forest area of 11 million acres for the establishment of industries including agriculture and that the cutting will start either in 1970 or in 1975 for completion in 1990.

FEMCO has also been requested to make a study on the feasibility of inviting 800 thousand - 1,000 thousand settlers to this region. The forest area to be cleared under this scheme is about 6-1/2 times larger than that under the Jengka Triangle Scheme.

2-3 Other Development Projects in Each State

The states involved in the Kuantan Port Project are Pahang State and Trengganu State. In addition to the aforementioned large scale projects, other development projects are being implemented by the Federal Land Development Authority (FLDA), state governments, Forest Office and private sectors in these two states.

FLDA is pushing forward oil palm and rubber plantation projects in several places.

For Pahang and Tengganu States a variety of industrial development projects are being planned and for agriculture, in particular, production of rice, coconut and tapioca is also envisaged in addition to the production of oil palm and rubber.

The falling programme which is under the overall control of the Forest Office is established as a detailed long-range plan.

Some of the development projects by private sectors are being guided and promoted by the state governments, but there are some which are not placed under the control of the state governments.

Details of regional development project for Trengganu State are given in the "Regional Economic Development Plan for the State of Trengganu, December 1968".

2-4 Petroleum Prospecting Project

In West Malaysia no crude oil is being produced at present. In Port Dickson there are two oil refineries, and of a total of 4.7 millions tons of petroleum landed at West Malaysian ports in 1968, the majority was crude oil handled in Port Dickson. The crude oil is brought in mainly from Saudi Arabia and Kuwait.

The oil production in West Malaysia is still at the prospecting stage and oil drilling fields have been established in the sea off the east coast and the west coast as shown in Fig. I-2. On the east coast ESSO and Continental Oil Co. are prospecting the area for oil but the results are not known at present.

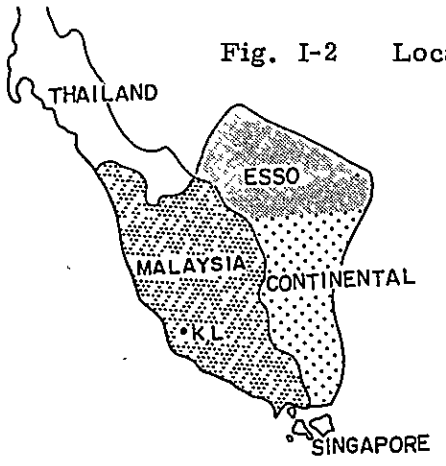


Fig. I-2 Location Map for Petrolume Prospecting

Should their prospecting succeed, the crude oil will be refined at the said refineries at Port Dickson or at the existing oil refineries on the west coast. Though the construction of temporary oil storage facilities on the east coast is conceivable, the scale of such facilities will not be such that have to be taken into consideration for the Kuantan Port Project. Therefore, the only factor to be taken into consideration in planning the Kuantan Port Project in respect of oil prospecting is the use of the port as the base of the prospecting.

The prospecting is being provided by work boats. The use of the port as the base of oil prospecting will be the loading of personnel, foodstuffs and necessary parts and storage of these items. At present the port of Singapore is being used for this purpose and the ferry service between the port and the field takes one full day. Therefore, the use of Kuantan Port for this purpose is expected upon completion of the port, but the question is how long the oil prospecting will last. For this reason, much cannot be expected of the oil prospecting for the use of Kuantan Port.

CHAPTER 3. PRESENT STATE OF KUANTAN PORT

3-1 General

The port of Kuantan is situated in Kuantan, the capital city of the State of Pahang which is the largest state in West Malaysia, and is an estuary port at the mouth of the Kuantan River. The city of Kuantan is on the left bank of the Kuantan River and the other side of the river is mostly marsh land with no community except a fishing village which is situated at the mouth of the river.

As the Kuantan River makes a sharp northeast to southeast turn in its course within the city area, the water on the side of the left bank is deep enough for use as a port. The city of Kuantan is situated at the most important location on the east coast. That is, the city is linked to Kuala Lumpur, the capital of Malaysia, by Route 2 and is located almost in the middle of the east coast.

Kuantan Port was originally used for the shipment of tin ore produced on the east coast. Until the beginning of this centry when the road linking with the west coast was completed, it played a vital role as the entrance to the State of Pahang. With the expansion of road network and the gigantification of sea vessels, however, its importance has been on the gradual decline.

As shown in Table I-15, the total volume of export cargo handled at the port, in which iron ore accounts for about 90%, has been decreasing sharply every year. However, the volume of timber and petroleum is expected to increase in the future.

Table I-15 Cargo Handling Volume at Kuantan Port

(Unit: tons)

	Inbound			
	General cargo	Petroleum products		Total
1966	9,932	38,277		48,239
1967	8,915	40,744		49,659
1968	5,741	40,441		46,183
1969	3,500	44,365		47,865
	Outbound			
	Timber, logs	Iron ore	Tin ore	Total
1966	25,262	619,841	2,191	645,294
1967	25,876	456,316	2,308	484,500
1968	29,653	291,993	2,281	323,927
1969	32,529	229,054	2,226	263,809

Iron ore is exported exclusively to Japan and timber is shipped to both Japan and Singapore. The ships carrying these cargoes are of 5,000－10,000 D/T and can not be accommodated in Kuantan Port. Therefore, these ships anchor in the offing of Tembeling point, with barges used for loading of these outbound cargoes. However, the cargo handling is suspended during the North-East monsoon season, particularly in the period from November to February when the stormy weather is prevalent.

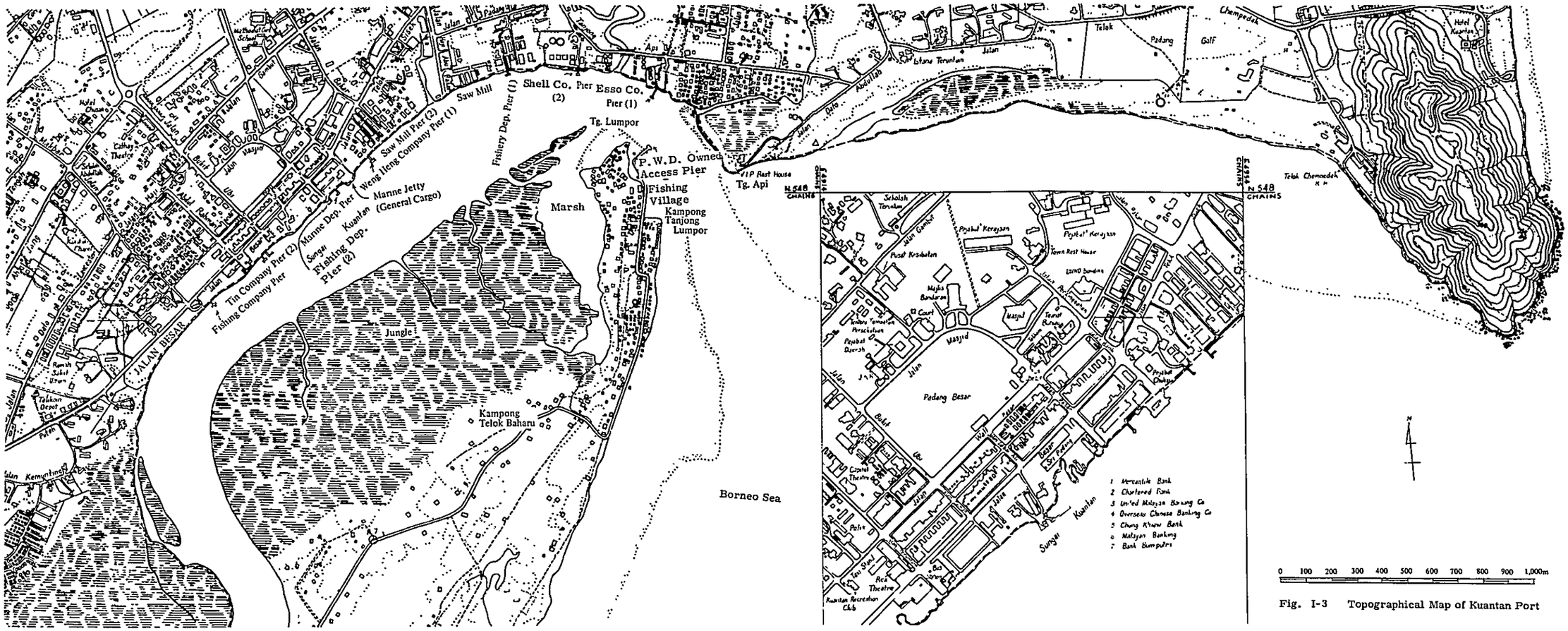


Fig. I-3 Topographical Map of Kuantan Port

The main item of coastal cargo is petroleum imported from Singapore. The coastal vessels are mostly of 200 G/T and the largest tanker available is of 557 G/T.

3-2 Fishery

The number of fishermen in the State of Pahang centering around the Kuantan district was 2,534 in 1969 and the number has been almost constant over the past few years. The haul has been increasing every year since 1967 and a record catch of 8,378 tons was achieved in 1969. The number of fishing boats as of the end of 1969 was 602, of which 422 were powered boats, 44 with outboard motors and the remaining 136 without motors. In 1967 six 50-ton trawlers were brought in by the Government and are now being used for fishing operation with an additional purpose of training fishermen.

Another fleet of five trawlers assigned to Kuala Trengganu is now operating with Kuantan Port as the base. Both of these fleets are giving satisfactory results and the increase in the number of trawlers is being considered, as well as the increase in the number of operating days.

Table I-16 Number of Fishermen and Catch in Kuantan District by Gear Group (1969)

Gear Groups	The Number of Fishermens	Landing of Fish
Seine Nets	675	1,473 ton
Drift Nets	562	1,325
Lift Nets	270	2,874
Lines	336	603
Traps	72	87
Trawl	524	1,736
The Other	95	280
Total	2,534	8,378

Table I-17 Number of Fishing Boats (Motored) in Kuantan District by Tonnage, 1969

Tonnage	Less than 5	5 ~ 14	15 ~ 29	30 ~ 44	45 ~ 59	More than 60
Number of boats	129	209	3	0	10	0

Note: Marketing of marine products
The catch landed is consumed as fresh supply and some are processed into salted or dried fish. In Kuantan there are two retail markets, a larger one and a smaller one. The larger market is located near the landing quay in the center of the city and the smaller one is about 2 miles apart from it.

The fish landed are handled by agents, who also buy fish from Kemmaman and Trengganu. Through the hand of the agents high-class fish are shipped mainly to Kuala Lumpur and Singapore, while popular fish are directed for consumption in and around Kuantan. Transportation of the catch is mostly in the hand of transport firms which use trollys. Retailers in the large market number 40 and each retailer sells 1.5 pikuls (Approximately 90 kg) of fish per day. About 4 tons of fish are handled by the large market per day.

In the Kuantan district there is a government-owned cold storage facility, which consists of a frozen fish storage room (19 ton in capacity), fresh fish storage room (22 ton capacity), salted fish storage room (33 ton capacity) and an ice storage room (95 ton capacity). Besides, there is a small freezer which the government installed for experiment purpose.

Facilities owned by private firms are three cold storage rooms of 10 ton capacity and one ice storage room of 10 ton capacity. Two privately owned ice-making plants having a daily production capacity of 30 tons are in operation to meet local demand.

3-3 Port facilities

The present facilities of Kuantan Port include a fishing port, petroleum and general cargo handling facilities located at the estuary, a timber shipping facility located at a point about 8 km upstream and an iron ore shipping facility at a point approximately 40 km farther upstream.

At the mouth of the river most facilities are provided on the left bank along the river. Facilities on the right bank include only a pier for ferry boats at the mouth of the river and some mooring bitts for fishing boats. The mooring bitts for fishing boats are provided mainly on both sides of the river and at the estuary close to the coastline at low tide and the material used are mostly palm trees. Because of slow grade of the sea-bed and a tidal range of 3.5 m, boarding and leaving the boats and the landing of the catch are being accomplished in the water.

Some of the facilities for small fishing crafts on the left bank utilize the revetment of the river, but most of them are either T-shaped or L-shaped landing stages. The length of berth varies greatly ranging from 2 m to 40 m and most of them are wooden piers but some are made of concrete.

Main facilities include:

o Landing stage owned by the Fishery Department

This is a 2.4 m wide L-shaped landing stage with a berth length of 17 m. It is used exclusively by the trawlers for the training of fishermen. At the back of the landing stage are a government-operated catch handling yard, refrigeration and cold storage room and ice-making plant.

o Lnanding pier owned by the Marine Department

This is a 17 m wide and 40 m long lateral landing pier used for handling of general cargo. At the back are the customs and immigration office and a warehouse. Pilots are also assigned here on a permanent basis. Besides, there is a small landing stage nearby for exclusive use by the boats owned by the Marine Department.

- o Landing stages owned by petroleum firms

  Each of ESSO and Shell has its own landing stage which is used for unloading of petroleum through pipe lines.

- o Others

  There are two landing stages owned by a tin firm and two landing stages, each owned by a timber firm and a fishery firm for their exclusive use.

- o For shipment of timber, a wooden revetment is used with a mobile crane employed for loading timber on barges.

- o For shipment of iron ore, the ore is first transported to the shipping yard by trucks and is loaded on barges through a chute installed on the pier extending about 5 m from the river bank.

3-4 Problems

Because of the sharp curve of the Kuantan River near its estuary, a fairway is provided along the left bank and a depth of 4 m is always maintained in front of mooring facilities. However, the navigation route off the estuary is often obstructed during the North-East monsoon season by the development of bars. The bars sometimes rise to a depth of about 60 cm beneath the water surface. Dredging of bars is conducted almost every year during a period from April to September following the North-East monsoon season to obtain a depth of 1.8 m. The bars are the most serious problem confronting Kuantan Port at present. Ocean going vessels are not able to enter the port and as a result, they have no alternative but to anchor off the coast and use barges for loading and unloading of cargo. However, during the period from November to March stormy weather and high sea is so frequent that the operation of barges becomes impossible and as a consequence, calls by ocean-going vessels are suspended during this period.

CHAPTER 4. KUANTAN PORT IN FUTURE

4-1 Forecast of Hinterland for Exports and Imports

4-1-1 General

In forecasting the hinterland of Kuantan Port for exports and imports for the period up to 1985, it was assumed that the port would not grow to the level of a liner port by that time but would only attain the level of a port capable of accommodating trampers and coastal vessels. For this reason, the hinterland forecast for 1985 was made only for exports and imports by trampers and coastal vessels.

4-1-2 Hinterland for Exports and Imports by Trampers

The forecast of hinterland for exports and imports by trampers calling at Kuantan Port was made by taking into consideration the possible future competition with Singapore, Johor, Malacca, Port Swettenham and Penang, all of which allow the entry of large vessels. The boundary between the hinterland of Kuantan Port and those of these competing ports was considered to be the line linking the points where the transport cost from Kuantan Port and other competing ports becomes equal.

Assuming that the area in which Kuantan Port competes with other ports is flat and without any obstruction to trucking, the plane so assumed allows free running of vehicles along an arbitrarily selected route and therefore, the boundary of hinterland is considered to be the line linking the points that vertically bisect the distance between Kuantan Port and each of the competing ports. This arrangement closely resembles a fully developed road network under such assumption, the "theoretical hinterland" of Kuantan Port may be represented by the demarcation line A-B-C-D-E shown in Fig. I-4.

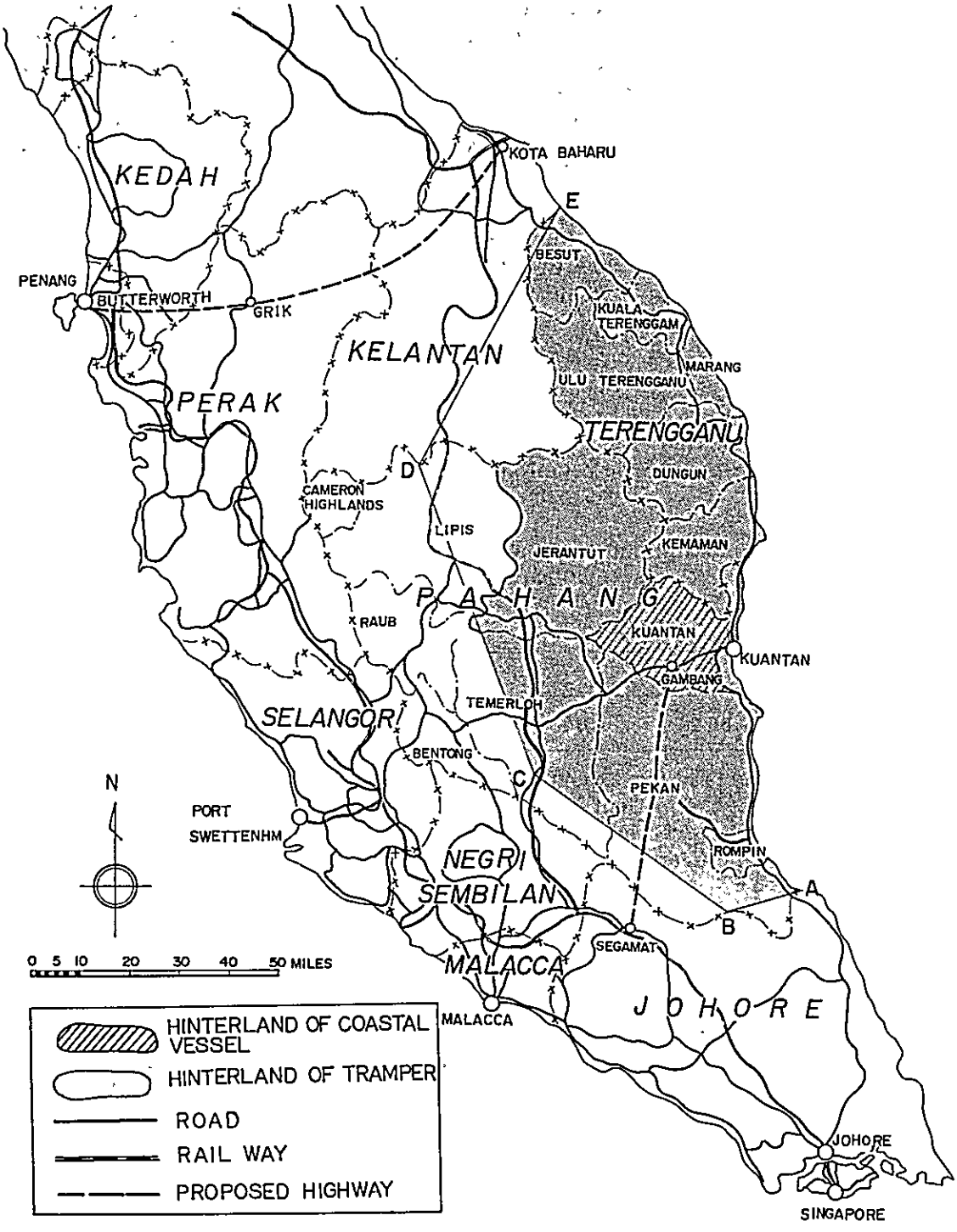
The said line is obtained by linking the point bisecting the straight lines connecting Kuantan Port with Singapore, Malacca, Port Swettenham and Penang, with the addition of the coastal line.

Many of the areas where competition between the Kuantan Port and other ports is expected are yet to be developed and access to these areas over the land from any of the above-mentioned ports is extremely difficult. However, for some of these areas, Pekan district and Temerloh district of the State of Pahang, for example, a large scale regional development project is being planned and consequently, development of a good road network which is an essential element of the development project. can be reasonably anticipated.

The Gambang — Segamat road under planning is considered to become the nucleus of the road network in these areas. Therefore, the hinterland in these areas is considered to coincide with the "theoretical hinterland" which is demarcated by lines A-B-C-C' in Fig. I-4. Point C' is the intersecting point of Jerantut and the line segment CD.

For the area north of point C', however, the topographic conditions cannot be ignored.

Figure I-4 HINTERLAND OF KUANTAN PORT



Though the eastern part of the State of Kelantan is included in the "theoretical hinterland", there is no road plan for the mountain range stretching between the States of Kelantan and Trengganu and therefore, the aforementioned method of forecasting the hinterland is meaningless.

The northern part of the State of Kelantan is expected to have close relations with Penang through East-West Highway in the future. Therefore, the State of Kelantan should be excluded from the hinterland of Kuantan Port. In the State of Pahang, a part of the Lipis district is included in the "theoretical hinterland". This part, however, is connected with Port Swettenham by railways and should therefore be also excluded from the Kuantan's hinterland. The whole area of Jerantut district is included in the hinterland of Kuantan Port mainly for the convenience in processing coefficients. Thus, the hinterland for exports and imports by trampers calling at Kuantan Port may be determined to be the hatched section shown in Fig. I-2. It includes:

State of Pahang:	100% of Kuantan district
	100% of Jerantut district
	80% of Pekan district
	50% of Temerloh district
State of Trengganu:	100%

The hinterland for exports and imports by trampers covers an area of 13,125 square miles. The population in the hinterland for each stage of the project period, calculated on the basis of the present growth rate and in proportion to the above-mentioned division of the districts, is estimated as follows.

Estimated Population in the Hinerland for Exports and Imports by Trampers

(Unit: 1,000)

1970	1975	1980	1985
644	858	1,168	1,471

The hinterland for exports and imports by trampers calling at Kuantan Port includes 75% of the project area covered by the Pahang Tenggara Scheme and the entire area covered by the Jengka Triangle Scheme. Also, 58% of the State of Pahang is included in the hinterland of Kuantan Port.

4-1-3 Hinterland for Exports and Imports by Coastal Vessels

The hinterland for exports and imports by coastal vessels calling at Kuantan Port is different from that by trampers. It is important to determine the hinterland for coastal vessels by taking into consideration mainly the possible competition between the land transportation by trucks direct from Port Swettenham and the sea-road transportation from Singapore via Kuantan Port. This competition is illustrated in Fig. I-5.

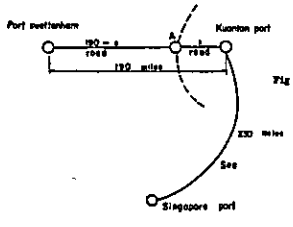


Fig I-5 Hinterland for Exports and Imports by Coastal Vessels Calling at Kuantan Port

In the course of study, account was taken of the competition with Kuala Trengann and other ports at which coastal vessels call. However, as it became clear that the overland transportation from Swettenham has an overwhelmingly large influence, competition with these ports was disregarded in actually determining the hinterland.

In this figure A is the point at which the cost of land transport from Port Swettenham and that of the sea-road transport from Singapore come to balance and x indicates the distance over the road from Kuantan Port to point A. As the distance between Kuantan Port and Port Swettenham is 190 miles*, $(190 - x)$ miles is the distance from point A to Port Swettenham. The distance between Singapore and Kuantan Port is 230 miles by sea route.

The transport cost from Port Swettenham to point A, assuming that the unit cost by a 5-ton lorry is 16.56 ¢ /t/mile, will be:

$$0.1656 \times (190 - x) \text{ \$/ton} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Against this, the cargo to be transported from Singapore to point A must go through such steps as the loading at Singapore, sea transportation from Singapore to Kuantan, unloading and storage at Kuantan Port and land transportation from Kuantan Port to point A. The transportation cost in this case will be:

$$6.30 + 0.05 \times 230 + (6.30 + 1.50) + 0.1656 \times x \text{ \$/ton} \quad \ldots\ldots \quad (2)$$

where, 6.30 \$/t: Cost of cargo handling through transit shed (For the case at Port Swettenham).

0.05 \$/t/mile: Coastal sea freight (Estimate).

1.50 \$/t: Minimum charge for use of transit shed (For the case at Port Swettenham)

By equating costs (1) and (2) above, the value of x can be obtained as follows.

$$0.1656 \times *(190 - x)$$

$$= 6.30 + 0.05 \times 230 + (6.30 + 1.50) + 0.1656 \times x$$

$$x \fallingdotseq 18$$

* obtained by multiplying 146 miles (the beeline distance between Kuantan Port and Port Swettenham) by 1.3 (actual road extension/air-line distance)

$$146 \times 1.3 = 190$$

Thus, the Port of Kuantan is most advantageous from the standpoint of transport cost in the area within a radius of 18 miles from it. The smaller the distance to the coast of Kuantan is, the greater should be the distance to the point where both costs are balanced. However, in consideration of the roughness of the calculation, a semicircle having a radius of 18 miles may be considered to be the hinterland for exports and imports by coastal vessels calling at Kuantan Port.

As a result of the above analysis, the hinterland of Kuantan Port for coastal trade may be considered to almost coincide with the District of Kuantan.

4-2 Estimated Volume of Cargo

4-2-1 General

(a) Liner cargo

As the accommodation of liners by Kuantan Port in 1985 is not conceivable, the volume of liner cargo was excluded from the estimated cargo handling volumes of the port in 1980 and 1985.

(b) Tramper cargo

The estimate on the volume of tramper cargo handled by Kuantan Port was based on the estimated production and consumption of materials during and following the development of the hinterland. Kuantan Port is expected to handle palm oil, saw-timber, and fertilizers. Of these items, palm oil and saw-timber are expected to be transported by trampers for export and fertilizers are expected to be imported also by trampers. However, the total production or consumption of materials does not necessarily correspond to the amount of exports or imports. In the team's estimate, the volume of cargo to be handled by Kuantan Port was obtained by deducting the amount of domestic consumption or domestic supply from the total production or consumption and further by deducting the volume of cargo to be handled through other liner ports. In the course of estimate a study was made also on the volume of palm kernel, rubber, minerals and timber. However, these items were not included in the estimate on the volume of cargo handled by Kuantan Port.

In estimating the volume of cargo following the development of the area, efforts were made to obtain as dependable future values as possible. However, there were naturally many uncertainties about the production 15 years hence. For this reason, daring assumptions had to be made at times in the course of the estimate. The most significant assumption made was for the estimate on the volume of cargo related with the Pahang Tenggara Scheme. In this connection, it will be necessary to make another estimate on the volume of cargo to be handled by Kuantan Port at the time when the development project becomes definite.

The estimate on the volume of cargo related with the development project was made separately for the Jengka Triangle Scheme, the Pahang Tenggara Scheme, State of Pahang and State of Trengganu. The estimate on the volume of cargo related with the Jengka Triangle Scheme was made on the basis of the Jengka Triangle Report. The only information available on the Pahang Tenggara Scheme besides the development scope under study was that clear-cutting will be made in 1.1 million acres of forest during the period from 1970 or 1975 to 1990 for regional development. For this reason, it was unavoidable for the team to make assumptions on the nature of this scheme by modifying the period and the scale of the Jengka Triangle Scheme. The State of Pahang of course includes Jengka Triangle and Pahang Tenggara.

In the estimate on the volume of cargo, the schemes planned by the central government and the state governments for the area excluding the above two regions are referred to as the project of the State of Pahang. As this project covers a period of only about 5 years, the estimate on the volume of cargo in 1980 and 1985 was made by extending this period.

The estimate on the volume of cargo related to the project of the State of Trengganu was also made on the basis of the schemes planned by the central government and the state government.

As stated in the Jengka Triangle Report, a large quantity of foodstuff, consumer goods and fuel is expected to be required for the implementation of these projects. The estimate on the volume of these cargoes was made separately as coastal cargo.

(c) Coastal cargo

General cargo such as foodstuff and consumer goods and petroleum products are expected to be transported by coastal vessels. The hinterland for imports of these goods by coastal vessels is considered much smaller than that by trampers and the increase in the volume of cargo transported by coastal vessels with the progress of the development project is not considered as sharp as that in the case of trampers. For this reason, the values in 1980 and 1985 were estimated by simply taking into account the present cargo handling trends of Kuantan Port.

For the transportation of tapioca, it was assumed that a part of the product would be transported to liner ports by coastal vessels.

4-2-2 Basis of the Item-wise Estimate on the Volume of Cargo Handled at Respective Ports

(a) Palm oil

(1) Estimated production

Production of palm oil in the hinterland of Kuantan Port in 1980 and 1985 is estimated as follows.

(Unit: 1,000 tons)

	1980	1985
Jengka Triangle	125	128
Pahang Tenggara	116	342
State of Pahang	108	642
State of Trengganu	108	120
Total	660	1,232

Yield of oil palm may be calculated by the following formula:

$$P_n = \sum_{i=1970}^{n} a_i P_i \qquad n = 1980 \ \& \ 1985 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where: a_i : Planted area in i year
P_i : Basic unit of palm oil yield in i year *1

- Figures for Jengka Triangle are based on the Jengka Triangle Report.
- Pahang Tenggara *2

Assuming that the planted area is 34,000 acres/year on the average and that planting will start in 1973:

P_{1980} = 155,000 tons, P_{1985} = 456,000 tons

Assuming that 75% is produced in the hinterland:

P'_{1980} = 155 x 0.75 - 116,000 tons

P'_{1985} - 456 x 0.75 = 342,000 tons

o Yield of oil palm in the State of Pahang may be obtained also by formula (1).

*1 Basic unit of palm oil yield

According to the Jengka Triangle Report, palm oil may be harvested from the 3rd palm oil year and the yield continues to increase to the 10th palm year. Thereafter, a constant yield of 1.8 tons/acre is maintained. The same trend is seen with palm kernel.

Table I-18 Estimated Palm Oil Yield

Palm year	Oil tons/year	Kernel tons/year
3rd	0.055	0.025
4th	0.468	0.162
5th	0.945	0.2855
6th	1.462	0.342
7th	1.60	0.36
8th	1.70	0.3725
9th	1.76	0.376
10th	1.80	0.405
11th	1.80	0.405
12th	1.80	0.405
13th	1.80	0.405
14th	1.80	0.405
15th	1.80	0.405

Source:

The Jengka Triangle Report, Resources and Development

* 2 Assumption of land use in Pahang Tenggara District

From the examples of the Jengka Triangle Scheme it is estimated that 79% of the cut-over area will be converted to substantial agricultural land. Consequently, the agricultural land in the District of Pahang Tenggara will be:

1.1 million acres x 0.70 = 870,000 acres

Under the Pahang Tenggara Scheme 1.1 million acres of forest is expected to be cleared during the period either from 1970 or 1975 to 1990. If the clear cutting begins in 1973, the cutting and planting period will be 18 years. Accordingly, the average annual planting area will be:

870,000 ÷ 18 = 48,000 acres/year

As there is a time lag of 13 months between cutting and planting as seen in the examples of the Jengka Triangle Scheme, planting is expected to last from 1974 to 1991.

Assuming that 70% of agricultural land is used for oil palm planting and the remaining 30% for rubber planting as in the case of the Jengka Triangle Scheme, the planting area of oil palm will be:

48,000 x 0.7 = 34,000 acres/year

and that of rubber will be:

48,000 x 0.3 = 14,000 acres/year

Agricultural Land (1,000 acres)

	1980	1985
Palm oil	240	400
Rubber	100	170
Total	340	570

As stated previously in 4-1, production in the State of Pahang as referred to in this section means the combined production under the schemes of the central government and the State of Pahang excluding the districts of Jengka Triangle and Pahang Tenggara.

The same description is used for rubber, timber and fertilizer. This project consists of many small schemes and is not systematic like the Jengka Triangle Scheme and the Pahang Tenggara Scheme and therefore, pi should be given a smaller value. At present, P_i in Malaysia is 0.6 ~ 0.7 tons/acre on the average. In the case of the state, the yield shown in Table I-18 should be 2/3. a_i is estimated to be about 40,000 acres/year after 1975.**

o State of Trengganu

For the State of Trengganu, calculation was made by taking into account such projects as FLDA project for the District of Ulu Trengganu, the State project for Kuala Trengganu District, state and private projects for Kemmaman District as well as the suitable land in Dungun District. a_i was considered to be the same as in the State of Pahang. The area of palm oil plantations was estimated at 91,000 acres in 1980 and 101,000 acres in 1985.

(b) Estimate on the volume of cargo handled by Kuantan Port

All of the production in the hinterland, obtained in the preceding paragraph (a), was considered to be shipped through Kuantan Port. It is conceivable that a small quantity of palm oil for export is shipped in exclusive containers. In such a case, palm oil will probably be transported by coastal vessels to liner ports where it will be packed in containers. In this estimate, however, the above-mentioned method of transporting palm oil was not considered to become a general trend in the future and therefore, the volume of cargo which might be transported in such a manner was not taken up for calculation. It was considered that part of palm oil produced in the State of Trenggara

would be transported by coastal vessels from Kuala Trengganu to Kuantan Port for transshipment by larger vessels (Details will be discussed later).

(c) Timber

In 1969 a total of 33,000 tons of timber was exported from Kuantan Port. However, the government policy prohibits the export of timber after 1980 and for this reason, timber was disregarded in estimating the volume of cargo to be handled by Kuantan Port in the future.

(d) Processed Timber

The volume of processed timber for export was estimated as follows:

Volume of export = (Total production) - (Domestic consumption) x (Ratio of shipment by trampers)

Total production and domestic consumption of processed timber, ratio of shipment by trampers and export volume were estimated to be as follows in 1980 and 1985.

(1,000 tons)

		1980	1985
Production:	Jengka Triangle	(105)	(105)
	Pahang Tenggara	(203)	(263)
	State of Pahang	(280)	(344)
	State of Trenggara	(231)	(222)
	Total	879	934
Domestic consumption		151	221
Ratio of shipment by trampers		0.5	0.5
Volume of export		364	357

(1) Estimate on production

o Jengka Triangle

As given in the Jengka Triangle Report.

o Pahang Tenggara

The area cleared annually:

$$\frac{1,100,000 \text{ acres}}{18 \text{ years}} = 60,000 \text{ acres (Refer to *2,)}$$

The volume of annual cutting will be:

60,000 acres/year x 15 tons/acre = 900,000 tons/acre

If the concepts of the Jengka Triangle Scheme are held:

The volume of saw-timber exported will be:

900,000 tons x 0.195 = 180,000 tons

The volume of processed timber will be:

900,000 tons x 0.805 = 720,000 tons

If 48.5% yield rate of processed timber envisaged in the Jengka Triangle Scheme is taken, production of processed timber will be:

720,000 tons x 0.485 % = 350,000 tons

Production in the hinterland of Kuantan Port, therefore, will be:

350,000 tons x 0.75 = 263,000 tons (in 1980 and 1985 respectively)

o State of Pahang

The area of clear cutting in the whole region of the State of Pahang in 1969 is estimated at about 70,000 acres. Assuming that this pace is maintained also in 1980 and 1985, timber production in each of the two years will be:

70,000 acres x 15 tons/acre = 1,050,000 tons

As the cutting area in the forest reserve in the State of Pahang in 1980 and 1985 is estimated at 34,000 acres respectively (Source: Forest Office), the volume of cutting will be:

34,200 acres x 15 tons = 520,000 tons

Therefore, the total volume of annual cutting in the State of Pahang will be:

1,050,000 tons + 520,000 tons ==1,570,000 tons

This figure does not include the production in Pahang Tenggara. For Jengka Triangle, however, development was already under way in 1969 and therefore, the production is considered to be included in the above figure. The share of forest land in the hinterland in the total area of forest land in the State of Pahang is 58.7%. The share in the total production will be:

1,570,000 tons x 0.587 = 922,000 tons

Deduction of 205,000 tons, annual saw production in Jengka Triangle, from this figure will leave:

922,000 tons - 205,000 tons = 717,000 tons

This is the production of timber in the State of Pahang in 1980 and 1985 respectively as defined in this section.

Assuming that the ratio of timber processed in the hinterland will increase annually and that the ratio which was 40% in 1970 will increase to 65% in 1980 and to 80% in 1985, and that the output/input ratio of saw-timber will remain at the current value of 60%, the output of saw-timber is estimated as shown in the table below.

	1980	1985
Production of timber in the hinterland (A)	717	717
Ratio of processing in the hinterland (B)	0.65	0.80
Input of saw-timber (C)=(A)x(B)	466	574
Output/input ratio (D)	0.60	0.60
Output of saw-timber (E)	280	340

o State of Trengganu

As the area of selective cutting in the State of Trengganu in 1980 and 1985 is estimated at 23,600 acres*, the production of timber by selective cutting will be:

23,600 acres x 15 tons/acre = 350,000 tons

* Source: Forest Office

The volume of clear cutting is estimated at 35,000 tons (1980) and 20,000 tons (1985) by the Forest Office. Accordingly the total production of timber in 1980 and 1985, will be as tabulated below.

(1,000 tons)

	1980	1985
By selective cutting	350	350
By clear cutting	35	20
Total production	385	370

The above figures do not represent a significant increase over the figures at present. Nonetheless the number of processing factories is expected to increase twofold in the near future. It will be appropriate, therefore to consider that all the timber produced in the State of Trengganu will be processed within the state. Assuming that the yield rate of processed timber is 60% as in the case of the State of Pahang, the output of processed timber will be as follows.

(1,000 tons)

	1980	1985
Production of processed timber	231	222

(2) Estimated domestic demands for processed timber

Domestic demands for processed timber may be expressed by the following simple formula.

(Domestic demands for processed timber) = (population) x (Consumption of processed timber per capita)

o Per capita consumption for the future was determined on the basis of the present growth rate in West Malaysia as a whole. The annual growth rate of consumption in West Malaysia in the past 10 year was 2.5% and is expected to increase further in the future although it may be accompanied by minor fluctuations. Therefore, the growth rate in the future is estimated at 3% with 1969 as the base year. As the achievement in 1969 was 0.093 ton/person, domestic demands for processed timber in the future are estimated as follows.

1969	1980	1985
Population* (1,000)	1,168	1,471
Per capita consumption (tons/person) 0.093	0.129	0.150
Domestic demands for processed timber (tons)	151	221

(3) Utilization of trampers

Utilization of trampers for export of processed timber was not practiced widely in the past. In recent years, however, there has been an increasing tendency to use trampers for such purpose with the increase in the size of timber lot. Meanwhile, some shipping firms are considering the containerization of processed timber. For this reason, it is extremely difficult to make an accurate prediction of the export pattern for processed timber in the circumstances. The hinterland of Kuantan Port is expected to play a vital role in the future as the main export base for timber in West Malaysia and the increase in the size of lot of the processed timber produced in the area is also conceivable. With the emergence of Kuantan Port, which will largely facilitate the transportation of cargo, the number of consignors who prefer to use this port will certainly increase in the future. Consequently, the rate of utilization of trampers for shipment of processed timber was estimated to be between 40% and 60%. In this estimate, 50% was adopted as a medium.

* Estimated population within the hinterland

An estimate on the population within the hinterland was made by making a separate estimation on the population in Jengka Triangle, Pahang Tenggara and in the State of Pahang and the State of Trenggara excluding the foregoing two districts. Table I-19 shows the population for each project year.

Table I-19 Population in the Hinterland of Kuantan Port

	1965	1970	1980	1985
Jengka Triangle	-	38	105	105
Pahang Tenggara	-	-	240	405
State of Pahang	175	201	263	301
State of Trengganu	341	405	560	660
Total	566	644	1,168	1,471

The population in Jengka Triangle was based on the Jengka Triangle Report. For Pahang Tenggara, it was considered that the population would increase in proportion to the expansion of agricultural land.

For the State of Pahang, an annual increase rate of 2.7% was considered and for the State of Trengganu, the increase was estimated at 2.5% annually.

(d) Tapioca (bullet type.)

For the shipment of tapioca, it was considered thatp art of bullet type tapioca, used for feed, would be shipped from Kuantan Port aboard coastal vessels. The shipment is estimated as follows.

1980	1985
75,000 tons	133,000 tons

The products of tapioca may be divided broadly into three types. They are Starch used for foodstuff, bullet type for export as animal feed and waste tapioca mostly used as domestic feed. Their shares in the total production of raw tapioca are 20%, 40% and 20% respectively. Shipment of all the three products is made in sacks. There is a UBIYU factory in Kuantan City and all tapioca produced in the State of Pahang is processed in this plant. In view of the production level of this plant and the type of packing for shipment of tapioca, it was considered that tapioca would not be exported directly from Kuantan Port aboard trampers but would rather be exported from Singapore.

The proposed acreage for planting tapioca by 1980 is 15,600 acres for the State of Pahang. The basic unit of production for raw tapioca is estimated at 12 tons/acre. Accordingly, the volume of bullet type tapioca to be handled by Kuantan Port in 1980 is estimated as follows:

15,600 acres x 12 tons/acre x 0.40 = 75,000 tons

Assuming that the production will grow by the same rate, the volume in 1985 is estimated as follows:

75,000 tons x 1.5 = 113,000 tons

(e) Fertilizer

The quantity of fertilizers to be imported by trampers was estimated by the following formula.

(Quantity of fertilizer imported) = (Demands within hinterland) x (1 - rate of domestic supply) x (Tramper utilization rate)

		1980	1985
Demands in hinterland			
Jengka Triangle		(32)	(32)
Pahang Tenggara		(74)	(128)
State of Pahang		(149)	(205)
State of Trengganu		(39)	(41)
Total	A	294	396
Domestic supply	B	0.5	0.5
Tramper utilization rate	C	0.5	0.5
Quantity of fertilizer imported	D	70	99

(1) Demands for fertilizer in the hinterland

o Jengka Triangle

In accordance with the Jengka Triangle Report

o Pahang Tenggara

Calculation may be based on the total agricultural area and the basic unit of fertilizer for Jengka Triangle shown in the table below.

	1980	1985
Agricultural area, A(In 1,000 acres)	340	570
Basic unit of fertilizer, B tons/acre	0.287	0.287
Fertilizer in demand C = A x B (In 1,000 tons)	98	157

o State of Pahang

It was assumed that chemical fertilizers are used for oil palm and rubber and that the basic unit of fertilizer is 0,145 x 2/3 = 0.097 tons/acre for rubber and 0.375 x 2/3 = 0.251 tons/acre for oil palm (0.145 and 0.375 are contained in a report of the World Bank)

		1980	1985
Area of plantations			
Rubber	A	229	229
Oil palm	A'	497	722
Basic unit			
Rubber	B	0.097	0.097
Oil palm	B'	0.251	0.251
Fertilizer in demand C = A x B + A' x B'		149	205

o State of Trengganu

Calculation is to be made by means of the same basic unit as used for the State of Pahang.

		1980	1985
Area of plantations			
Rubber	A	165	165
Oil palm	A'	91	101
Basic unit			
Rubber	B	0.097	0.097
Oil palm	B'	0.251	0.251
Fertilizer in demand C = A x B + A' x B'		39	41

(2) Domestic supply of fertilizer

Import and domestic production of fertilizer in West Malaysia in 1968 are estimated to have been at 157,000 tons and 200,000 tons (Estimated from the amount of sale) respectively and 44% of the all consumption are met by import. With the anticipated sharp growth of demand and the resultant unbalance of supply and demand in the future, the share

of import is expected to increase slightly while that of domestic supply is expected to decrease to about 50%.

(3) Tramper utilization rate

The characteristics with the import of fertilizers is that a large quantity is purchased from a small group of countries. Imports of N (bulk), P(bulk) and Potassic (bulk) manure and fertilizer (pack) in 1968 by country of origin are shown below.

Total imports from the countries each exporting more than 10,000 tons to Malaysia	A	104,000
Total imports from the countries each exporting more than 20,000 tons to Malaysia	B	70,000
Total imports	C	137,000
	A/C	0.76
	B/C	0.51

In this estimate, therefore, the tramper utilization rate was considered to be 50%.

(f) Iron ore

A record for 1969 shows that a total of 229,000 tons of iron ore was shipped from Kuantan Port in that year. It is said, however, that the export of iron ore will cease before long because of depleting ore deposits. For this reason, the iron ore was excluded from the estimate on the volume of cargo to be handled by Kuantan Port in the future.

(g) Tin ore

Since a mere 2,000 tons of tin ore was exported from Kuantan Port in 1969, the tin was also excluded from the estimate on the volume of cargo to be handled by Kuantan Port in the future.

(h) Palm oil (Inbound to Kuantan)

For the Port of Kuala Trengganu, construction of three palm oil tanks is being planned and one of them has already been completed. There is also a shipping pier already completed in this port. As a result, it was considered that the palm oil produced around this port would be stored in the tanks at the Port of Kuala Trengganu first and then transported to Kuantan Port by coastal vessels rather than brought directly to Kuantan Port by lorries over a long way. The area to be benefited most by such feeder service via Kuala Trengganu is considered to be the northern part of the State of Trengganu, or all the districts of the State of Trengganu excluding the Districts of Kemaman and Dugun. The area of oil palm plantations planned for these districts is 31,000 acres for both 1980 and 1985. With the basic unit of 2/3 of the value shown in Table 4-2, the production in these districts is estimated as follows:

$$31,000 \text{ acres} \times 1.8 \text{ ton/acre} \times \frac{2}{3} = 37,000 \text{ tons}$$

(i) Petroleum products

The past record on the import of petroleum products through Kuantan Port is shown below.

Table I-20 Import of Petroleum Products through Kuantan Port

Year	Quantity of petroleum products imported
1961	35,000
62	27,000
63	29,000
64	33,00
65	39,000
66	39,000
67	41,000
68	6,000
69	44,000

As the import of petroleum product has grown 6% annually in the five year period from 1964 to 1967, an estimate was made on the future volume of cargo as follows by using the same growth rate.

Table I-21 Estimated Volume of Petroleum Products Imported through Kuantan Port

	1969	1980	1985
Import of petroleum products	44,000 tons	82,000 tons	110,000 tons

(j) General cargo

The past record on inbound general cargo handled at Kuantan Port is shown below.

Table I-22 General Cargo Brought to Kuantan Port

Year	General Cargo Brought In (tons)
1961	33,000
62	20,000
63	41,000
64	23,000
65	12,000
66	10,000
67	9,000
68	40,000
69	4,000

The above table shows great annual fluctuations in the volume of cargo and does not offer a trend suited for the estimation by statistical methods. As a result, an attempt was made to obtain mean value of five consecutive years as shown in the following table.

Table I-23 Mean Value of Five Consecutive Years for General Cargo

1961	65	26,000 tons
62	66	21,000 tons
63	67	19,000 tons
64	68	19,000 tons
65	69	15,000 tons

The average of the above figures, 20,000 tons, was then considered as the value for 1970.

With this 20,000 tons as the base figure and the population growth rate of 33%/year, the volume of general cargo in the future is estimated as follows.

Table I-24 Estimated Volume of General Cargo (in thousand tons)

1970	1980	1985
20	28	33

4-2-3 Estimated Total Cargo Handling Volume at Kuantan Port

Table I-25 Past and Future Cargo Handling Volume at Kuantan Port

(In 1,000 tons)

Item \ Year	1969	1980	1985
Exports			
Palm oil	-	660	1,232
Timber	33	-	-
Processed timber	-	364	357
Tapioca (Bullet type)	-	75*	113*
Iron ore	229	-	-
Tin ore	2	-	-
(Sub-total)	(264)	(1,099)	(1,702)
Imports			
Palm oil	-	37*	37*
Petroleum products	44*	82*	110*
Fertilizers	-	70	99
General cargo	4*	28*	33*
(sub-total)	(48)	(217)	(270)
Total	(312)	(1,316)	(1,981)

(Note) Figures with * marks represent volume of cargo expected to be transported by coastal vessels and those without the mark show the volume to be transported by tramp vessels.

Table I-26 Volume of General and Bulk Cargoes Handled at Kuantan Port

(In 1,000 tons)

Type \ Year	1969	1980	1985
General cargo	4	502	553
Bulk cargo	308	814	1,428
Total	312	1,316	1,981

Note: General cargo: Processed timber, tapioca, sundry goods and 1/2 of fertilizers

Bulk cargo: Palm oil, timber, iron ore, tin ore, petroleum products and 1/2 of fertilizers

Production and consumption of items mentioned in the course of estimate on the cargo handling volume are shown in the following table.

Table I-27 Production and Consumption of Main Items Following the Development of Hinterland of Kuantan Port

(In 1,000 tons)

Year	1980					1985				
Development projects	Pahang Tenggara	Jengka Triangle	State of Pahang	State of Trengganu	Total	Pahang Tenggara	Jengka Triangle	State of Pahang	State of Trengganu	Total
Outbound Commodities										
Palm oil	116	125	311	108	660	342	128	642	120	1,232
Palm kernel*	30	28	70	26	154	80	29	144	28	281
Rubber*	2	16	39	31	88	30	28	39	31	128
Saw-timber*	135	50	250	-	435	135	50	143	-	328
Processed timber	263	105	280	231	879	263	105	344	222	934
Tapioca (bullet type)	-	-	75	58	133	-	-	113	87	200
Inbound Commodities										
Fertilizers	74	32	149	39	284	118	32	205	41	396

(Note) Items with * were disregarded in the estimate.

4-3 Forecast of Type of Vessels to be Accommodated by the Proposed Port

In planning a port project it is very important to determine the type of vessels to be accommodated by the port under planning. The type of vessels determines the scale and plan of the port under consideration. For this reason, it is particularly important to forecast the maximum tonnage of vessels to be accommodated. However, in view of the rapid progress of transport revolution including the gigantification of exclusive cargo vessels and the inauguration of container vessels, it is extremely difficult to accurately predict the future type of vessels. For the proposed port, however, the sea-bed has a very slow grade and as a result, the port is not considered to allow the entry of vessels of more than 30,000 D/W. Also from the present volume of cargo such as palm oil, it is not considered probable that vessels of extremely large tonnage will enter the proposed port.

In forecasting the type of vessels to be accommodated by Kuantan Port it is essential to determine the origin and destination of the cargo to be handled. As the main cargo items to be handled by Kuantan Port are palm oil, processed timber and fertilizers, the destination of cargo is considered to be mainly the European and North American countries and Japan. These countries own large and modern port facilities and the berth commonly used in these countries for ocean going vessels is for 15,000 D/W class vessels. Also, in the face of world-wide trend for containerization, it is very probable that the shipping world will suffer from the excess of the liners of the present type and will attempt to convert these liners to trampers.

With regard to berths for trampers the type which aims at accommodating vessels having a much smaller tonnage than trampers which may be accommodated by Port Swettemham and Singapore will result in the defeat in competition with these neighboring ports.

Based on the above concepts, the vessel for the transportation of palm oil and timber was considered to be of the maximum 15,000 D/W class, the common tonnage of cargo boats nowadays, and the use of 5,000 D/W vessels was also considered. It was also determined that 5,000 D/W trampers would be sufficient for the transportation of fertilizers in view of the relatively small quantity of cargo to be transported.

- For coastal vessels, it was considered that vessels having a much smaller tonnage than ocean-going vessels would be used and the vessels of 3,000 D/W at the maximum were considered. As for oil tankers, the size of vessels is generally determined by the enterprises. Here, tankers of 3,000 D/W at the maximum were considered.

4-4 Goal of Fishing Industry

For the expansion of fishing industry in the region surrounding Kuantan Port, the first and second fishing port survey teams made the following forecast.

Following the increase in population and the rise of income level in the future, consumption of marine products in West Malaysia is expected to increase sharply and the total production of fishery in West Malaysia 10 years hence is expected to reach the 700,000 ~ 800,000 ton level. It is considered appropriate to set the production goal at 240,000 ~ 250,000 tons in proportion to the fishing population on the east coast. To attain this goal, however, there must be positive

government measures for improvements of fishing ports, introduction of large trawlers, promotion of purse seine operation, financial aid for the construction of related land facilities (Transit shed, cold storage room, ice-making plant and marine products processing plant), training of fishermen, establishment of fishermen's cooperatives and improvements of distribution system.

In view of the fact that Kuantan is situated in the strategic point of communication with the two major consumer centers, Kuala Lumpur and Singapore, that the hinterland development is now in progress and that the operation of large trawlers has already begun with Kuantan Port as the fishing base, there is a great potential for future growth as a fishing port.

For this reason, the highest priority must be given to the improvement of Kuantan Port as a fishing port with the target 10 years hence set as follows.

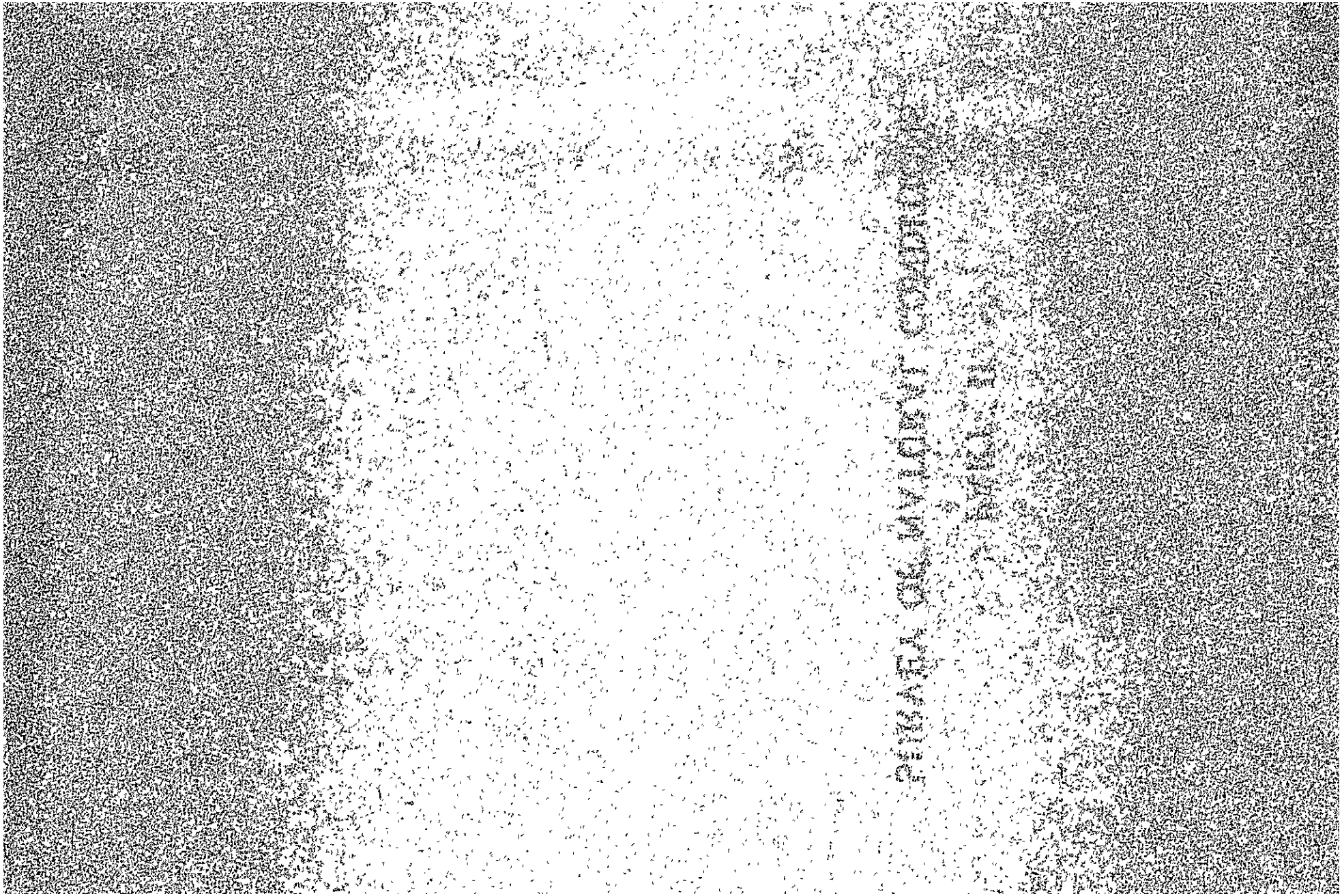
(a) Type of operation to be expanded promptly ..... Mainly large scale trawling and large scale purse seine operation.

(b) Number of fishing boats to be maintained ..... 580 (Of these, 300 are to be large boats of more than 30 tons)

(c) Annual haul ..... 93,000 tons

PART II

SURVEY OF NATURAL CONDITIONS



CHAPTER 1. GENERAL TOPOGRAPHY

The Kuantan Port project covers an area extending from the estuary of the Kuantan River to Tembeling point approximately 2.5 km east of the estuary.

In this area the arm of the sea penetrates deep into the flat land, forming a bay called Sesik Bay and Tembeling point plays the role of a natural breakwater against north-eastern waves during the North-East monsoon season.

The hinterland of the proposed construction site is flat and the sea bottom in front of the project area has a very slow gradient, forming a shoal extending to a great distance. Topography of the project area is shown in Fig. I-3 and the hydrographic chart is given in Fig. II-4(a) plan (See Fig. I-3, II-4(a).

1-1 Topography

The Kuantan River runs through the city toward northeast, makes a turn to southeast near the estuary and flows into South China Sea. Because of this geographical feature, the left bank of the river, on which the city has been growing, is favoured by deep water and has facilities for small coastal vessels, while the right bank is marshy and left unexploited.

On the right bank of the river's estuary there is an extensive sand spit from which a sandy beach stretches south on the coast. Kampong Tenjong Lumpur, the largest fishing village in this region, is situated along this coastline.

The area along the coast extending from the estuary of the Kuantan River to Tembeling point was used as a firing range once but now is a resort area for the holiday makers of Pahang State.

On Api point on the left bank of the Kuantan River is a VIP Rest House and the area stretching approximately 1.5 km to the east along the coast is a marsh land and left unexploited in the state of a jungle. In the north is a football ground and in the east there is a golf course extending to the Telok Chempedak Rest House located at the base of Tembeling point. The bottom of the sea facing this area forms a gently sloped shoal which rises above the water surface at low tide to a considerable distance from the coast.

The Tembeling point is a small hill covered with unexploited jungles of thick vegetations to the beach. Along the beach huge rocks lie here and there, blocking access to the area.

On the north side of Tembeling point a rather steep sloped sand dune deploys, forming a small bay called Chempedak and serves as a recreation beach. In the back, Mt. Pelindo stands to a height of 267 m with two radio transmission towers on its top.

1-2 Depth of Water

In the Kuantan Port project site, the fairway at the estuary of the Kuantan River has frequently changed in the past due to sediment load of the river and the north-east waves during the North-East monsoon season. In recent years, however, dredgings have been provided adequately for the maintenance of navigation channel and as a result, the navigation channel has become quite stabilized. Yet, the sediment transport of the Kuantan River makes it extremely

difficult to maintain the required depth of the channel and navigation by vessels other than small crafts is very difficult under ordinary conditions.

The grade of the sea bottom in front of the Kuantan Port project area is as slow as 1/400 but the contour lines are not completely uniform. Shoals deploy in the depth of -8 m about 2 km off the Tembeling point and in the depth of -6 m to -8 m about 5 km off the coast of Tembeling point. The ocean-going vessels anchor in the deep water inside of these shoals for loading and unloading cargo by means of barges.

Bottom materials consist of fine sand mixed with dark grey silts or silts containing fine sand.

CHAPTER 2. METEOROLOGY

The project area, being surrounded by the Indian Ocean and South China Sea, is subject to the monsoon and the climate is featured by high temperature and humidity and heavy rainfalls, with no clear distinction between four seasons. The year is divided largely into the Sout-West monsoon season and the North-East monsoon season, each corresponding almost exactly to the summer and winter season in the northern hemisphere. The South-West monsoon season begins in May and ends in September and the North-East monsoon season sets in around October and lasts until March. The rainfall is heavier in the North-East monsoon season and lesser in the South-West monsoon season. Except a few days during the North-East monsoon season, when the wind with a velocity up to about 10 m/sec blows, the weather is normally calm throughout the year. Meteorological observations for Kuantan area are being conducted at Kuantan airport.

2-1 Climate

2-1-1 Temperature

According to the records for the 1965 ~ 1967 period, the annual average temperature does not show great fluctuations. The temperature remains within the range of 76° to 80°F and seldom fluctuate by more than 4°F. The daily fluctuation of the temperature, meanwhile, is as much as 13°F ~ 15°F. The highest temperature was 93.9°F recorded in April 1965 and the lowest was 62.2°F recorded in January 1965.

2-1-2 Relative Humidity

The average daily humidity is comparatively high during the November ~ March period of the North-East monsoon season, but it remains within the range of 85 ~ 95% throughout the year. The daily fluctuation of humidity is so great that the humidity which rises close to 98% early in the morning drops to about 68% around one o'clock in the afternoon.

2-1-3 Wind

The wind records for the 1956 ~ 1967 period show that the winds having a velocity of 5.5 ~ 10.7 m/sec blow only in about 15 days throughout the year and strong winds are slightly more frequent in the October ~ March period of the North-East monsoon season than in other season.

Frequency distribution of wind velocity is shown in Fig. II-1 and the maximum wind velocity recorded is shown in Table II-1.

Table II-1 Maximum Instantaneous Wind Velocity

Period: 1959 ~ 1962
1964 ~ 1968

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Wind velocity m/sec.	18.0	15.2	18.1	23.7	18.6	30.0	23.0	20.6	21.0	19.8	20.6	17.0
Wind direction	40°	30°	10°	-	250°	230°	-	170°	300°	360°	170°	40°

2-1-4 Rainfall

According to the records for the 1965 ~ 1967 period, the annual rainfall in the area is in the range of 2700 mm ~ 4, 300 mm, with more rainfall in the October ~ March period of the North-East monsoon season than in the May September period of the South-West Monsoon season.

Rainfalls by month are shown in Fig. II-2.

2-1-5 Cyclone

There is no record of cyclone brewing in the sea of this region nor has cyclone developed in other sea regions approached this region.

Figure. II - 1
ANNUAL WIND VELOCITY DISTRIBUTION
(Mean value for three years from 1965 to 1967)

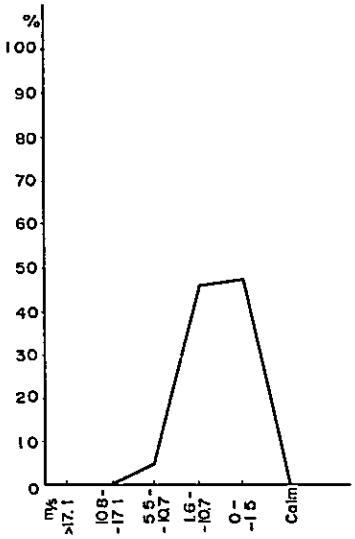
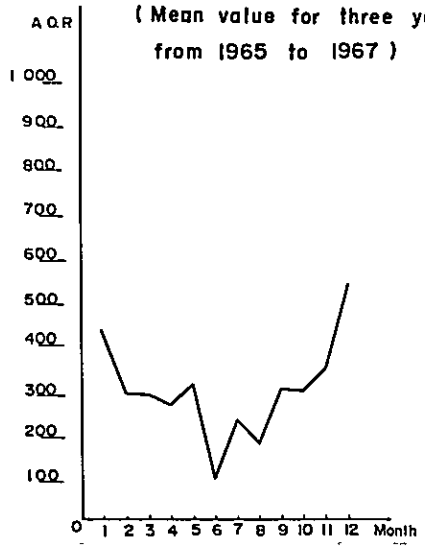


Figure. II - 2
MONTHLY AMOUNT OF RAINFALL



CHAPTER 3. MARINE METEOROLOGY

Since no surveys have ever been made on marine meteorology in this region, there is no other way but to make assumptions to provide data on marine meteorology required for the projected port construction.

During the May ~ September period of the South-West monsoon season, the so-called sea wind blows the land and high waves generated by fairly strong wind dash against the shore. However, since the sea extending in front of the project area is shallow with its depth not reaching 100 m even in the offing more than 200 km from the coast, the high waves generated between the Taiwan Straights to South China Sea are damped and reduced to less than 3 m in height when reaching this region.

The tidal level at the Kuantan Port is calculated on the basis of the results of tidal level observations made in 1904 and 1910 and tide tables are also available.

3-1 Waves

According to the calculations made on the basis of weather maps issued by the Meteorological Agency in Japan for the period from January 1960 to April 1967 and the weather reports from the vessels sailing in the offing of Kuantan, the highest waves in this region occur in the North-East monsoon season. Elements of the wave are as follows:

Elements of deep sea waves:

Wave height:	Ho = 2.5 m
Wave period:	T = 10.0 sec.
Wave direction:	NE

Elements of the waves along the projected port construction area (Depth of water: -0.8 m)

Wave height:	H = 2.8 m *
Wave period:	T = 10.0 sec.
Wave length:	L = 83.8 m
Wave direction:	N 65°E *

The elements of the highest waves generated by E-ESE winds are as follows.

Wave height:	Ho = 1.0 m
Wave period:	T = 6.0 sec

The frequency of the highest waves is 2 or 3 times a months and the highest frequency is seen in August, September and October.

* To be revised according to the results of a future study to be conducted following the presentation of a report on the survey for the fishing port construction project.

3-2 Tide

Though the coastline of the region is of simple configuration, the region is situated close to the equator and therefore, the tidal range is considerably large. According to the available tide table, the maximum tidal range at Kuantan in 1970 was recorded on January 8 when the highest sea level was 3.54 m and the lowest 0.21 m with the tidal range of 3.33 m.

Elements of tide for 1970 are shown in Table II-2.

Table II-2 Elements of Tide

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Extreme value	Average
Highest sea level m	3.54	3.35	3.02	2.90	3.05	3.14	3.08	2.93	2.71	2.96	3.26	3.44	3.54	3.11
Lowest sea level m	0.21	0.27	0.34	0.09	-0.06	-0.09	-0.06	0.12	0.34	0.24	0.21	0.27	-0.09	0.15
Mean sea level	1.80	1.74	1.65	1.52	1.43	1.43	1.46	1.46	1.52	1.58	1.68	1.77	1.43 1.80	1.58
Maximum tide range	3.33	3.08	2.59	2.80	3.11	3.23	3.14	3.05	2.29	2.71	2.99	3.14	3.32	2.96

CHAPTER 4. SOILS

Soil investigations were conducted at 14 locations shown in Fig. II-3 through earth boring. The earth borings were made with the use of rotary-type boring machines fixed on the flat barge which was shored by anchors.

The soil investigation consisted of field investigations employing standard penetration tests and laboratory tests through sampling of undisturbed soils. The standard penetration tests were conducted in conformity with JISA 1219 and aimed at obtaining data on sandy soils, clayey soils and clayey soils mixed with gravels, which were not available by the thin-wall smapling method and the boring was made for every 2 m in principle. Sampling of undisturbed soil was made with thinwall tubes and piston samplers of brass having a wall thickness of 1.5 mm, inside diameter of 75 mm and a length of 1000 mm.

Judging from the results of soil investigations, soils at the project area are not considered satisfactory in general.

The results of soil investigations conducted at each boring point are shown in Fig. II-4 (a ~ s) together with boring logs.

4-1 Soil Composition

4-1-1 Top Sand Layer

The top sand layer comprises very loose clayey or silty fine sand having a thickness depth of 20 m ~ 40 m and dips gradually towards southwest with increasing thickness. At boring point No. 14 a silty layer about 1 m thick is seen overlying the sand layer but at boring points No. 3 ~ No. 7 the ratio of clay increases and clayey sand layer becomes dominant.

4-1-2 Clayey Layer

The clayey layer underlying the top sand layer consists of two strata having different physical and dynamical properties. The upper stratum is dark grey or simple grey in color and consists of soft clay containing a lot of silts and sand. This layer has a depth of 4 m ~ 6 m immediately below the top layer and covers a wide area excluding boring point No. 14.

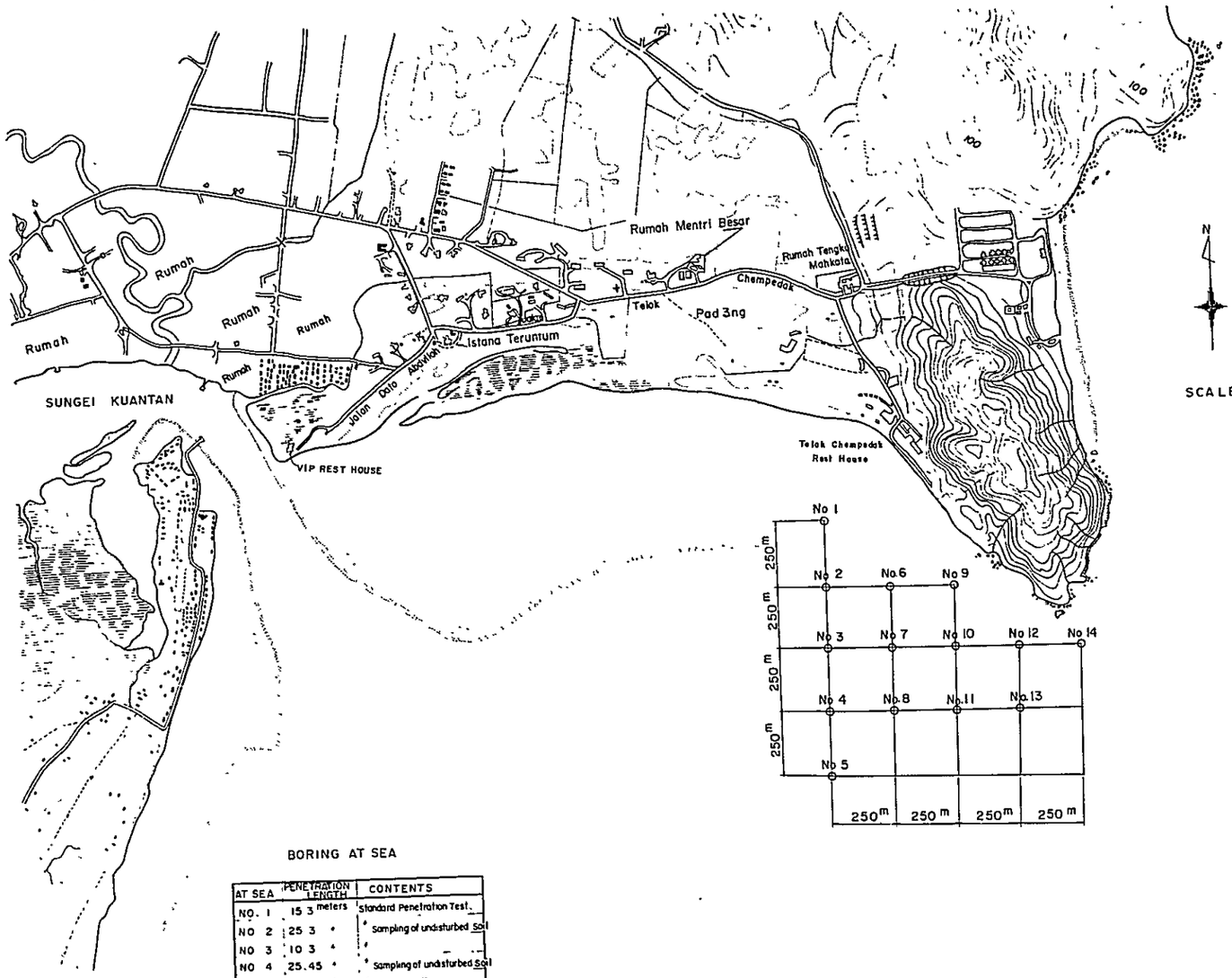
4-1-3 Gravel Layer

This layer is seen below the clayey layer and consists of white or grey whitish small gravels. The N-value obtained from standard penetration tests fluctuates greatly ranging from less than 10 to about 30.

4-1-4 Layers below Gravel Layer

The gravel layer extends to a depth of about 15 m from the ground surface but at the boring points Nos. 1, 2, 5 and 11 it is underlain by a clayey layer containing gravels, forming alternating layers. At all boring point No. 14 the weathered rock layer is found below the gravel layer.

Figure. Ⅱ – 3
LOCATION OF BOREHOLES COMPLETED



BORING AT SEA

AT SEA	PENETRATION LENGTH	CONTENTS
NO. 1	15 3 meters	Standard Penetration Test.
NO 2	25 3 "	" Sampling of undisturbed Soil
NO 3	10 3 "	" — "
NO 4	25.45 "	" Sampling of undisturbed Soil
NO 5	20 45 "	" " "
NO 6	15 3 "	" — "
NO 7	10 3 "	" — "
NO 8	10.3 "	" — "
NO 9	19 3 "	" — "
NO 10	10 45 "	" — "
NO 11	25 45 "	" Sampling of undisturbed Soil
NO.12	6 3 "	" — "
NO 13	10 3 "	" — "
NO 14	14 63 "	" — "
TOTAL	219.13 "	

Figure Ⅱ-4 (a)

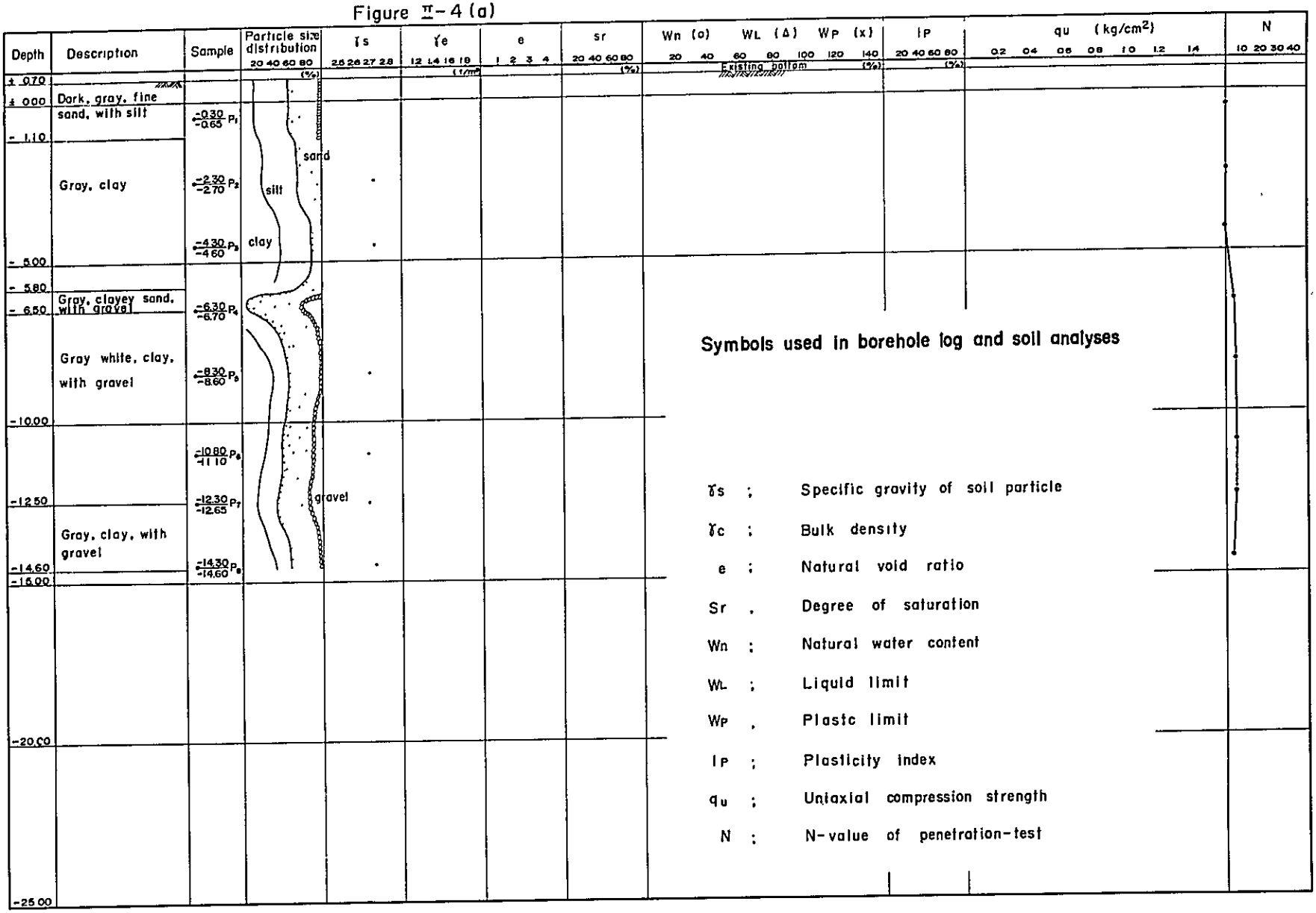

Depth
Description
Sample
Particle size distribution
γs
γe
e
sr
Wn (o) WL (Δ) WP (x)
IP
qu (kg/cm²)
N
+0.70
±0.00
Dark, gray, fine sand, with silt
-0.30 P1
-0.65
-1.10
Gray, clay
-2.30 P2
-2.70
-4.30 P3
-4.60
-5.00
-5.80
Gray, clayey sand, with gravel
-6.30 P4
-6.70
-6.50
Gray white, clay, with gravel
-8.30 P5
-8.60
-10.00
-10.80 P6
-11.10
-12.30 P7
-12.65
-12.50
Gray, clay, with gravel
-14.30 P8
-14.60
-14.60
-15.00
-20.00
-25.00
sand
silt
clay
gravel
Existing bottom
Symbols used in borehole log and soil analyses
γs ; Specific gravity of soil particle
γc ; Bulk density
e ; Natural void ratio
Sr ; Degree of saturation
Wn ; Natural water content
WL ; Liquid limit
WP ; Plastc limit
IP ; Plasticity index
qu ; Uniaxial compression strength
N ; N-value of penetration-test

Figure Ⅱ- 4 (b)

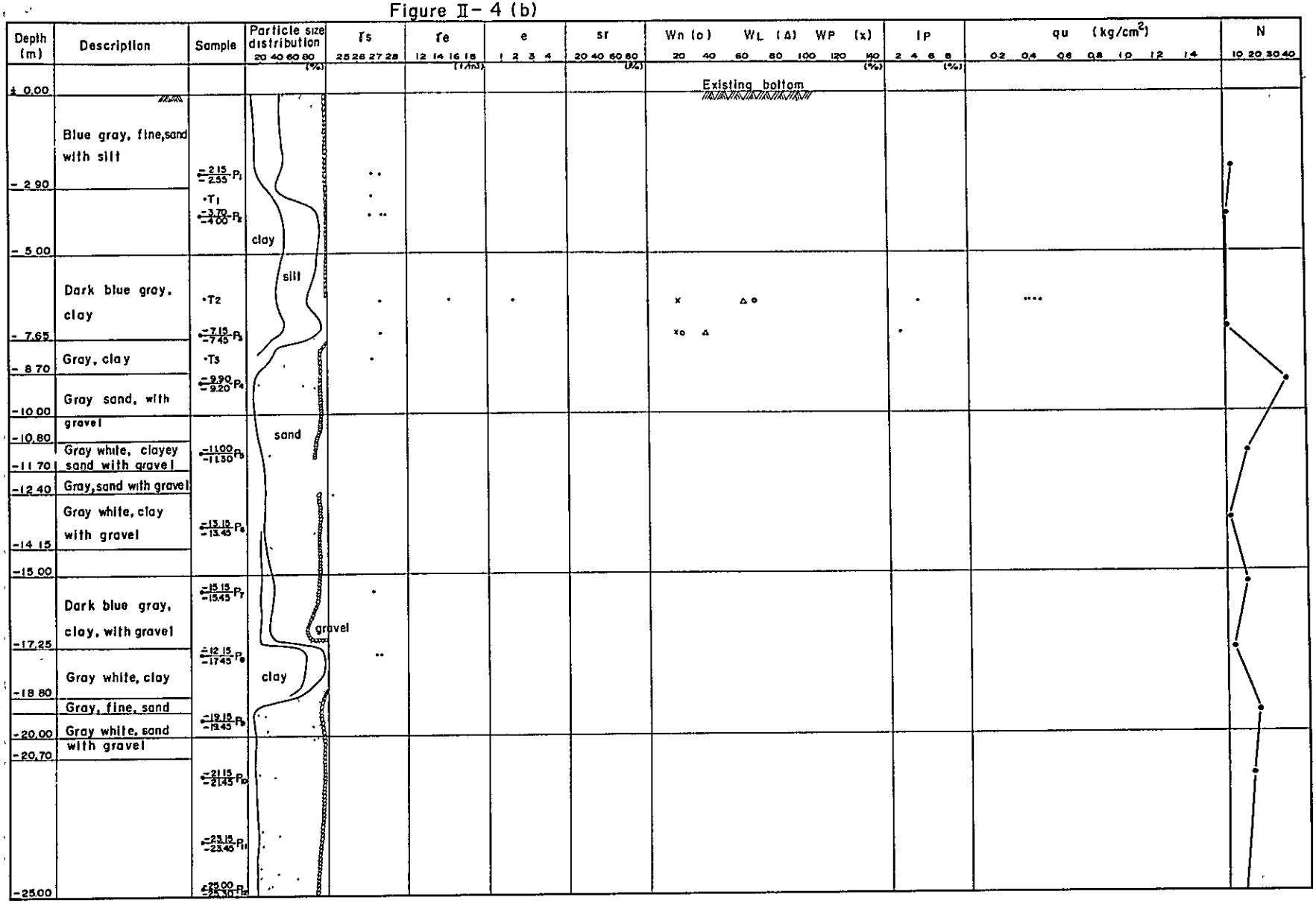

Depth (m)
Description
Sample
Particle size distribution
γs
γe
e
sr
Wn (o) WL (Δ) WP (x)
Ip
qu (kg/cm²)
N
Existing bottom
± 0.00
Blue gray, fine, sand with silt
- 2.90
- 5.00
clay
Dark blue gray, clay
- 7.65
Gray, clay
- 8.70
Gray sand, with gravel
-10.00
-10.80
silt
Gray white, clayey sand with gravel
-11.70
-12.40
Gray, sand with gravel
Gray white, clay with gravel
-14.15
-15.00
sand
Dark blue gray, clay, with gravel
-17.25
Gray white, clay
-18.80
Gray, fine, sand
-20.00
Gray white, sand with gravel
-20.70
-25.00
gravel
clay

Figure II-4 (c)

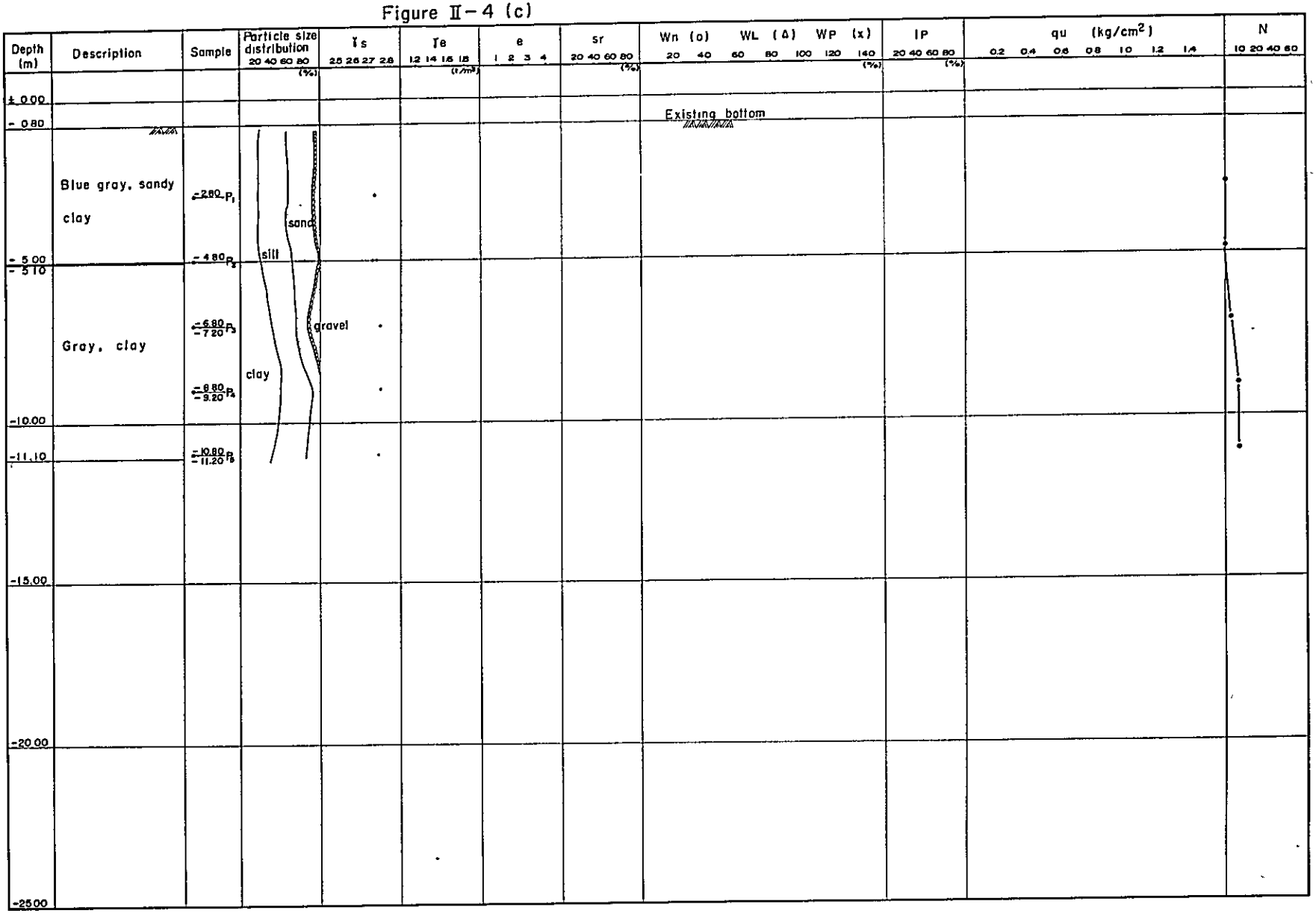

Depth (m)
Description
Sample
Particle size distribution
20 40 60 80 (%)
Is
25 26 27 28
Te
12 14 16 18 (t/m³)
e
1 2 3 4
sr
20 40 60 80 (%)
Wn (o) WL (Δ) WP (x)
20 40 60 80 100 120 140 (%)
IP
20 40 60 80 (%)
qu (kg/cm²)
0.2 0.4 0.6 0.8 1.0 1.2 1.4
N
10 20 40 60
± 0.00
- 0.80
Existing bottom
Blue gray, sandy clay
P1
P2
sand
silt
- 5.00
- 5.10
Gray, clay
P3
P4
gravel
clay
-10.00
-11.10
P5
-15.00
-20.00
-25.00

Figure II－4 (d)

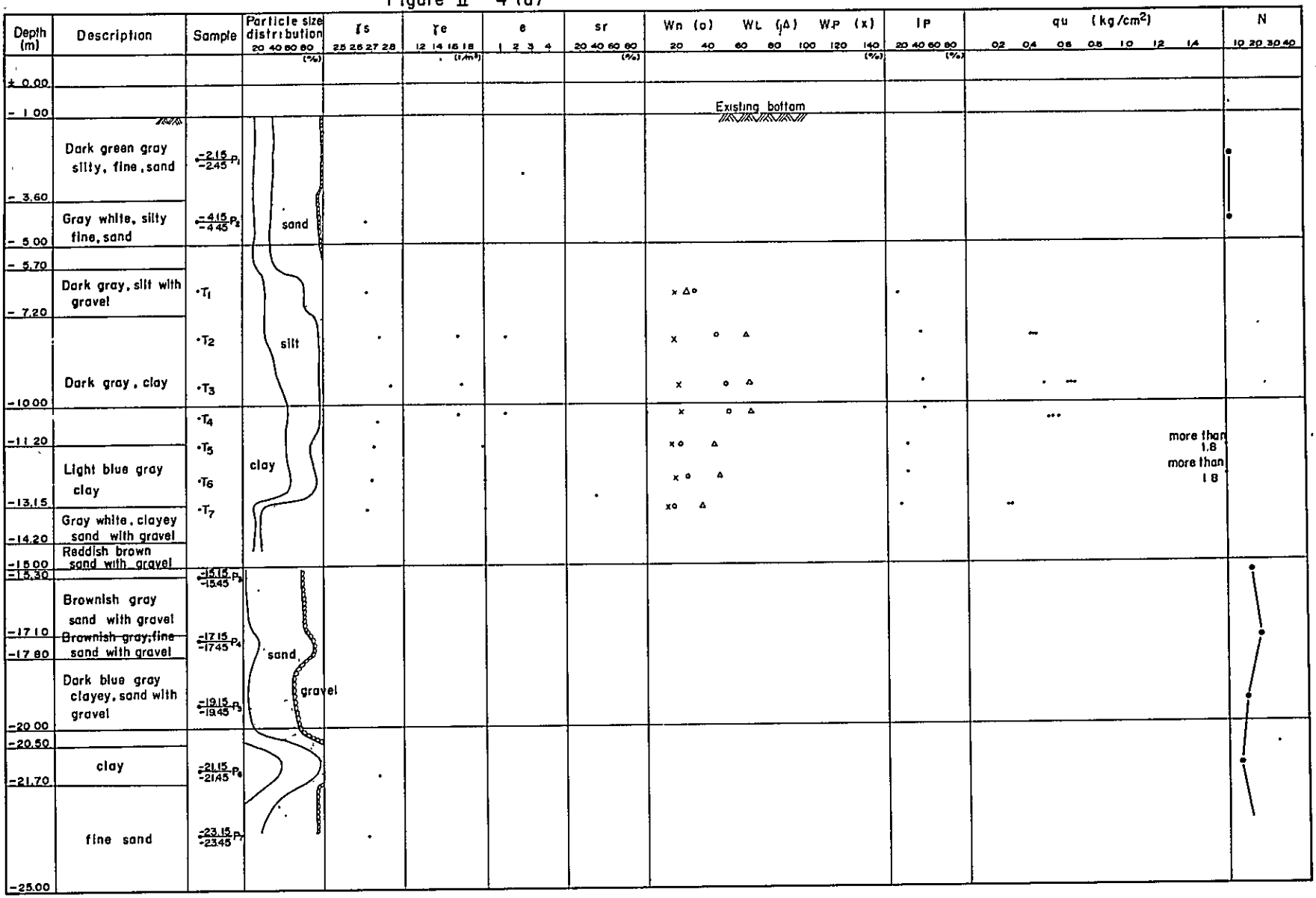

Depth (m)
Description
Sample
Particle size distribution (%)
γs
γe (t/m³)
e
sr (%)
Wn (○) WL (△) WP (×) (%)
IP (%)
qu (kg/cm²)
N
± 0.00
－1.00
Existing bottom
Dark green gray silty, fine, sand
－2.15 P1
－2.45
－3.60
Gray white, silty fine, sand
－4.15 P2
－4.45
sand
－5.00
－5.70
Dark gray, silt with gravel
－7.20
T1
T2
T3
silt
Dark gray, clay
－10.00
T4
T5
T6
T7
clay
－11.20
Light blue gray clay
－13.15
Gray white, clayey sand with gravel
－14.20
Reddish brown sand with gravel
－15.00
－15.30
－15.15 P3
－15.45
Brownish gray sand with gravel
－17.10
Brownish gray, fine sand with gravel
－17.80
－17.15 P4
－17.45
sand
gravel
Dark blue gray clayey, sand with gravel
－19.15 P5
－19.45
－20.00
－20.50
clay
－21.70
－21.15 P6
－21.45
fine sand
－23.15 P7
－23.45
－25.00
more than 1.8
more than 1.8

Figure II－4 (e)

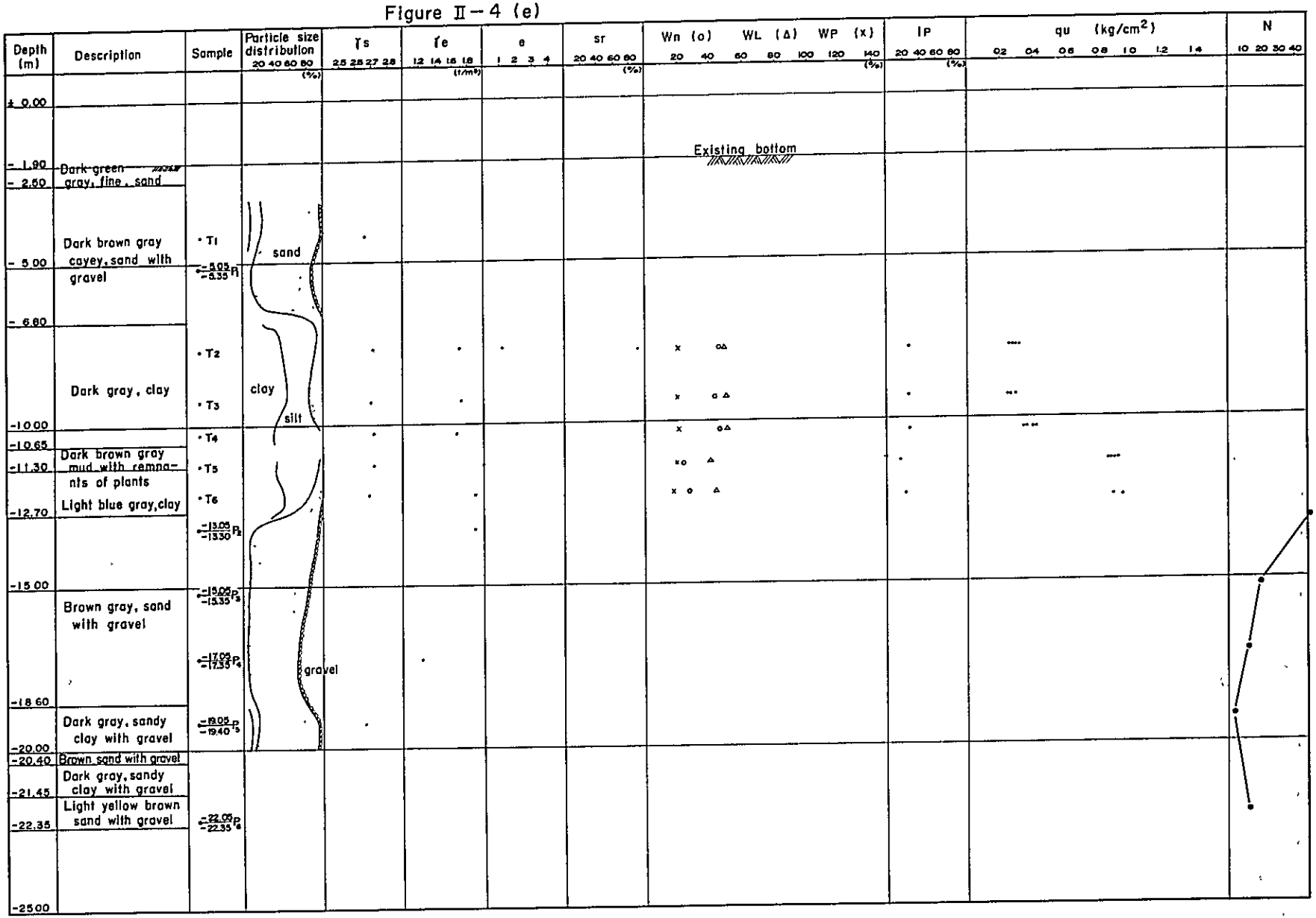

Depth (m)
Description
Sample
Particle size distribution (%)
Ts
fe (1/m²)
e
sr (%)
Wn (o) WL (Δ) WP (x) (%)
IP (%)
qu (kg/cm²)
N
± 0.00
Existing bottom
- 1.90
Dark green gray, fine, sand
- 2.50
Dark brown gray cayey, sand with gravel
T1
sand
- 5.00
P1
- 6.60
Dark gray, clay
T2
T3
clay
silt
-10.00
T4
-10.65
Dark brown gray mud with remnants of plants
-11.30
T5
Light blue gray, clay
T6
-12.70
P2
-15.00
P3
Brown gray, sand with gravel
P4
gravel
-18.60
Dark gray, sandy clay with gravel
P5
-20.00
Brown sand with gravel
-20.40
Dark gray, sandy clay with gravel
-21.45
Light yellow brown sand with gravel
P6
-22.35
-25.00

Figure Ⅱ－4 (f)

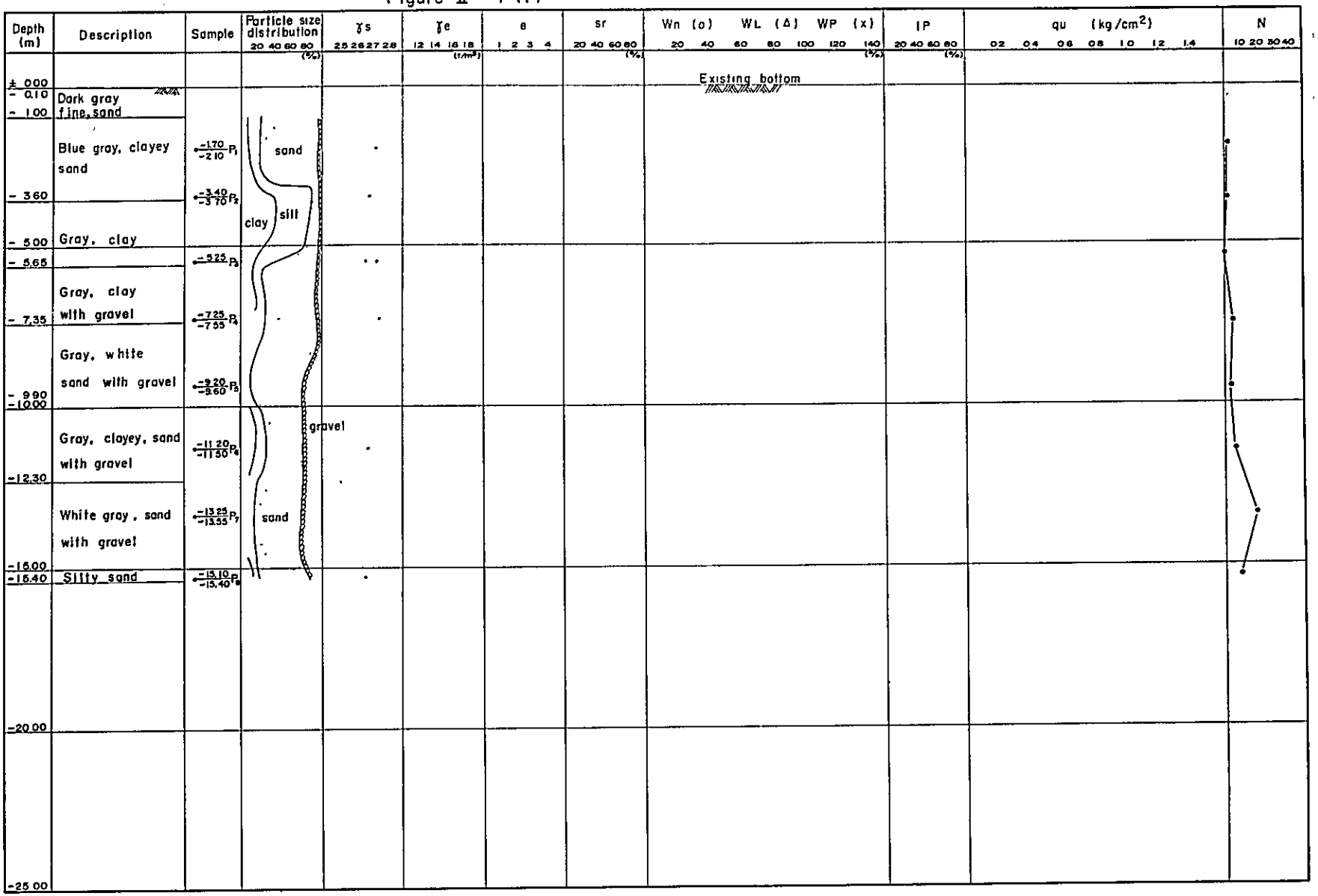

Depth (m)
Description
Sample
Particle size distribution
20 40 60 80 (%)
γs
25 26 27 28
γe
12 14 16 18 (t/m³)
e
1 2 3 4
sr
20 40 60 80 (%)
Wn (o) WL (Δ) WP (x)
20 40 60 80 100 120 140 (%)
IP
20 40 60 80 (%)
qu (kg/cm²)
0.2 0.4 0.6 0.8 1.0 1.2 1.4
N
10 20 30 40
± 0.00
Existing bottom
- 0.10
- 1.00
Dark gray fine sand
Blue gray, clayey sand
-1.70 / -2.10 P1
-3.40 / -3.70 P2
- 3.60
Gray, clay
- 5.00
- 5.65
-5.25 P3
Gray, clay with gravel
-7.25 / -7.55 P4
- 7.35
Gray, white sand with gravel
-9.20 / -9.60 P5
- 9.90
-10.00
Gray, clayey, sand with gravel
-11.20 / -11.50 P6
-12.30
White gray, sand with gravel
-13.25 / -13.55 P7
-15.00
-15.40
Silty sand
-15.10 / -15.40 P8
-20.00
-25.00
sand
clay
silt
gravel
sand

Figure Ⅱ－4 (g)

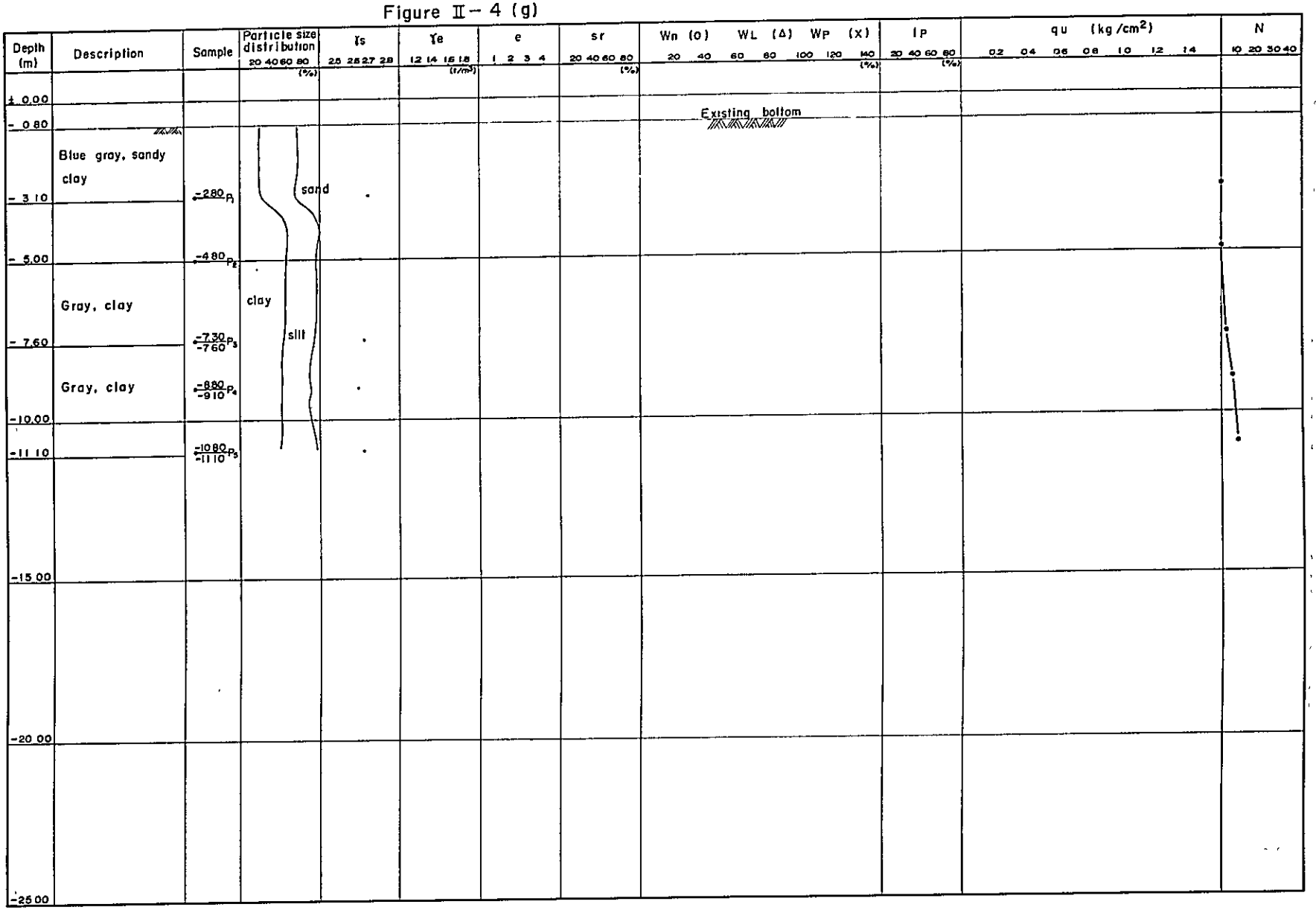

Depth (m)
Description
Sample
Particle size distribution
20 40 60 80 (%)
γs
25 26 27 28
γe
12 14 16 18 (t/m³)
e
1 2 3 4
sr
20 40 60 80 (%)
Wn (○) WL (△) WP (×)
20 40 60 80 100 120 140 (%)
IP
20 40 60 80 (%)
qu (kg/cm²)
0.2 0.4 0.6 0.8 1.0 1.2 1.4
N
10 20 30 40
±0.00
- 0.80
Existing bottom
Blue gray, sandy clay
- 3.10
-2.80 P1
sand
-4.80 P2
- 5.00
Gray, clay
clay
silt
- 7.60
-7.30 P3
-7.60
Gray, clay
-8.80 P4
-9.10
-10.00
-11.10
-10.80 P5
-11.10
-15.00
-20.00
-25.00

Figure II－4 (h)

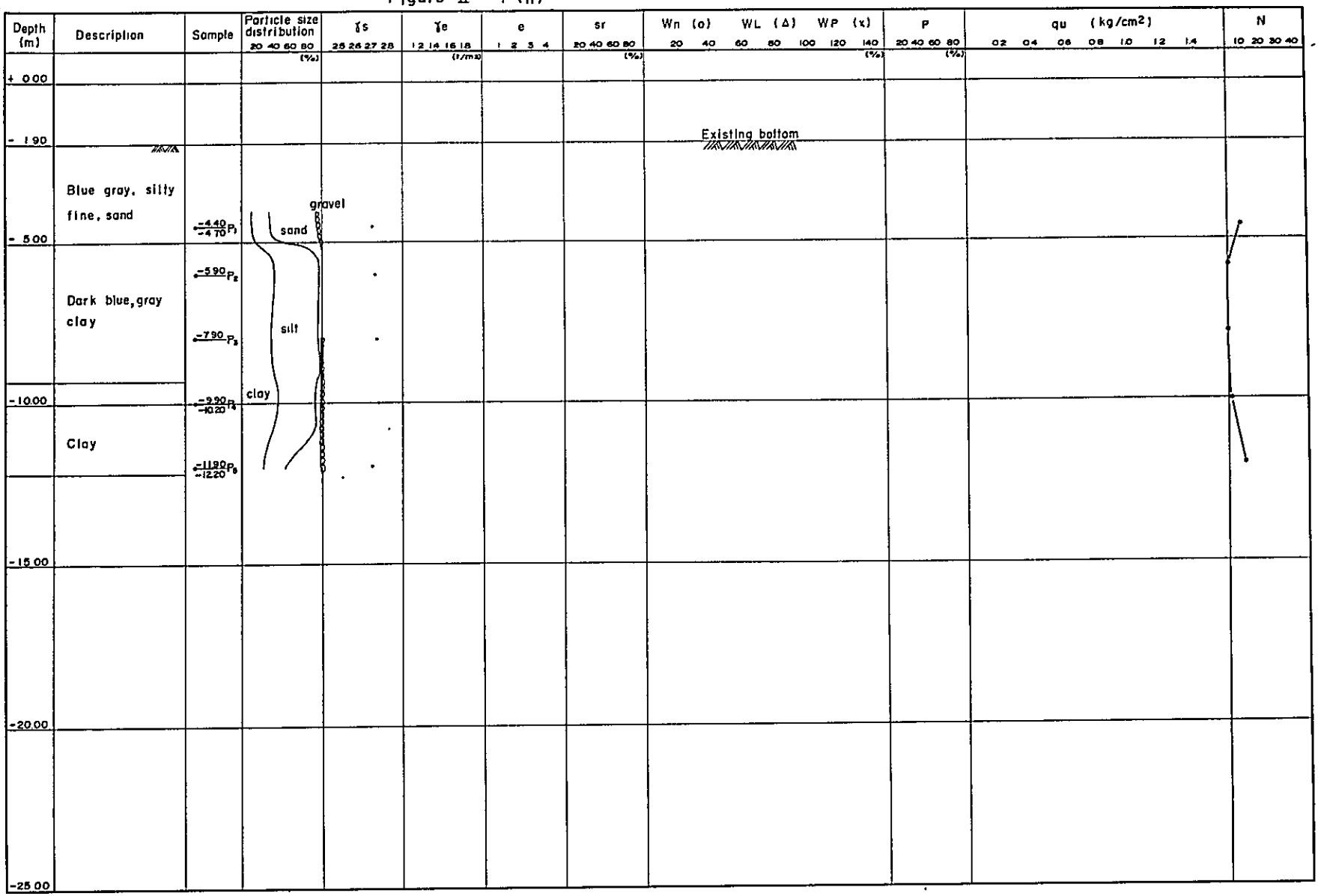

Depth (m)
Description
Sample
Particle size distribution
20 40 60 80 (%)
γs
25 26 27 28
γe
12 14 16 18 (t/m³)
e
1 2 3 4
sr
20 40 60 80 (%)
Wn (o) WL (Δ) WP (x)
20 40 60 80 100 120 140 (%)
P
20 40 60 80 (%)
qu (kg/cm²)
02 04 06 08 10 12 14
N
10 20 30 40
+ 0.00
- 1.90
Existing bottom
Blue gray, silty fine, sand
-4.40
-4.70 P1
gravel
sand
- 5.00
-5.90 P2
Dark blue, gray clay
-7.90 P3
silt
clay
-10.00
-9.90
-10.20 P4
Clay
-11.90 P5
-12.20
-15.00
-20.00
-25.00

Figure II－4 (i)

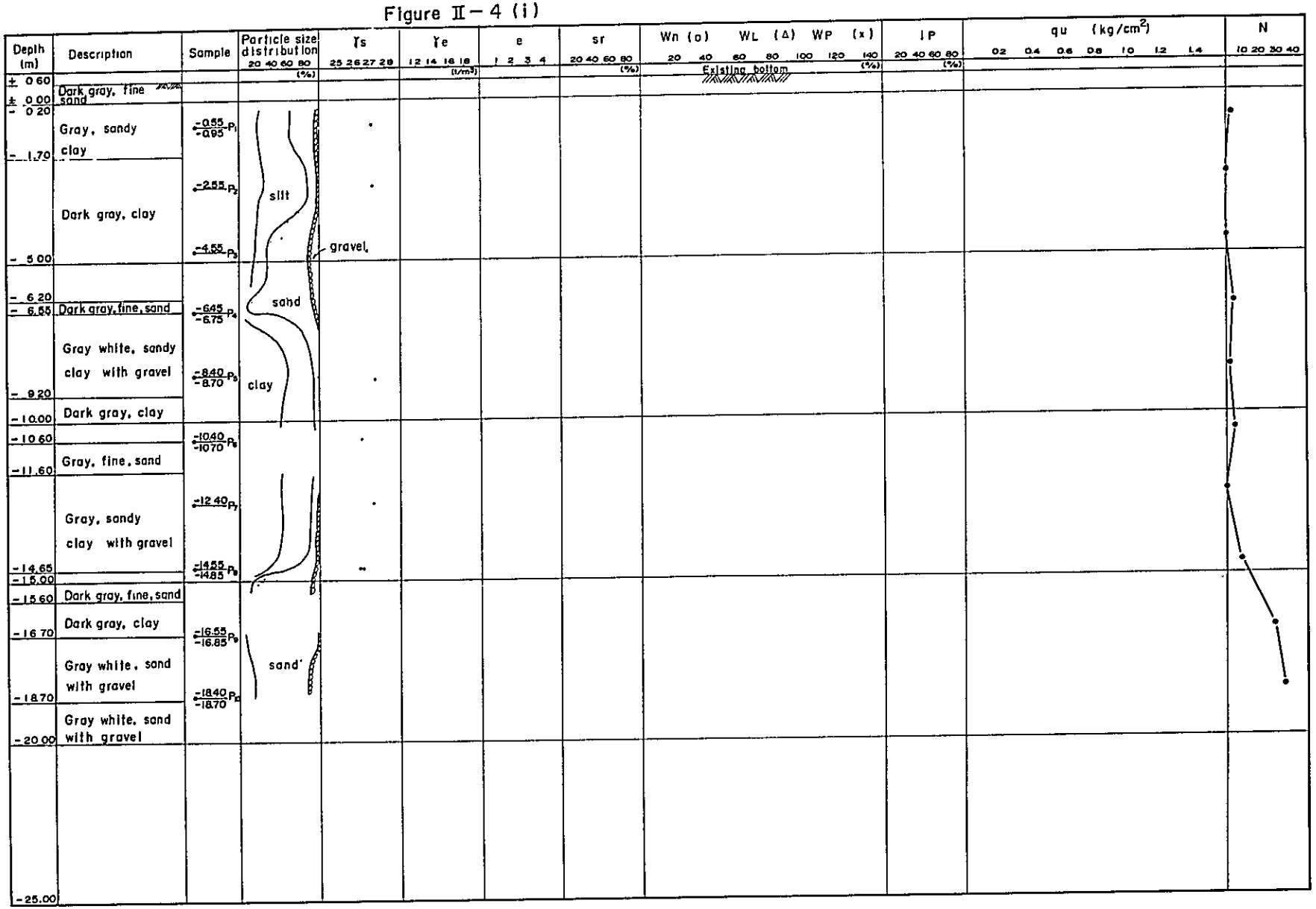

Depth (m)
Description
Sample
Particle size distribution 20 40 60 80 (%)
γs 25 26 27 28
γe 12 14 16 18 (t/m³)
e 1 2 3 4
sr 20 40 60 80 (%)
Wn (o) WL (Δ) WP (x) 20 40 60 80 100 120 140 (%)
Existing bottom
IP 20 40 60 80 (%)
qu (kg/cm²) 0.2 0.4 0.6 0.8 1.0 1.2 1.4
N 10 20 30 40
± 0.60
± 0.00
Dark gray, fine sand
- 0.20
Gray, sandy clay
- 1.70
Dark gray, clay
- 5.00
- 6.20
- 6.55
Dark gray, fine, sand
Gray white, sandy clay with gravel
- 9.20
- 10.00
Dark gray, clay
- 10.60
- 11.60
Gray, fine, sand
Gray, sandy clay with gravel
- 14.65
- 15.00
- 15.60
Dark gray, fine, sand
- 16.70
Dark gray, clay
Gray white, sand with gravel
- 18.70
Gray white, sand with gravel
- 20.00
- 25.00
-0.55 -0.95 P1
-2.55 P2
-4.55 P3
-6.45 -6.75 P4
-8.40 -8.70 P5
-10.40 -10.70 P6
-12.40 P7
-14.55 -14.85 P8
-16.55 -16.85 P9
-18.40 -18.70 P10
silt
gravel
sand
clay
sand

Figure Ⅱ－4 (j)

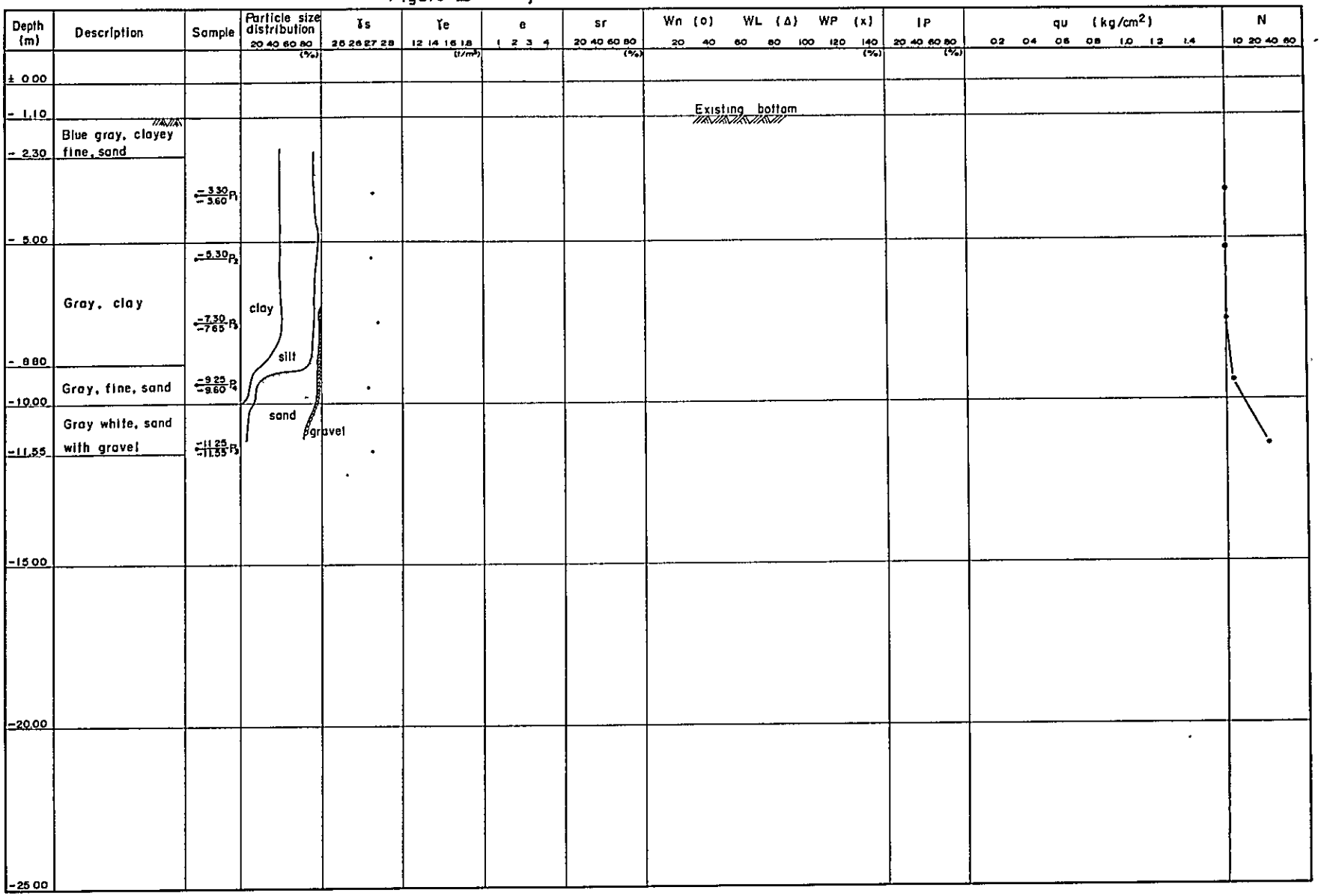

Depth (m)
Description
Sample
Particle size distribution (%)
20 40 60 80
γs
26 26.2 27 28
γe (t/m³)
12 14 16 18
e
1 2 3 4
sr (%)
20 40 60 80
Wn (○) WL (△) WP (×) (%)
20 40 60 80 100 120 140
IP (%)
20 40 60 80
qu (kg/cm²)
0.2 0.4 0.6 0.8 1.0 1.2 1.4
N
10 20 40 60
± 0.00
- 1.10
Existing bottom
- 2.30
Blue gray, clayey fine, sand
-3.30
-3.60 P1
- 5.00
-5.30 P2
Gray, clay
-7.30
-7.65 P3
clay
silt
- 8.80
-9.25
-9.60 P4
Gray, fine, sand
-10.00
Gray white, sand with gravel
sand
gravel
-11.25
-11.55 P5
-11.55
-15.00
-20.00
-25.00

Figure II－4 (k)

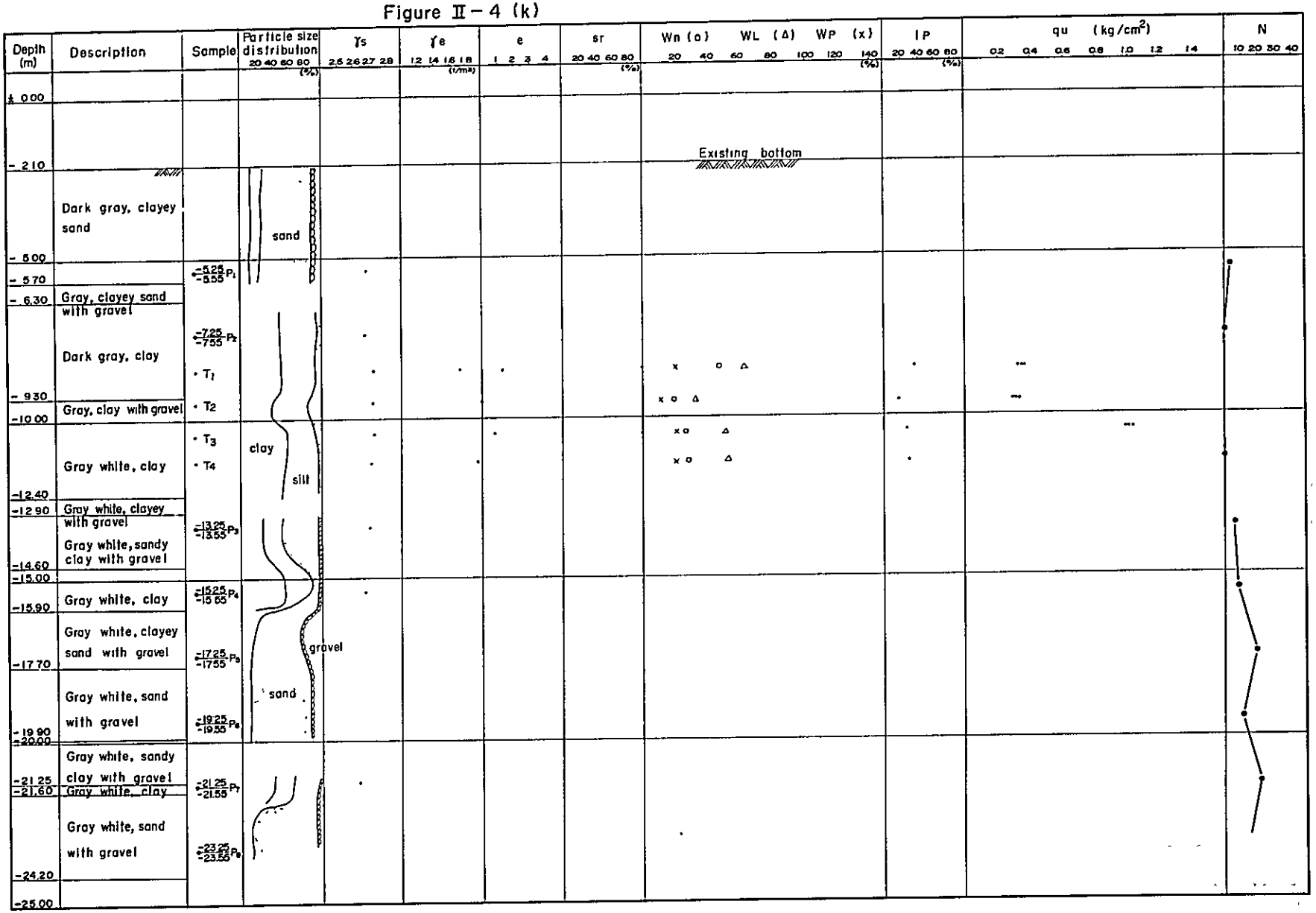

Depth (m)
Description
Sample
Particle size distribution 20 40 60 80 (%)
γs 2.5 2.6 2.7 2.8
γe 1.2 1.4 1.6 1.8 (t/m³)
e 1 2 3 4
sr 20 40 60 80 (%)
Wn (o) WL (Δ) WP (x) 20 40 60 80 100 120 140 (%)
IP 20 40 60 80 (%)
qu (kg/cm²) 0.2 0.4 0.6 0.8 1.0 1.2 1.4
N 10 20 30 40
± 0.00
- 2.10
Existing bottom
Dark gray, clayey sand
sand
- 5.00
- 5.70
-5.25 -5.55 P1
Gray, clayey sand with gravel
- 6.30
-7.25 -7.55 P2
Dark gray, clay
T1
T2
- 9.30
Gray, clay with gravel
-10.00
T3
T4
clay
silt
Gray white, clay
-12.40
Gray white, clayey with gravel
-12.90
-13.25 -13.55 P3
Gray white, sandy clay with gravel
-14.60
-15.00
-15.25 -15.65 P4
Gray white, clay
-15.90
Gray white, clayey sand with gravel
-17.25 -17.55 P5
gravel
-17.70
Gray white, sand with gravel
sand
-19.25 -19.55 P6
-19.90
-20.00
Gray white, sandy clay with gravel
-21.25 -21.55 P7
-21.25
-21.60
Gray white, clay
Gray white, sand with gravel
-23.25 -23.55 P8
-24.20
-25.00

Figure Ⅱ－4 (1)

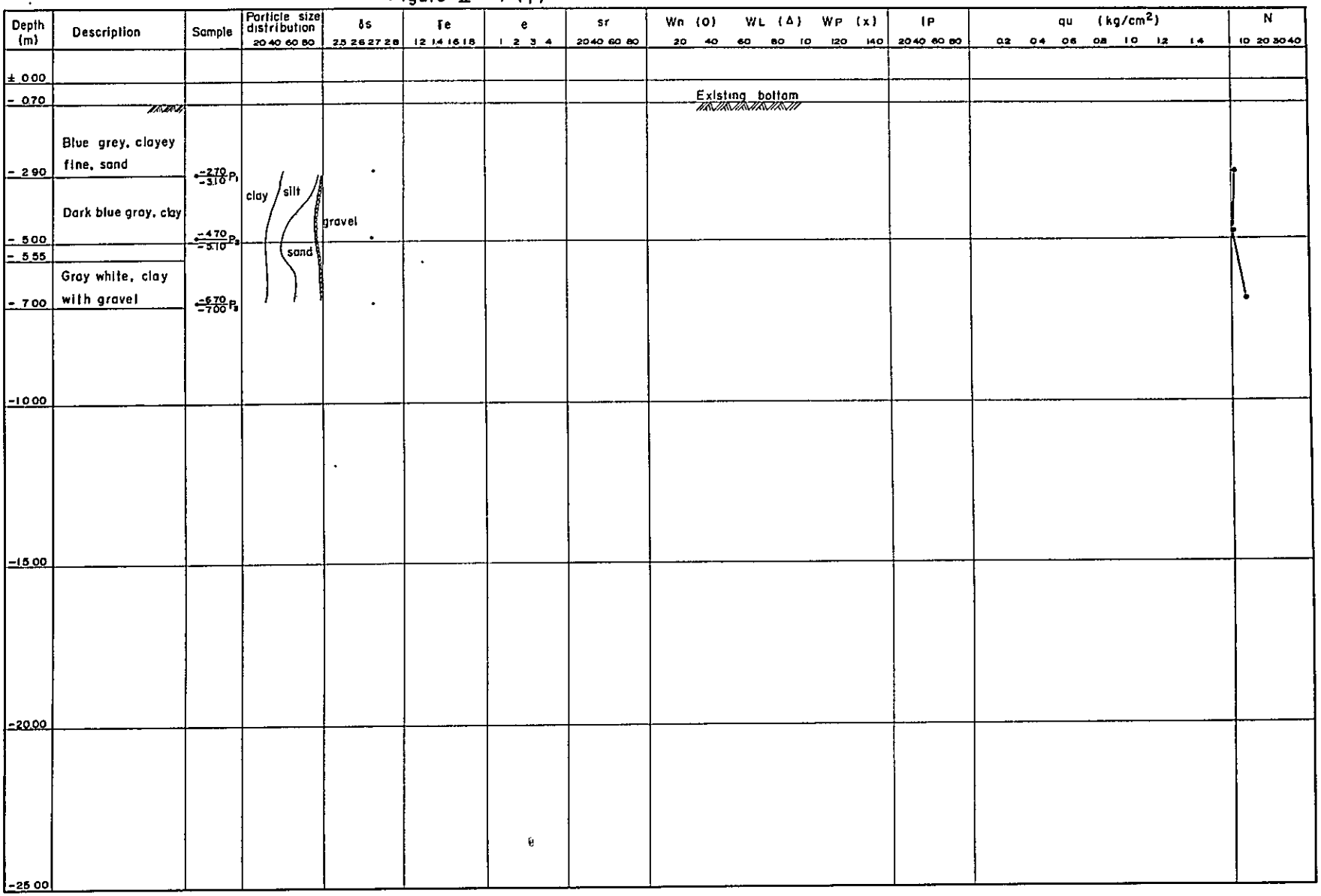

Depth (m)
Description
Sample
Particle size distribution
20 40 60 80
δs
2.5 2.6 2.7 2.8
γe
1.2 1.4 1.6 1.8
e
1 2 3 4
sr
20 40 60 80
Wn (O) WL (Δ) WP (x)
20 40 60 80 10 120 140
IP
20 40 60 80
qu (kg/cm²)
0.2 0.4 0.6 0.8 1.0 1.2 1.4
N
10 20 30 40
± 0.00
- 0.70
Existing bottom
Blue grey, clayey fine, sand
- 2.90
-2.70
-3.10
P1
Dark blue gray, clay
clay
silt
gravel
sand
- 5.00
-4.70
-5.10
P2
- 5.55
Gray white, clay with gravel
- 7.00
-6.70
-7.00
P3
-10.00
-15.00
-20.00
-25.00

Figure Ⅱ－4 (m)

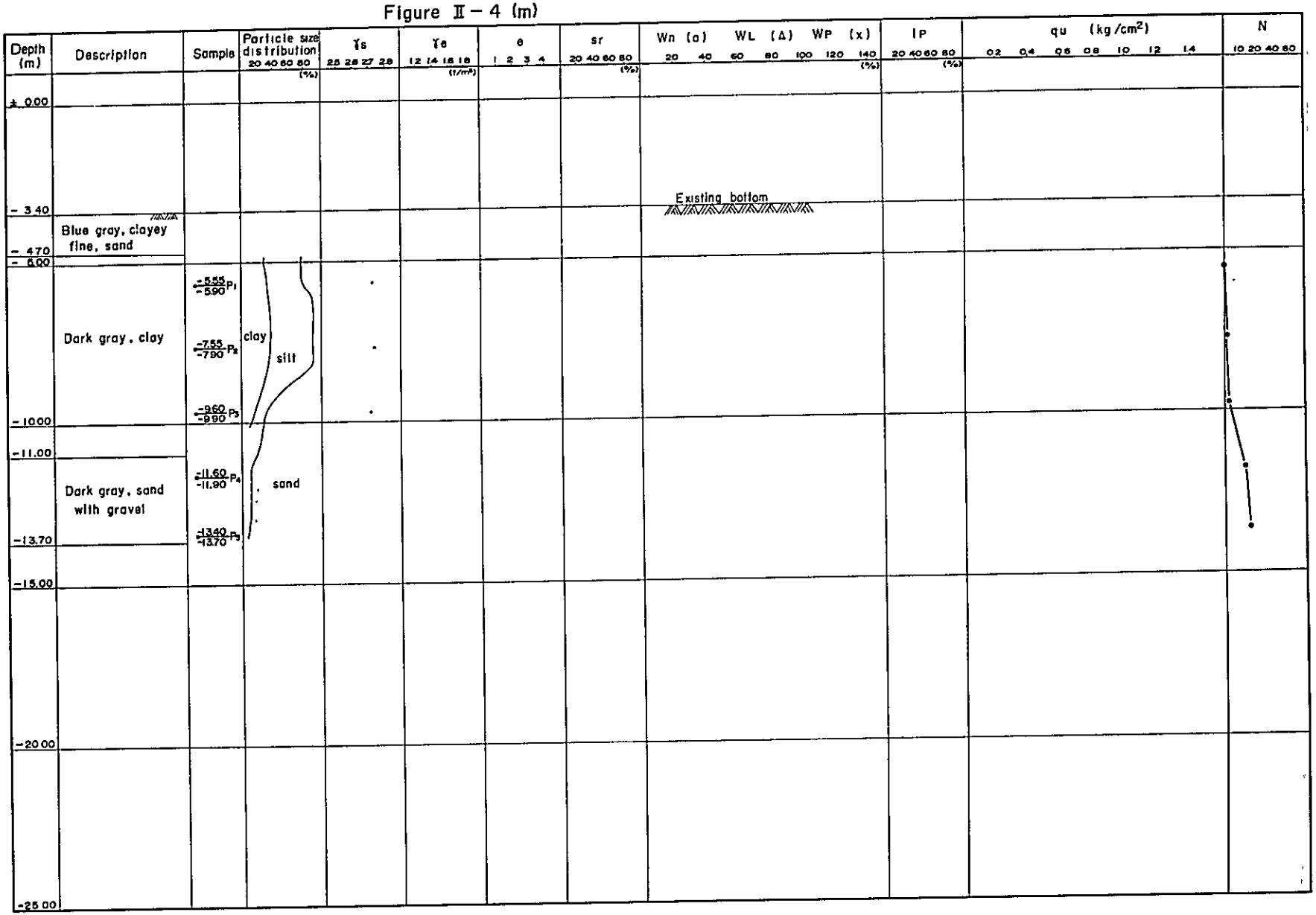

Depth (m)
Description
Sample
Particle size distribution
20 40 60 80 (%)
γs
25 26 27 28
γe
12 14 16 18 (t/m³)
e
1 2 3 4
sr
20 40 60 80 (%)
Wn (o) WL (Δ) WP (x)
20 40 60 80 100 120 140 (%)
IP
20 40 60 80 (%)
qu (kg/cm²)
0.2 0.4 0.6 0.8 1.0 1.2 1.4
N
10 20 40 60
± 0.00
- 3.40
Existing bottom
- 4.70
Blue gray, clayey fine, sand
- 6.00
Dark gray, clay
-5.55 / -5.90 P1
-7.55 / -7.90 P2
-9.60 / -9.90 P3
clay
silt
- 10.00
- 11.00
Dark gray, sand with gravel
-11.60 / -11.90 P4
-13.40 / -13.70 P5
sand
- 13.70
- 15.00
- 20.00
- 25.00

Figure II－4 (n)

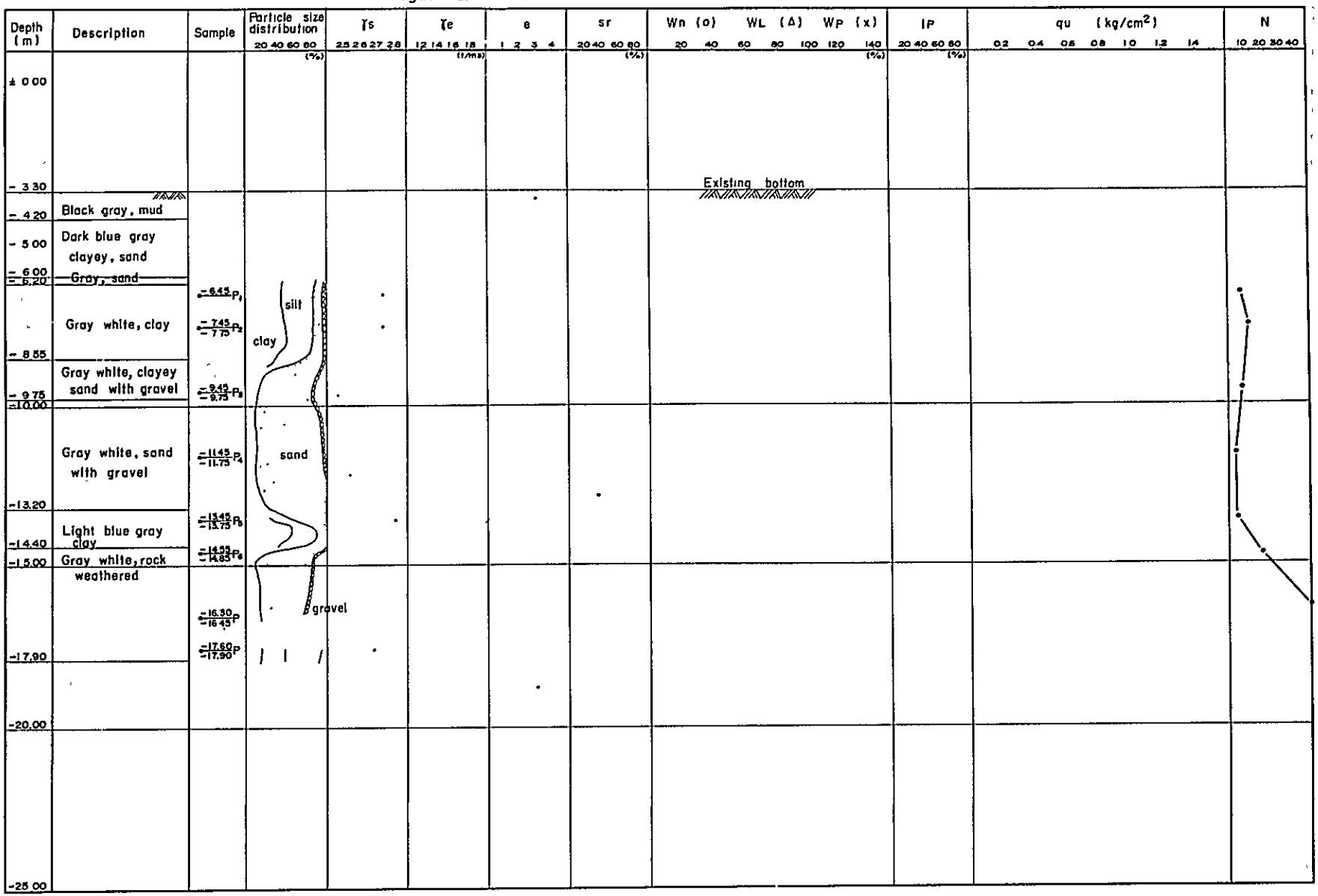

Depth (m)
Description
Sample
Particle size distribution (%)
γs
γe (t/m³)
e
sr (%)
Wn (o) WL (Δ) WP (x) (%)
IP (%)
qu (kg/cm²)
N
± 0.00
－3.30
Existing bottom
－4.20
Black gray, mud
－5.00
Dark blue gray clayey, sand
－6.00
－6.20
Gray, sand
－8.55
Gray white, clay
－9.75
Gray white, clayey sand with gravel
－10.00
－13.20
Gray white, sand with gravel
－14.40
Light blue gray clay
－15.00
Gray white, rock weathered
－17.90
－20.00
－25.00
－6.45 P1
－7.45 P2
－7.75
－9.45 P3
－9.75
－11.45 P4
－11.75
－13.45 P5
－13.75
－14.55 P6
－14.85
－16.30 P7
－16.45
－17.60 P8
－17.90
silt
clay
sand
gravel

Figure. II - 4 (o) Plasticity diagram (By Unified Soil Classification System)

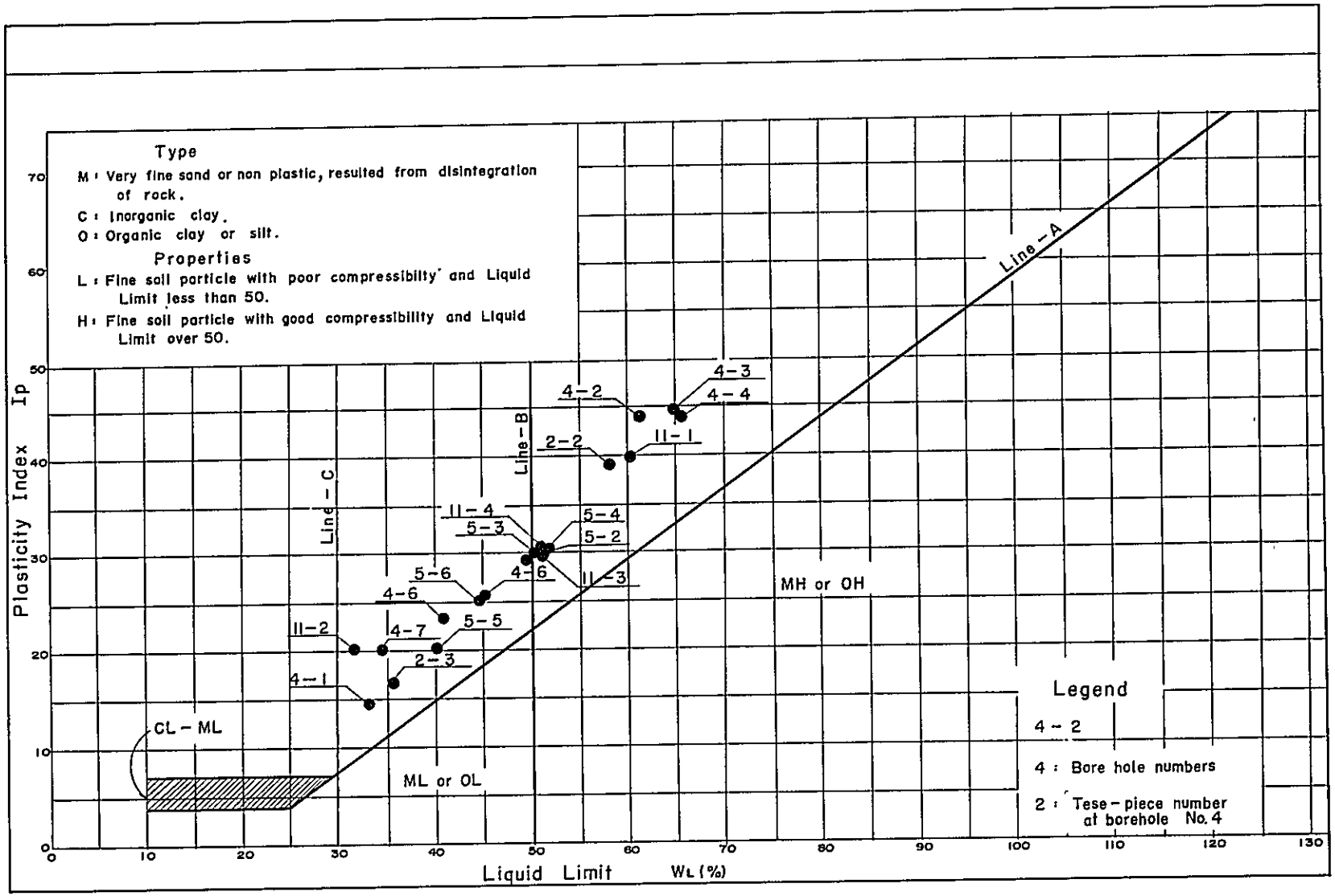


Figure. II－4(P)　qu－Z Relation

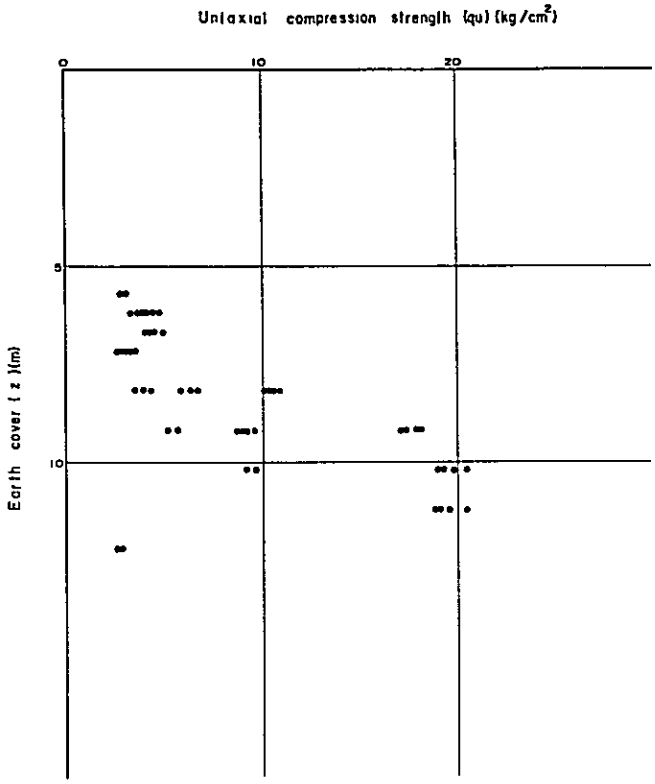


Figure. II－4 (9)　Coefficient of consolidation (Cv)

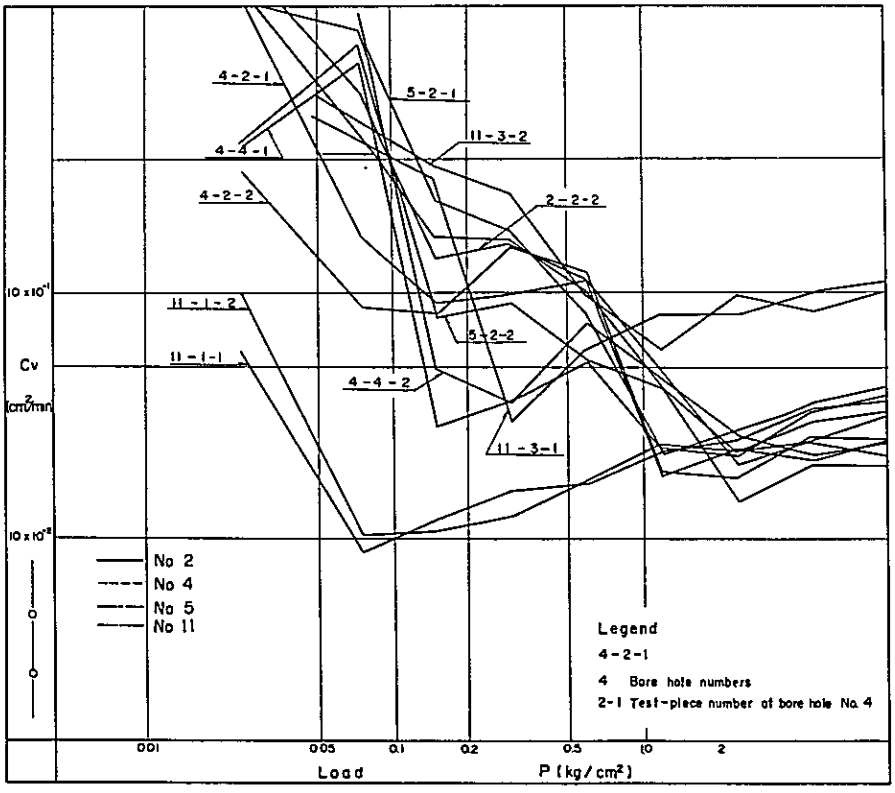


Figure II-4(r) Coeffficient of volum compressibility (Mv)

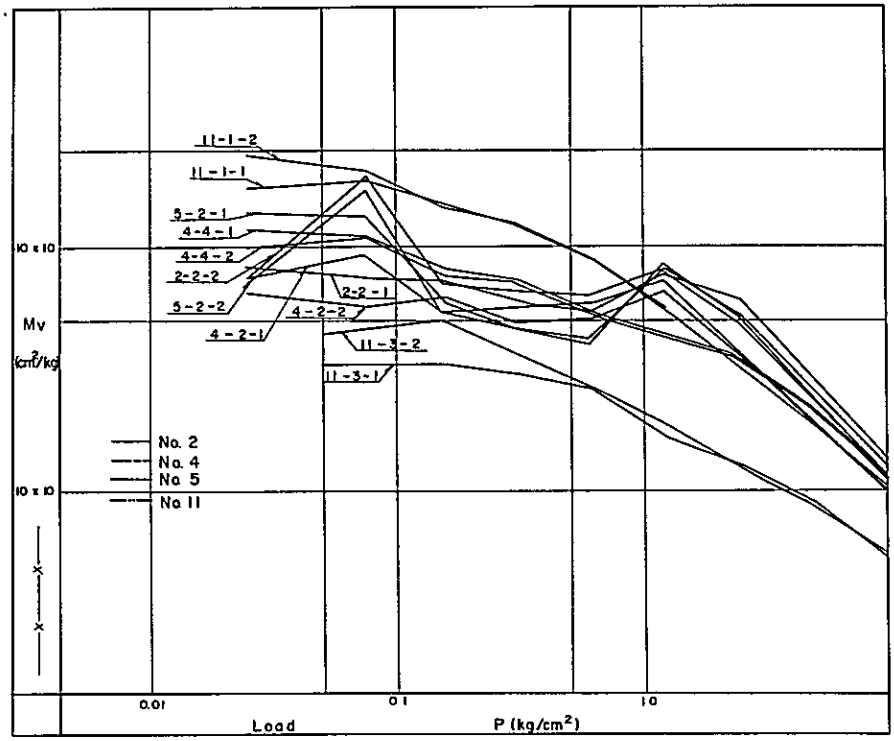
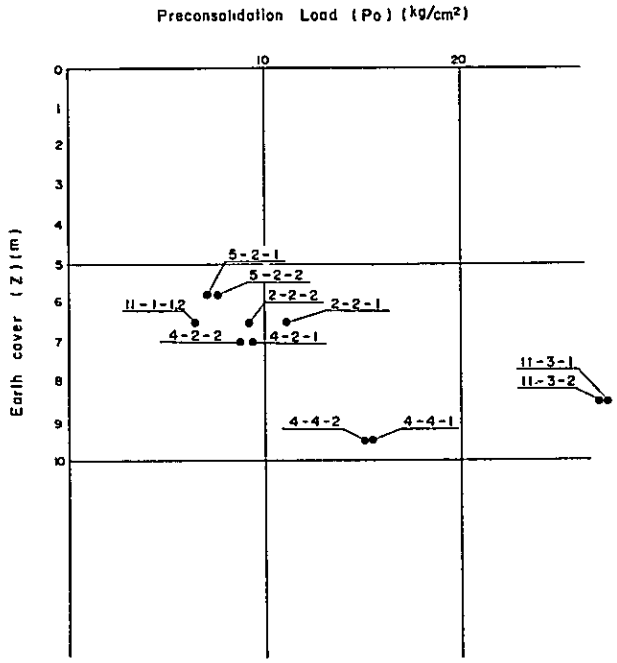


Figure II-4(s) Po-Z Relation



4-2 Soil Tests

Soil tests consisted of field tests which were conducted at the site immediately after sampling and laboratory tests which were conducted in Japan. The field tests included such mechanical tests as unconfined compression test and direct shear test. The laboratory tests conducted in Japan included such physical tests as specific gravity test, natural water content test, mechanical analysis, liquid limit test, plastic limit test and tests on the bulk density and such mechanical tests as unconfined compression test, consolidation test and direct shear test. Specific gravity test and mechanical analysis of disturbed soil specimens were also conducted.

Test items and methods are shown in Table II-3.

Table II-3 Test Items and Test Methods

	Test items	Test method	Remarks
Physical test	Specific gravity test of soil particle	JIS A 1202	
	Natural moisture ratio test	JIS A 1203	
	Mechanical analysis	JIS A 1204	
	Liquid limit test	JIS A 1205	
	Plastic limit test	JIS A 1206	
	Weight of unit volume	JIS A 1209	
Mechanical test	Unconfined compression test	JIS A 1216	Dimensions of test piece: 8.75 cm in height, 3.50 cm in diameter, straightening, strain rate of 1 mm/min.
	Direct shear test		Dimensions of test piece: 1.20 cm in height, 5.00 cm in diameter, consolidated quick test, straightening, strain rate 1 mm/min.
	Consolidation test	JIS A 1217	Dimensions of test piece: 200 cm in height, 6.00 cm in diameter, $\sqrt{t}$ analysis.

4-2-1 Specific Gravity of Soil Grain

Surface sand	Gs = 2.67
Upper clay	Gs = 2.70 ~ 2.77
Bottom clay	Gs = 2.67 ~ 2.68
Gravel	Gs = 2.66 ~ 2.68
Weathered rock	Gs = 2.70

4-2-2 Natural Water Content

Upper clay	W = 42.5% ~ 52.8%
Bottom clay	W = 17.5% ~ 30.3%

4-2-3 Grading

Distribution of gravel, sand, silt and clay in the top sandy layer, upper clayey layer, bottom clayey layer and the clayey soil mixed with gravel is shown in Table 2-4.

Table 2-4 Crain Size Distribution

	Gravel content %		Sand content %		Silt content %		Clay content %	
Top sand layer	1	13	50	74	20	50	10	25
Upper clay layer	0.5	5	1	40	40	50	25	59
Lower clay layer	-		1	16	30	40	50	61
Clay mixed with gravel	10	29	40	80	10	30	20	40

Classification of soils by the equitriangle chart method is as follows.

Top sandy layer: Sandy or clayey loam
Clayey layer: Mainly clay and partly clayey, sandy and silty loam

Clay mixed with gravel: Sandy or clayey loam

4-2-4 Consistency

Upper clay:

Liquid limit WL = 50%～65%
Plastic limit Wp = 20%
Plasticity index Ip = 30～45

According to the indices of consistency, the upper clay is generally stabllized, but part of the upper clay at boring point No. 2 is somewhat instabilized with 1c = 0.03.

With the standard classification, this layer may be classified as CH (good compressibility and inorganic clay).

Lower clay:

Liquid limit WL = 32%～50%
Plastic limit Wp = 15%～20%
Plasticity index Ip = 17～30

According to the indices of consistency, the lower clay is in the state of instability. With the standard classification method, this layer may be classified as C.L (poor compressibility and inorganic clay).

4-2-5 Bulk Density

Upper clay γ = 1.65 g/cm^3～1.80 g/cm^3
Lower clay γ = 1.90 g/cm^3～2.08 g/cm^3

4-2-6 Unconfined Compression Strength

Upper clay: Unconfined compression strength

q_u = 0.28 kg/cm^2～ 0.65 kg/cm^2

Compressive strain ε = 3.5%～4.5%

Lower clay: Unconfined compression strength

$q_u = 0.90\ kg/cm^2 \sim 2.04\ kg/cm^2$

Compressive strain ε = Approximately 5%

4-2-7 Direct Shear Test

Upper clay: Cohesion C = $0.08\ kg/cm^2 \sim 0.20\ kg/cm^2$

Apparent internal friction angle $\varphi_a = 17° \sim 22°$

Lower clay: Cohesion C = $0.44\ kg/cm^2$

Apparent internal friction angle $\varphi_a = 20°$

Cohesion C obtained by this test is somewhat smaller than $C = q_u/2$ which was obtained from unconfined compressive strength q_u.

4-2-8 Consolidation Test

Consolidation test shows a considerably wide variation.

Against the preconsolidation load:

$Cv = 20 \times 10.02\ cm^2/min \sim 7.0 \times 10.02\ cm^2/min$

Against the preconsolidation load, the volumetric variation rate:

$Mv = 4.0 \times 10.02\ cm^2/kg \sim 8.0 \times 10.02\ cm^2/kg$

CHAPTER 5. TECHNICAL PROBLEMS AND FUTURE SURVEYS AND TESTS

Technical surveys generally required ror a port construction project include meteorologic observations, wave observations, sea level observations, tide current observations, sounding survey, observations of littoral drift, survey of estuary silting up, hidraulic model test and geological investigations. It is important, however, to give priority to essential surveys and tests by selecting items from among the above according to the requirements of the project area.

Since none of these surveys and observations has ever been conducted for the Kuantan Port project area, it will be necessary to make an utmost effort for the implementation of surveys and observations with emphasis on the most needed surveys so that the planning of the port construction project may be substantiated by the data actually obtained by field surveys.

5-1 Technical Surveys Needed in the Future

5-1-1 Meteorological Observations

Though the meteorological observations are being conducted at Kuantan Airport for the area, the airport is located in the inland considerably far from the port project area and besides, it must be realized that the data obtained through observations vary greatly with geographical location and topography.

It is recommended, therefore, that observations of wind direction and wind velocity, which are vital for the port construction project, be conducted at the location not influenced by the topography of Tembeling point during the North-East monsoon season.

5-1-2 Wave Observations

Wave observations have never been conducted in this region and the only data available are those which were calculated on the basis of weather maps issued by the Japanese Meteorological Agency. To substantiate or correct the calculated value by the actually measured values, it is recommended that instrument observations of wave height and time and visual observations of wave direction be made during two North-East monsoon seasons at the location where the depth of water is -8 m, approximately 1 km northeast of Tembeling point.

5-1-3 Tide Current Observations

No tide current observations have ever been conducted around this area and the maps giving an outline of surface tide current are the only guide available to navigators. In order to obtain necessary information on the tide current in the vicinity of the project area, it is recommended that observations of the direction and velocity of tide current be made during the North-East monsoon season around the shoals located about 2 km and 5 km off the shore, respectively.

5-1-4 Sounding Survey

Extensive sounding surveys have not been conducted in the port project area for many years. The only marine chart now available is the British

hydrographic chart No. 1397.

According to this chart, the sea bottom in the project area has a very slow gradient and there are shoals in the depth of -8 m at the point about 2 km and in the depth of -6 m ~ -8 m at the point about 5 km off Tembeling point. In order to obtain necessary information on the transformation of the sea bottom including shoals, it is recommended that extensive sounding surveys be made for a wide area including a detailed sounding to be made specifically for the port construction area. It is also recommended that the said extensive sounding surveys be ensued by a follow-up sounding survey to be made on the base line following the first monsoon season.

5-1-5 Surveys on Littoral Drift

As no surveys have ever been conducted on littoral drift in this area and there are no structures in the sea, no data is available on the movement of littoral drift. In order to obtain information on the movement of bottom materials, particularly on the trend of the two shoals off the coast, it is recommended that a follow-up survey be made on the movement of fluorescent sand in the vicinity of the shoals during the North-East monsoon season.

5-1-6 Hydraulic Model Test

Sheltering tests are to be conducted on the basis of the results of wave observations, sounding surveys and according to the face lines and center lines of port structures.

5-1-7 Soil Surveys

In the port project area the hard base is quite deep and the foundation is not considered favourable in general. The data available is not adequate for the design of structures. It is recommended, therefore, that earth borings and soil tests be provided along the face lines and center lines of port structures.

Items of technical surveys which must be provided in the future and the place to be surveyed are shown in Fig. II-5.

5-2 Estimated Cost of Future Surveys

1.	Meteorological observations	US$ 2,800
2.	Wave observations	US$61,000
3.	Observation of tide current (Harmonic analysis included)	US$ 5,600
4.	Sounding survey (First)	US$44,500
5.	Sounding survey (Second)	US$13,900
6.	Survey on littoral drift	US$ 5,600
7.	Hydraulic model test	US$13,900
8.	Soil survey	US$41,700
	Total	US$189,100

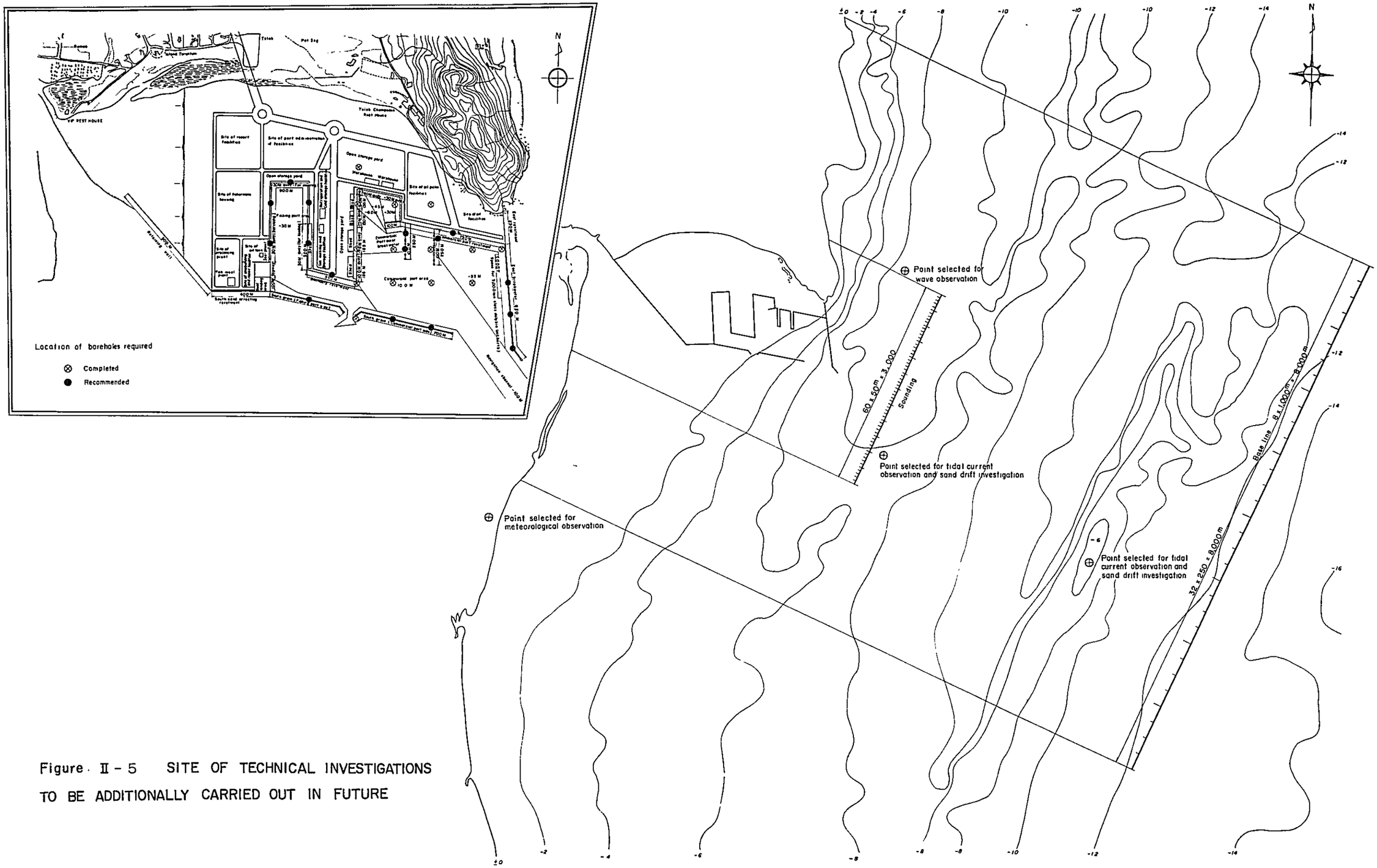


Figure Ⅱ - 5 SITE OF TECHNICAL INVESTIGATIONS TO BE ADDITIONALLY CARRIED OUT IN FUTURE

PART III

PORT CONSTRUCTION SCHEME

CHAPTER 1. BASIC CONCEPTS OF PORT CONSTRUCTION SCHEME

1-1 Object of Scheme

When the economic activities of West Malaysia are analyzed from a geographical point of view, it is obvious that West Coast overwhelmingly outranks East Coast in the intensity of economic activities. As previously mentioned in Part I, this is mainly due to the fact that the production of rubber and tin, key industries of the country, concentrates on the West Coast. The majority of East Coast, despite some progress in its development promted by Japan's rising demand for iron ore and timber after World War II, has been left unnoticed and unexploited.

For stepped-up development of the East Coast, the Government of Malaysia has worked out various projects as previously mentioned in Part I-2. and has been exerting vigorous efforts for their implementation. To provide a means of handling cargoes required for these inland development works as well as commercial cargoes which are expected to increase in volume with the industrial growth of the East Coast, the government has planned construction of a port on the East Coast, capable to cater large ocean-going vessels at any time of the year. The proposed port aims at serving the economy of the nation as a strategic point of commodity distribution and providing a modern fishing operation base for the promotion of income level of fishermen living on the East Coast.

1-2 Nature of the Port

As previously mentioned in 1-1, the proposed port is required to demonstrate the function of both a commercial port and a fishing port. The commercial port section is expected to play a role in the export judging from the type of cargo anticipated from inland. The fishing port section is to be planned as an overall fishery center with multiple functions such as operating base of coastal fisheries and distribution and processing center of catches.

CHAPTER 2. SELECTION OF SITE FOR PORT CONSTRUCTION

2-1 Outline

As it has already been decided to consider Kuantan and its vicinity as the site for the construction of the proposed port which has multi purposes as mentioned in III-1, no study was made on other locations. Compared with the West Coast, the East Coast is very disadvantageous with respect to topography and climate as mentioned in I and III. That is, flat sand beach and slow grade sea-bottom which provide the required water depth for catering large vessels only far off the coast, adverse weather conditions observed particularly in the North-East monsoon season and unfavourable marine meteorology act combinedly against the construction of a port on the East Coast.

If a port is to be constructed in or around Kuantan, the site most conceivable will be the estuary of the Kuantan River or the adjacent coast area in view of geography and weather condition and the relations of the port with hinterland.

2-2 Estuary Port Plan

The present Kuantan Port occupies the estuary of the Kuantan River and its mooring facilities extend 2.5 km upstream on the left bank. The present state of Kuantan Port has already been discussed in Part III-1. Construction of a new port for large vessels in the vicinity of existing port facilities is not considered possible for the following reasons.

(1) No space is available for land facilities on the left bank because of growing city facilities.

(2) The area on the right bank is marshy and is too far from the city area over the land unless access is provided by constructing a new bridge.

(3) As stated previously, construction of navigation channel and anchorage require a large scale dredging work which increases in the upper reaches proportionately to the distance ffom the estuary.

For these reasons, the estuary port plan envisages the construction of jetty wharves extending from both banks at the estuary to the sea and reclamation of the area on the side of the land with soils dredged from the navigation channel to create a new port district.

Main points of this plan are:

(1) Jetty wharves are to be extended to the point where the depth of water is about 7.5 m and should serve as both breakwater and groin to prevent the fill up of the navigation channel and at the same time to prevent the silting up of the port by flush effect of floods.

(2) The left bank jetty wharf near the estuary is to be used as a mooring quay.

(3) The left bank is to be used as a commercial port area and the right bank as a fishing port area.

(4) Small crafts are to use the existing facilities.

Advantages of this plan are:

(1) That the fishing port facilities are located close to fishing villages

(2) That the existing port facilities may be utilized as an integral part of the new port.

(3) That the port is very close to the town of Kuantan.

Disadvantages of the plan are:

(1) That constant dredgings are necessary to prevent fill up of navigation channel by sediment load of the river.

(2) That, because of the gentle slope of the seabed (approximately 1 : 600) along the course of the river, jetty wharves have to be extended to a considerable distance.

2-3 Coastal Port Plan (Refer to Fig. 2)

If a port is to be constructed along the coast near Kuantan, the coastal area extending from the mouth of the Kuantan River to Tembeling point is considered most appropriate. Reasons are:

(1) That Tembeling point may be effectively used in shielding high waves during the North-East monsoon season.

(2) That, because of the fairly steep slope of the sea-bed near Tembeling point as compared with other locations, it is comparatively easy to obtain a water depth required by large vessels.

(3) That a road extends for about 5 km to the vicinity of the proposed site from the center of Kuantan.

Disadvantages of this plan are:

(1) That the proposed site is far from fishing villages.

(2) That the existing port facilities cannot be utilized as an integral part of the new port.

The main points of this plan are:

(1) That a breakwater extending southwards from the tip of Tembeling point must be constructed to shelter the port from high waves during the North-East monsoon season.

(2) That a groin is to be constructed at the location about 1.5 km off and parallel to the shoreline to protect the port from the invasion of sediment load from the Kuantan River and littoral drift along the coast.

(3) That an anchorage is to be provided by dredging the water basin surrounded by the breakwater and the groin and at the same time, the sea along the coast is to be reclaimed with dredged soils for construction of mooring facilities and land facilities.

2-4 Comparison of the Two Plans

Upon a comparative study of the two plans on merits and demerits, it was concluded that the coastal port plan was more advantageous than the other for the following reasons.

(1) That the construction of jetty wharves requires a large amount of investment resulting in higher over-all construction costs as compared with the other plan.

(2) Sediment load from the Kuantan River will require dredging every year resulting in higher maintenance cost after completion of the port and at the same time, the fill up of the port is expected to hinder the entrance of vessels.

A cost comparison of the two plans is shown in Table III-1. Calculation of costs was made on the following preconditions.

(a) That the land facilities common to both plans are to be excluded from calculation and only outer facilities such as breakwaters and groins, navigation channel and anchorage, and mooring facilities are to be included.

(b) That, as the sites under both plans are located close each other, soil conditions are to be considered to be practically the same and therefore, the unit cost of construction is to be the same under both plans.

(c) That the calculation is to be made for the purpose of estimating the construction cost for comparison of the two plans.

Table III-1 Comparison of Construction Cost Between Estuary Port and Coastal Port

(In US Dollar)

Facilities	Estuary Port				Coastal Port			
	Work	Quantity	Unit cost	Amount	Work	Quantity	Unit cost	Amount
Outer facilities	East sea wall	4,100(m)	2,110	8,651,000	East sea wall	200(m)	2,190	438,000
	West jetty wharf	3,800	1,940	7,372,000	East breakwater	900	4,220	3,798,000
	Retaining wall	1,000	130	130,000	South sea wall	400	780	312,000
					South groin	1,300	1,310	1,703,000
					Retaining wall	1,000	130	130,000
	Sub-total			16,153,000	Sub-total			6,381,000
Basin facilities	Dredging of navigation channel	4,800,000(m3)	1.11	5,328,000	Dredging of navigation channel	4,500,000	1.03	4,635,000
	Dredging of anchorage	1,800,000	0.97	1,746,000	Dredging of anchorage	1,500,000	0.97	1,455,000
	Sub-total			7,074,000	Sub-total			6,090,000
Mooring facilities	-10.0 m dolphin	1	833,000	833,000	-10.0 m dolphin	2	833,000	1,666,000
	-10.0 m quay	400(m)	9,030	3,612,000	-10.0 m quay	400(m)	9,030	3,612,000
	- 7.5 m quay	500	6,670	3,335,000	- 7.5 m quay	150	6,700	1,005,000
	- 3.0 m quay	1,700	1,420	2,414,000	- 6.0 m quay	150	3,900	585,000
					- 4.5 m quay	150	1,940	291,000
					- 3.0 m quay	1,600	1,420	2,272,000
	Sub-total			10,194,000	Sub-total			9,431,000
Total				33,421,000				21,902,000

CHAPTER 3. PORT FACILITIES SCHEME

3-1 Basic Concepts

Arrangement of port facilities is to be made on the following preconditions.

(a) A clear distinction is to be made between the commercial port area and the fishing port area and separate facilities are to be provided for each area with the exception of those facilities which are considered to be used more advantageously when used as common facilities.

(b) Piers are to be of finger-type so that as many mooring facilities as possible may be provided in one specific area.

(c) Though the handling of container cargoes is not being considered at present, space must be reserved for the possible construction of a container yard.

(d) Facilities for the handling of dangerous cargoes including petroleum are to be isolated from other facilities.

(e) As the beach in the project area is a resort area, port facilities are to be constructed as far from the beach as possibe and no attempt is to be made to alter the existing condition.

(f) Facilities are to be provided to handle a total of 93,000 tons of cargoes on the basis of the estimated quantity of cargoes to be handled in 1985 at the commercial port and the report prepared by the survey team for the fishing port. As further expansion of the port even after the target year is considered, allowance is to be made for future extension of the facilities.

3-2 Common Facilities Plan

3-2-1 Breakwater

To shelter high waves during the North-East monsoon season, a breakwater and a rivetment, each having a length of 1,000 m, are to be constructed at the tip of Tembeling point. The breakwater is to be designed by taking into account the relationship with wave direction, course of navigation channel, groin and other port facilities and is to be extended south to the point where the depth of water is 7.5 m. As the port is designed to accommodate vessels with the tonnage up to 15,000 D/W, a minimum of 10 m in the depth is required for navigation channel and anchorage. This means that when the navigation channel having a depth of 10 m is provided, there is a possibility that the section of the channel not sheltered by the breakwater will be filled up by littoral drift as the breakwater extends only to the point where the depth of water is only 7.5 m. Depending on the results of future surveys on littoral drift, dredging of navigation channel outside of the breakwater may be required. Under the present plan the tip of the breakwater, 100 m in length, curves along the direction of the navigation channel. It is advisable that a further study be made on the shape along with the direction and the length of the breakwater by conducting a model test.

3-2-2 Groin

As previously stated in Section II, the beach in the project area is covered with sand consisting of weathered granite but the top layer of adjoining

sea-bed is soft containing some silts. These silts are considered to be the sediment load from the Kuantan River. As the depth of water in navigation channel and anchorage in the project area is smaller than the planned depth, a large scale dredging must be provided to obtain required depth. Consequently, it is possible that the navigation channel and anchorage provided with a required depth is again filled up with the previously stated silts carried by the river. A groin must be constructed to prevent this possibility. This groin is also useful to shelter the port from high waves in the south direction (The maximum wave height is about 1 m and these high waves occur two or three times during the period from August to October). The groin is to be 1,300 m in length and an entrance is to be provided in the middle of the groin for use by small fishing boats.

3-2-3 Navigation Channel

As stated previously, the depth of water in the project area is smaller than the planned depth of navigation channel and as a result, a large volume of deposits must be dredged to provide a navigation channel of required depth. In order to avoid such extensive dredging, the navigation channel should be provided at the location where the grade of sea-bed is as steep as possible. Within the project area the sea in the vicinity of Tembeling point is considered most appropriate. As the contour line is at a right angle to the SE direction up to the point where the depth of water is about 10 m, the navigation channel is to be provided in the SE direction and the effective width at the harbour is to be 200 m for vessels up to 15,000 E/W. The depth of 10 m is available only at the point about 3 km off the tip of the planned breakwater. As there is a bar (About 1 km wide and 7 km long) at the point about 2 km off in the sea where the depth is 8 m, it will be necessary to study whether the planned navigation channel should cross this bar or avoid it by detouring.

3-2-4 Access Road

As the beach in the project area is a resort equipped with a good road, extension of this road to the roads in the project area will be easily accomplished. The port-roads are to be connected to one main road running through the center of the project area and the main road is to be connected to the existing Telokside street (This street leads to the center of Kuantan City). The total length of the planned access road is 600 m.

3-3 Commercial Port Facilities

3-3-1 Number of Mooring Facilities Required

The volume of cargoes to be handled in the commercial port as estimated in 1.4 is as follows.

	Items	Handling volume (t)
Ocean-going vessells	Processed timber	357,000
	Palm oil	1,232,000
	Fertilizer	99,000
	Sub-total	1,688,000
Coastal vessels	Tapioca (Bullet type)	113,000
	Petroleum products	110,000
	General sundry goods	33,000
	Palm oil	37,000
	Sub-total	293,000
	Total	1,981,000

The capacity of one berth may be calculated by the following formula:

$$V = \frac{365 \times \alpha}{t_b} \times \xi$$

where:

V = Volume of cargoes handled (t)
α = Coefficient of utilization

$$t_b = \frac{\xi}{\mu} + t_o$$

where:

ξ = Average load per vessel (t)
t_b = Average number of days each vessel is on the berth
μ = Average volume of cargoes handled per day (5)
t_o = Number of days required for preparations prior to entry and clearance

(a) For one berth of quay wall, 10 m in depth 185 m in length, with a capacity of up to 15,000 D/W vessels:

$$\alpha = 0.65 \quad \xi = 9,000 \quad \mu = 1,000 \quad t_o = 1.5 \quad t_b = \frac{9,000}{1,000} + 1.5 = 10.5$$

$$V = \frac{365 \times 0.65}{10.5} \times 9,000 = 225,000$$

(b) For one berth of quay wall, 7.5 m in depth, 130 m in length, with a capacity of up to 5,000 E/W vessels:

$$\alpha = 0.65 \quad \xi = 3,000 \quad \mu = 700 \quad t_o = 1.5 \quad t_b = \frac{3,000}{700} + 1.5 = 5.8$$

$$V = \frac{365 \times 0.65}{5.8} \times 3,000 = 123,000$$

For handling the combination of processed timber and fertilizer totaling 456,000 tons, allocation of one berth of quay wall, 10 m in depth and two berths of quay wall, 7.5 m in depth, with a total capacity of 471,000 tons, will be sufficient.

To meet the future increase in the volume of cargoes, one of the berths of quay wall planned for a depth of 7.5 is to be designed to have a depth of 10 m and a length of 185 m. This will make the total length of quay walls 400 m and the use of a total of four berths will be possible for 5,000 D/W vessels.

(c) For one dolphin, 10 m in depth with a capacity of up to 15,000 D/W vessels:

$$\alpha = 0.5 \quad \xi = 10,000 \quad \mu = 5,000 \quad t_o = 1.5 \quad t_b = \frac{10,000}{5,000} + 1.5 = 3.5$$

$$V = \frac{365 \times 0.5}{3.5} \times 10,000 = 520,000$$

(d) For one dolphin, 7.5 m in depth with a capacity of up to 5,000 D/W vessels:

$$\alpha = 0.5 \quad \xi = 3,500 \quad \mu = 3,000 \quad t_o = 1.5 \quad t_b = \frac{35,000}{3,000} + 1.5 = 2.7$$

$$V = \frac{365 \times 0.5}{2.7} \times 3,500 = 235,000$$

For palm oil, exclusive dolphins are to be provided. Two dolphins of 10 m in depth and one of 7.5 m in depth will provide a total annual capacity of 1,275,000 tons, which will be adequate to handle an estimated volume of cargoes totaling 1,269,000 tons.

(e) For one berth of quay wall, 6 m in depth, 105 m in length, with a capacity of up to 3,000 D/W vessels:

$$\alpha = 0.65 \quad \xi = 1,800 \quad \mu = 500 \quad t_o = 1.0 \quad t_b = \frac{1,800}{500} + 1.0 = 4.6$$

$$V = \frac{365 \times 0.65}{4.6} \times 1,800 = 93,000$$

(f) For one berth of landing quay, 4.5 m in depth, 60 m in length, with a capacity of up to 700 D/W vessels:

$$\alpha = 0.65 \quad \xi = 350 \quad \mu = 200 \quad t = 1.0 \quad t_b = \frac{350}{200} + 1.0 = 2.7$$

$$V = \frac{365 \times 0.65}{2.7} \times 350 = 31,000$$

For tapioca and general sundry goods, one berth of quay wall of 6 m deep and two berths of landing quay wall of 4.5 m deep will provide a total capacity of 155,000 tons, which will be sufficient to handle an estimated volume totaling 146,000 tons. For petroleum products, meanwhile, private firms are expected to provide their own facilities and therefore, such facilities are not considered.

3-3-2 Arrangement of Mooring Facilities

The eastern half of the central jetty wharf is to be used for the commercial port and the water line on the eastern side of the jetty wharf is to be allocated mainly to the ocean going vessels. One berth of 10 m in depth and two berths of 7.5 m in depth, are to be provided starting from the eastern edge and these three berths are to be used for handling mainly processed timber and fertilizers.

One berth of 6 m deep and two landing berths of 4.5 m deep for coastal vessels are to be provided next to the previously stated large berths.

As the loading of palm oil is to be made through pipe lines, a jetty dolphin capable of accommodating vessels on both sides is to be provided in the center of the commercial port.

For petroleum products, a dolphin is to be provided at the base of the breakwater.

Government owned vessels and small passenger boats are to use the space at the north end between the central jetty wharf and the dolphin for palm oil handling, and a quay wall of 3 m deep is to be provided. The work boats for petroleum prospecting may use the landing quay of 4 m deep.

3-3-3 Transit Sheds

Construction of transit sheds is to be aimed at temporary storage of sawn-timber, fertilizers, tapioca and general cargo totaling 602,000 tons annually. Assuming that the turnover of a transit shed is 20 - 25 times a year and its capacity is 1.5 t/m^2, the required floor space of a transit shed will be from 16,000 m^2 to 20,000 m^2.

In the area extending in the rear of the quay wall of 10 m to 6 m deep, a total of four transit sheds are to be provided, comprising two which are 100 m in length and 40 m in width and two which are 100 m long and 30 m wide. The total floor space of these transit sheds will be 18,000 m^2.

3-3-4 Warehouse

Commodities which require storage in the port area are fertilizer, tapioca and general cargo. Of these, tapioca is expected to be transported to the transit sheds directly from the plant for shipment. Therefore, only half of the estimated total quantity is to be considered. Assuming that the total volume of cargo to be handled is 182,000 tons, capacity 2.5 t/m^2 and the turnover 10 times a year, the required floor space will be 7,000 m^2.

The sawn-timber is considered to be transported to the transit sheds directly from the plants in the hinterland in most cases. Even when its storage in the port area is required, open storage yards with simple roofs will be sufficient for the purpose. Therefore, only a land space is to be provided.

3-3-5 Palm Oil Storage Facilities

The quantity of palm oil to be handled in 1985 is estimated at 1,269,000 tons, of which 1,232,000 tons is expected to be shipped by ocean-going vessels and 37,000 tons by coastal vessels. With the turnover estimated at 12 times a year, storage tanks having a combined total capacity of 106,000 tons are to be constructed. Six tanks, each having a capacity of 10,000 tons and ten tanks, each having a capacity of 5,000 tons, are to be provided.

Dimensions of the tank are to be 29.1 m in diameter and 15.9 m in height for the former and 20.3 m in diameter and 16.5 m in height for the latter.

The total land space required for these tanks and ancillary facilities is estimated at about 20,000 m^2.

3-4 Fishing Port Facilities

3-4-1 Basic Concepts of Facilities Planning

Based on the report prepared by the fishing port survey team, the fishing port facilities planning will be made in line with the following guidelines.

(a) Kuantan Port is to be used as an operating base for large scale trawling and purse seine operations.

(b) Special landing quay walls are to be provided so that all the large fishing boats may be moored at the quay wall for landing of catches. In designing the quay wall consideration is to be given to provide an extra length so that smaller fishing boats may use the quay for landing of their catches.

(c) A mooring quay is to be provided for specific use by fishing boats which have finished the landing of their catches to wait until the following departure and to shelter in the inclement weather.

(d) A service quay is to be provided for specific use by fishing boats for supply of fuel and water in preparation for departure.

(e) Land areas of sufficient space are to be secured for the construction of all land facilities required of a modern fishing port and other related facilities.

(f) Consideration is to be given to the future expansion of facilities in preparation for the event when the small fishing boats now utilizing the Kuantan River operate from the proposed port and when further expansion is made in the number of large fishing boats.

(g) Construction of the fishing port is to be divided into the first phase and the second phase and facilities are to be added in stages corresponding to the growth of fishery industry in the region. The portion to be completed in the first phase is to include such central facilities as landing quay, cargo handling yard, and ice-making plant and cold storage.

3-4-2 Required Facilities and the Size of Facilities

Within the fishing port area, facilities having the following functions are to be provided.

Function	Type of Facilities
Facilities related to the operation of fishing boats	Navigation channel, berth, quay wall, slip way, warehouse for storage and maintenance of fishing gear and required land space. Facilities for the supply of water, fuel and ice.
Facilities related to the disposition, storage and processing of catch	Landing quay, selling places, open storage yard, ice-making, refrigeration and cold storage facilities, roads, parking lots and processing plant.
Other facilities	Administration office, radio station, brokers' offices, carriers' offices, shipyard, fishermen's housing, welfare facilities for fishermen, and fishermen's hall.

As a barometer for determining the size of these facilities, utilization of the fishing port is estimated as follows.

Type of fishing boats	Number of boats	Haul (Annual) (ton)	Number of boats entering the port per day and time of arrival	Landing quantity prt day (ton)	
60 ton-class trawl-boat	140	42,000	35 (Arrival early in the morning)	(117) 180	
30 ton-class trawler	85	17,000	43 (Arrival in the evening)	(46) 70	Landing of load during the same hour totals 245 tons
30 ton-class purse seiner	75	30,000	38 (Arrival in the evening)	(160) 160	
Total of large fishing boats	300	89,000			
Other small fishing boats		4,000	(Arrival in the evening)	(15) 15	
Total		93,000		(338) 425 ton	

Notes: 1. For 60 ton-class trawlers, the number of operating days per trip is assumed to be 4 and 1/4 of the total number of boats are presumed to arrive per day. Therefore, the number of boats entering the port per day will be: 140 ÷ 4 = 35.

2. For 30 ton-class trawlers, the number of operating days per trip is assumed to be 2 and 1/2 of the total number of boats are presumed to arrive per day, Therefore, the number of boats entering the port will be: 85 ÷ 2 = 43.

3. For 30 ton-class purse seiners, the number of operating days per trip is assumed to be 2 and 1/2 of the total number of boats are presumed to arrive per day. Therefore, the number of boats entering the port per day will be: 75 ÷ 2 = 38.

4. Of the small fishing crafts, those entering the port for landing of catches per day are estimated at 40 in number.

5. Figures in parentheses represent the quantity of fish for food.

(1) Depth of navigation channel and anchorage

The minimum depth of 3 m is to be secured for the navigation channel and anchorage for 30 ~ 60 ton class fishing boats so that they may be used even at low tide.

(2) Length of quay walls

The total length of quay walls has been determined to be as follows on the basis of the report prepared by the fishing port survey team.

Landing quay:	320 m	
Mooring quay:	900 m	Total: 1,400 m
Service quay:	180 m	

(3) Length and total space of slip way

The slip way is to be planned for small fishing crafts of less than 5 tons which accompany the purse seiners, and it is to be 100 m in length with a total space of 10,000 m^2.

(4) Space of selling place

Of the total quantity of landed catch per day, the maximum quantity of load to be landed during the same hour in the evening is estimated at 245 tons. As approximately 30% of the 70 tons unloaded from trawl-boats are presumed to be waste fish which must be processed at the fish-meal plant, the total quantity of fish for food to be handled at the selling place during the same hour will be: 70 x 0.7 + 160 + 15 = 224 tons.

In consideration of the event when the landing quantity is extremely large, calculation of the space for selling place is to be made on the design capacity of 336 tons, which is 1-1/2 times the estimated average landing of 224 tons. As the capacity of the selling place is estimated to be 0.05 t/m^2, the total space required will be:

$$336^t \div 0.05\ t/m^2 = 6,720\ m^2$$

Also a parking lot is to be provided at the back of the selling place.

(5) Size of ice-making and ice storage plant

The quantity of ice required is estimated as follows.

For fish boats:	0.5 ton of ice for 1 ton of fish
For transportation of fresh fish:	1 ton of ice for 1 ton of fish

Assuming that the average daily catch is 425 tons and that 75% of the total quantity of landed fish for food are shipped to consuming areas, the quantity of fresh fish to be transported is 250 tons. (The remaining 25% is assumed to be processed into salted fish or dried fish locally). Consequently, the daily requirement for ice is:

$$0.5^t \times 425 + 1^t \times 250 = 462.5^t$$

As the existing facility has a daily capacity of 60 tons, the required total capacity is about 400 tons after deducting the aforementioned 60 tons. However, in consideration of non-fishing days and other factors, a deduction by 30% may be allowed and the facility having a total capacity of 300 tons is considered sufficient. The capacity of the ice storage room is to be 900 tons or 3 days supply of ice-making capacity. In order to add facilities in the future corresponding to the expansion of the fishing port, initial installation is to be three units each having an ice-making capacity of 100 tons and a storage capacity of 300 tons.

(6) Cold storage facilities

The size of cold storage facilities is to be sufficient for four days' supply of the average quantity of fresh fish shipped to consuming areas daily. Consequently, the holding capacity of the cold storage is to be:

$250^t \times 4 = 1,000^t$ (25°C)

A refrigeration room having a daily freezing capacity of 30 tons (-35°C) is to be provided.

(7) Fuel storage tank

Consumption of fuel by fishing boat is to be 0.23 ℓ/ps hr. Horsepower and hours of navigation of fishing boats departing the port daily are assumed as follows.

Type of fishing operations	Number of fishing boats (N)	Average horsepower per boat (P)	Hours of navigation (H)	Total horsepower N.P.H.
		p.s	hr	
Purse seine fishing	38	130	20	98,800
30 ton-class trawling	43	120	24	123,840
60 ton-class trawling	35	190	40	266,000
Total				488,640

Accordingly, the total consumption of fuel per day will be:

$488,640 \text{ pshr} \times 0.23 \ell/\text{ps hr} = 112,387 \ell$
$\fallingdotseq 112 \text{ K}\ell$

The fuel tanks are to have a capacity of 3 days' supply, which will be:

$112 \text{ k}\ell \times 3 = 336 \text{ k}\ell$

Accordingly, six tanks, each having a capacity of 60 kℓ, are to be provided.

(8) Fish-meal plant

Approximately 30% of the total annual catch, or 28,000 tons, and some of the leftovers of processed fish are to be processed into fish-meal. The daily requirement for processing will be:

$28,000^t \div 300 \text{ day} = 93^t$

The quantity of fish meal is presumed to be 15% of the quantity of fish processed. The daily production of fish-meal, therefore, will be:

$$93^t \times 15\% = 14^t$$

(Note) For effective utilization of the facilities, the fish-meal plant is to be of the type which allows the round-the-clock operation. The capacity of the plant is to be 150 tons, with an allowance for some extra capacity.

(9) Land space for processing facilities

Though the present requirement is for the construction of a fish-meal plant, a storage tank for salt to be used for salting fish and fish drying yard, a tract covering an area of about 300,000 m^2, is to be secured to provide a space for the construction of tinning works and other facilities as necessary.

3-4-3 Arrangement of Facilities

For arrangement of the fishing port facilities, it is considered appropriate to start withe the construction of the central jetty wharf which will be provided in parallel to the commercial port facilities as shown in the attached plan. As the first step of the project, a jetty wharf having a total length of 320 m, which is equivalent to the length of the landing quay at the final stage, is to be provided as an extension of the quay to be used by 60 large fishing boats for landing of their catches and for mooring five years hence. Thereafter, a mooring quay and a service quay are to be added to the facilities in that order corresponding to the expansion of fishing industry in the area. Therefore, a selling place, ice-making and storage facilities and a cold storage and an administration office, all of which are the central facilities of a fishing port, are to be constructed in the reclaimed area along the central jetty wharf which is scheduled to be completed first. Two ice-making plants with ice-supply towers are to be provided at the back of landing quay to supply ice to the selling place, as well as to the fishing boats prior to the completion of the service quay. Upon completion of the service quay, one ice-making facility is to be provided at the back of this quay.

In planning the arrangement of required facilities, the following points were taken into consideration.

(a) A land of sufficient space was provided at the back of the mooring quay for use as an open storage yard which may also be used for repairing and storage of nets and also as a common work place.

(b) Fuel tanks were isolated from other facilities in prevention of fire hazards and explosions, with a sufficient space provided around them.

(c) The shipyard and the processing plant were located closest to the shoreline so that sewage would not be discharged directly into the port.

CHAPTER 4. CONSTRUCTION PLAN

4-1 Outline

Though the estimate on the volume of cargo to be handled at the port was made for two stages, 1980 and 1985, there seems to be very little difference between the two years in the volume of cargo except palm oil. In working out the construction plan, therefore, efforts were made to arrange the work schedule so that a part of facilities might be used even during the construction period, with the target for completion set around 1980.

The key points of construction plan are as follows.

(1) Part of the facilities are to be put in service in 1976. For this purpose, one dolphin quay for palm oil and one landing quay, 320 m in length and with a depth of 3 m, for fishing boats, are to be completed in 1976.

(2) Priority is to be given to the construction of the east breakwater. Construction of breakwaters and groins is to be nearly completed within 1976.

(3) Dredging of the basin is to begin as early as possible in conformity to the increase in the sheltering effect of the east breakwater and is to be continued until the completion of the project.

(4) One quay wall with a depth of 10 m is to be completed within 1977.

(5) Land facilities are to be provided in conformity to the progress in the construction of mooring facilities.

4-2 Outline of Design Policy for Main Structures

4-2-1 Matters Given Special Attention in the Design of Structures

Special attention was given to the following points in designing port facilities in view of unique geographical features of Kuantan.

(1) Rich resources of stone available in Tembeling point in the vicinity of the project area are to be utilized to the fullest extent.

(2) As the proposed site is close to the estuary of the river with muddy water having a high turbidity, facilities are to be of the design which minimizes the underwater construction work.

(3) To obtain a higher efficiency and dependability of the work, use of machinery is to be planned to the maximum extent.

(4) The design of the work is to be such that will not require large scale construction facilities.

(5) Consideration is to be given to the use of locally available materials, ships and machinery to the extent possible.

(6) For such conditions as the allowable unit stress of materials, Japanese Industrial Standards (JIS) are to be applied.

4-2-2 Design Criteria

Design criteria for the port facilities are as follows:

(1) Sea level: H.W.L.: +3.1 m L.W.L: ± 0.0m

(2) Waves: (Deep water waves)

Wave height: 2.5 m
Wave direction: NE
Wave period: 11 seconds

(3) Wind velocity: 30 m/sec

(4) Earthquakes: Not considered

(5) Elevation of the highest point :

Mooring facilities:

Commercial port mooring facilities:	+4.2 m
Fishing port mooring facilities:	+3.8 m

Breakwaters and groins:

East jetty wharf, east breakwater:	+6.0 m
South groin, south sea wall, retaining wall:	+4.0 m
Commercial port inner breakwater, commercial port revetment:	+4.2 m
Reclaimed area:	+4.0 m

(6) Type of vessels to be accommodated and the depth of frontal sea :

	Type of vessels	Tonnage of vessels	Planned depth (m)	Type of mooring quays
Fishing port	Fishing boat	60 G/W	3.0 m	Quay wall
Commercial port	Cargo boat	200 D/W	3.0	"
"	"	700 "	4.5	"
"	"	3,000 "	6.0	"
"	"	5,000 "	7.5	"
"	"	15,000 "	10.0	"
"	Tanker	15,000 "	10.0	Dolphin

(7) Approaching speed of vessels :

Fishing boats:	50 cm/sec
Merchant ships:	50 cm/sec (Over 700 D/W)
Merchant ships:	15 cm/sec (Over 3,000 D/W)

(8) Live load :

Type of vessels	Tonnage of vessels	Uniform load	Automobile load
Fishing boat	60 G/W	1.0 t/m^2	TL - 20
Freight vessel	200 D/W	" "	"
"	700 "	" "	"
"	3,000 "	2.0 t/m^2	"
"	5,000 "	" "	"
"	15,000 "	" "	"
Tanker	15,000 "	0.5 "	"

(9) Width of aprons:

Fishing port quay wall:	10.0 m
Commercial port quay wall (Less than 4.5 m of planned depth):	10.0 m
Commercial port quay wall (More than 6.0 m of planned depth):	20.0 m

(10) Pavement of aprons and roads :

Pavement is to be asphalt macadam.

(11) Soils

Sea-bed geology:

Data on soil exploration (Results of survey made by the Fishing Port Survey Team) are to be used after analyses and reviews have been made.

Reclaimed area

Dredged earth and pit earth is to be used for reclamation. Pit earth is to be obtained from the site approximately 2 miles from the port project area.

(12) Preservative treatment

Quay walls having a planned depth of less than 4.5 m:

Corrosion allowance = 10 ~ 20 mm

Quay walls having a planned depth of more than 6.0 m:

Corrosion allowance of 10 ~ 20 mm is to be provided in combination with electric anti-corrosion treatment.

4-2-3 Outline of Design Policy for Main Structures

Basic concepts of design for structures are as follows.

(1) East jetty wharf

The weight and the grade of slope of concrete blocks are to be determined

for the waves in NE direction by the Hudson's formula.

(2) East breakwater

- o The weight and the grade of slope of concrete blocks are to be determined for the waves in NE direction by the Hudson's formula.

- o Because of lack of data on soil composition at the proposed location of the east breakwater, a detailed study has not been made. However, judging from available data on soil composition in the area, a circular slippage of bed-rock is expected at points of great water depth. Consequently, the design of the breakwater should incorporate counter-weight to hold down the breakwater.

(3) Dolphin having a water depth of 10.0 m

- o Modulus of elasticity of soils in the area extending from boring point No. 11 to the point where the depth of water is 10 m is estimated to be Es = 765 t/m^2.

- o Transverse resistance of post is to be calculated by the U. L. Chang's method.

- o Dolphin system has been adopted after comparing the economy of this system with that of the vertically driven landing pier.

- o Configuration of the section of the post of the dolphin for rope tying is to be so determined that the horizontal deviation due to the accommodation of a ship will be held within a range of 5 cm.

- o The dolphin and the pipe line are to be separated from each other so that no impact load will act directly on the pipe line.

(4) Commercial port quay walls having a water depth of 10.0 m, 7.5 m and 6.0 m, respectively

- o According to the data obtained at boring points No. 2 and No. 4, the sea-bed in this area is composed of soft clay. As it is necessary to provide a slow grade of slope resulting in greater area of plane for cross landing pier and a greater amount of cost for the construction of retaining wall, the sheet pile type quay wall is to be provided.

- o As the soil in the sea-bed up to the depth of 15.0 m is considered to consists of clay with low tenacity, the configuration of the section and the depth of embedment for sheet pile and the type of tie-rod are to be determined by Lohmeyer's deflection method. Because of particularly soft clay found in the area around planned depth, portion of soil is to be replaced with sand.

- o To ensure easiness of the work, tie-rod made of high strength steel is to be used.

(5) Quay walls having a water depth of 4.5 m and 3.0 m respectively

- o Upon making a comparative study of quay wall of piles type, landing pier type quay wall and sheet pile quay wall, the last one which is most easily constructed has been chosen.

- o Since the quay wall is not particularly large in size, replacement of soil with sand is not required.

(6) Palm oil storage tank

- o Concrete pile is to be used for foundation and the friction pile system which allows a slight sinking is to be employed.

- o Specific gravity of palm oil is to be 0.91.

4-2-4 Sections of Main Structures

Sections of main structures are shown in Drawing III-1 (a)～(n).

4-3 Construction Schedule

The construction schedule has been worked out as follows on condition that required construction materials, ships and machinery are to be procured within Malaysia to the extent possible.

4-3-1 Methods of Work

(1) Banking

The main structure of breakwater and jetty wharf and their foot protection consist of mainly stones. These stones are to be quarried at Tembeling point and transported to the site. The stones are to be banked with the use of trucks, bulldozers and cranes. For the construction of breakwaters and groins on south side, a temporary access road is to be built in the sea. Estimated quantity of stone to be required is shown in the following table.

Structure	Quantity of stone (m^3)	Remarks
East jetty wharf	35,000	
East breakwater	376,000	
Commercial port revetment	53,000	
Commercial port inner breakwater	7,000	
Temporary access road	113,000	Pit earth may be used
South sea wall	37,000	
South groin	231,000	
Retaining wall	8,000	
Total	860,000	

Assuming that the number of working days is 240 a year and that the work is completed in six years, the pace of progress in the work is estimated to be 600 m^3/day. For this, 120 truck/day and corresponding numbers

Figure. Ⅲ - 1(a) PLAN OF KUANTAN PORT FACILITIES

SCALE = 1 / 1,000
UNIT : m

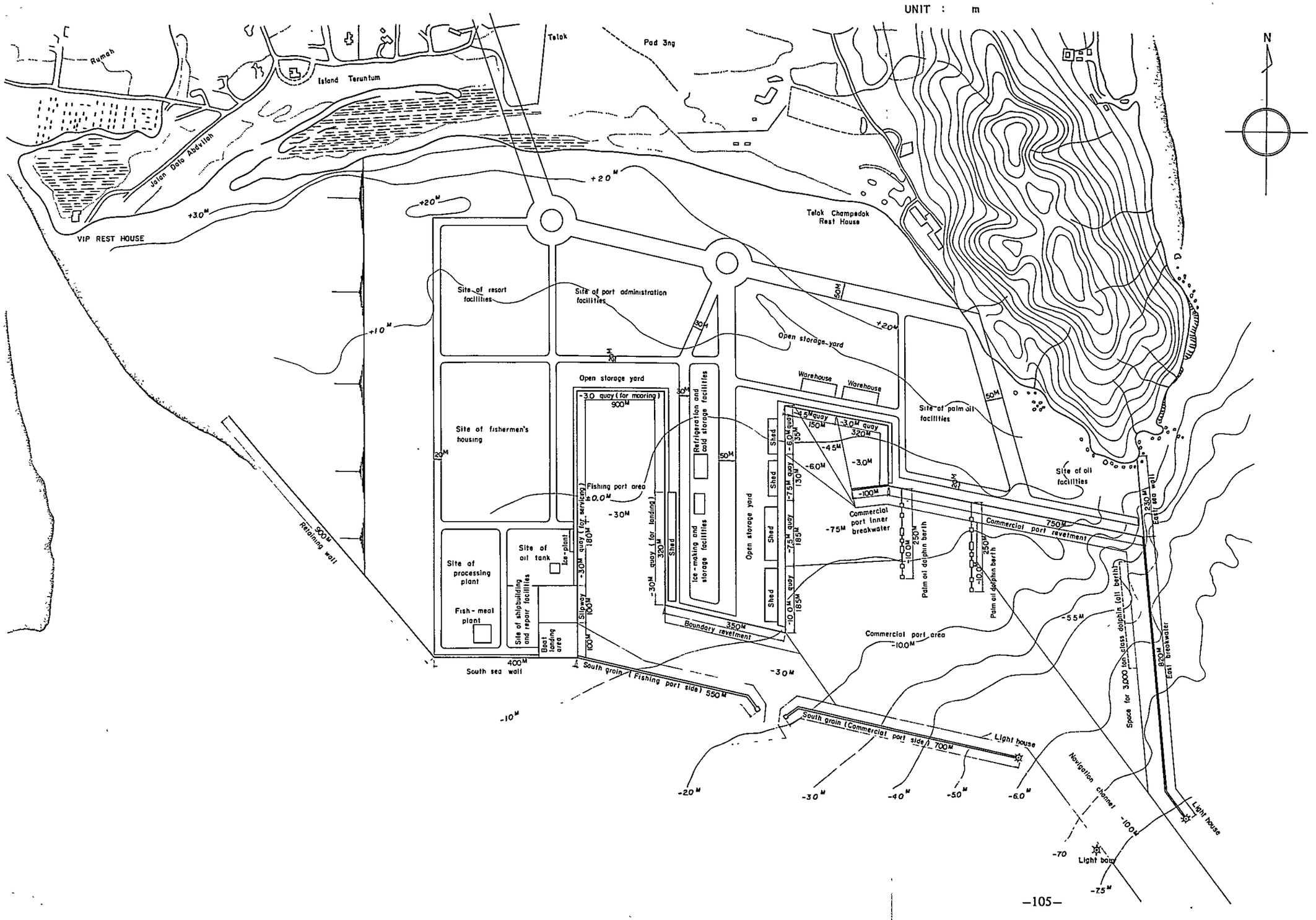


Figure. Ⅲ－1(b)　STANDARD SECTION OF EAST SEA WALL

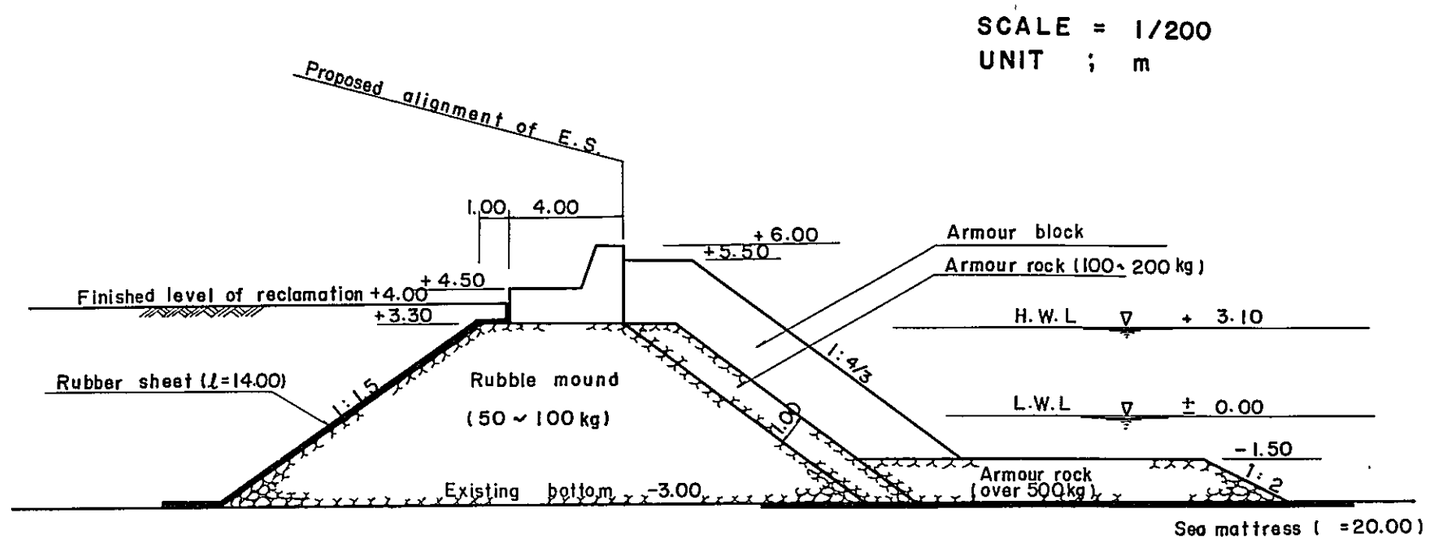


Figure. Ⅲ－1(c)　STANDARD SECTION OF EAST BREAKWATER

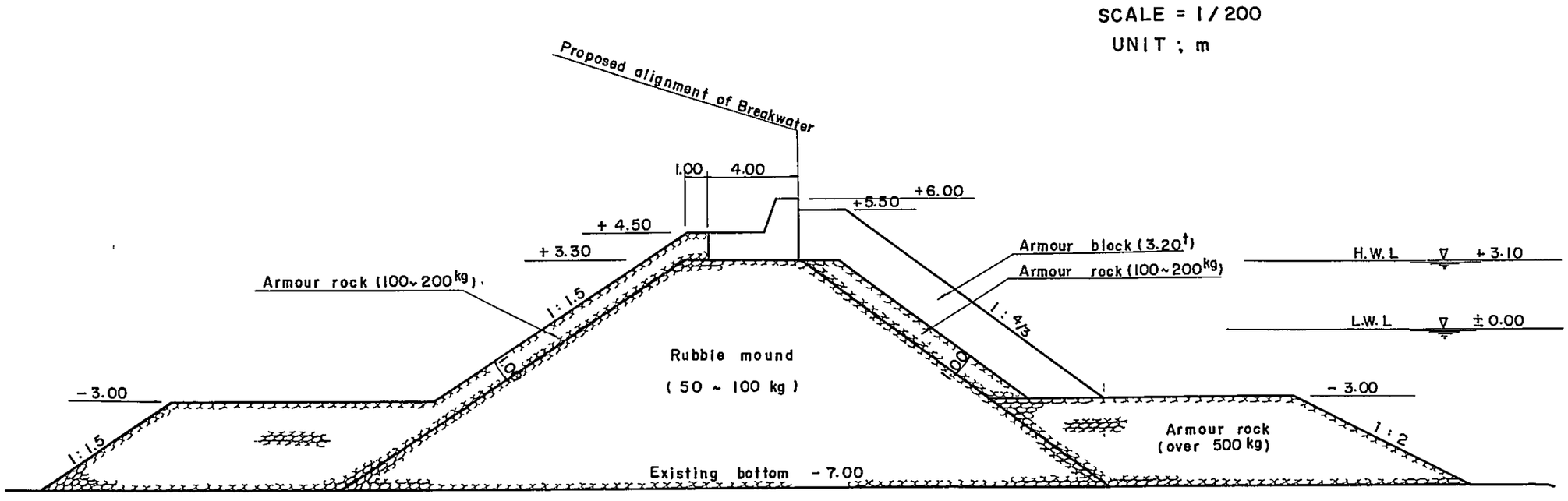


Figure. Ⅲ-1(d) STANDARD SECTION OF SOUTH GROIN

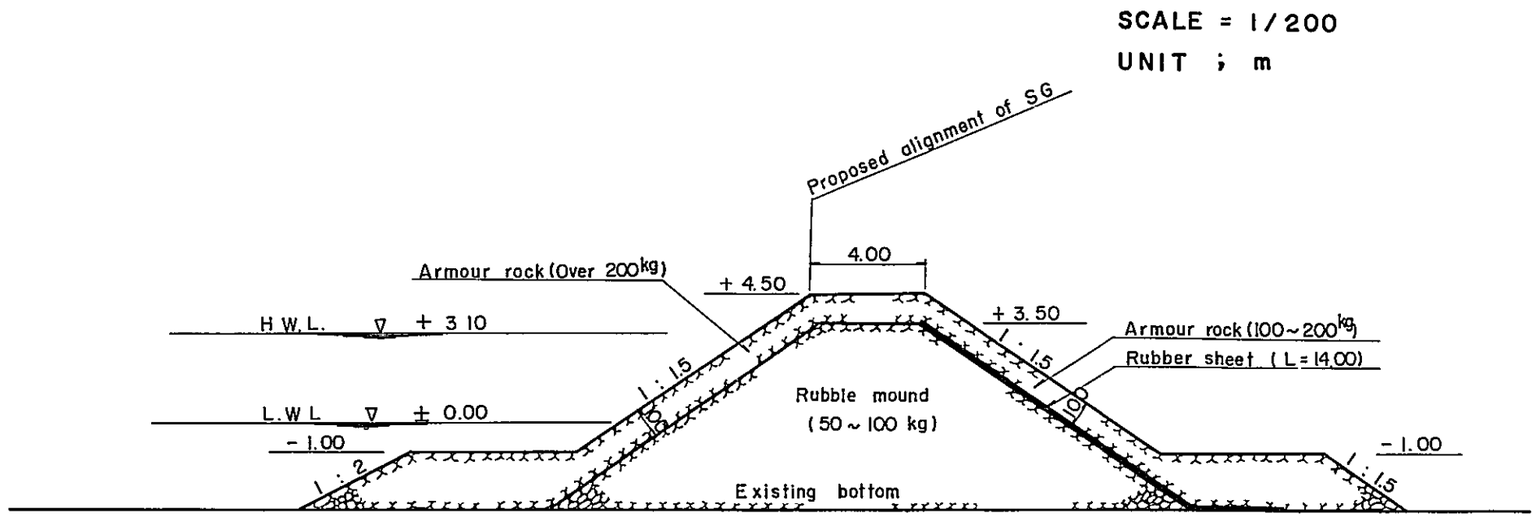


Figure. Ⅲ-1(e) STANDARD SECTION OF SOUTH SEA WALL

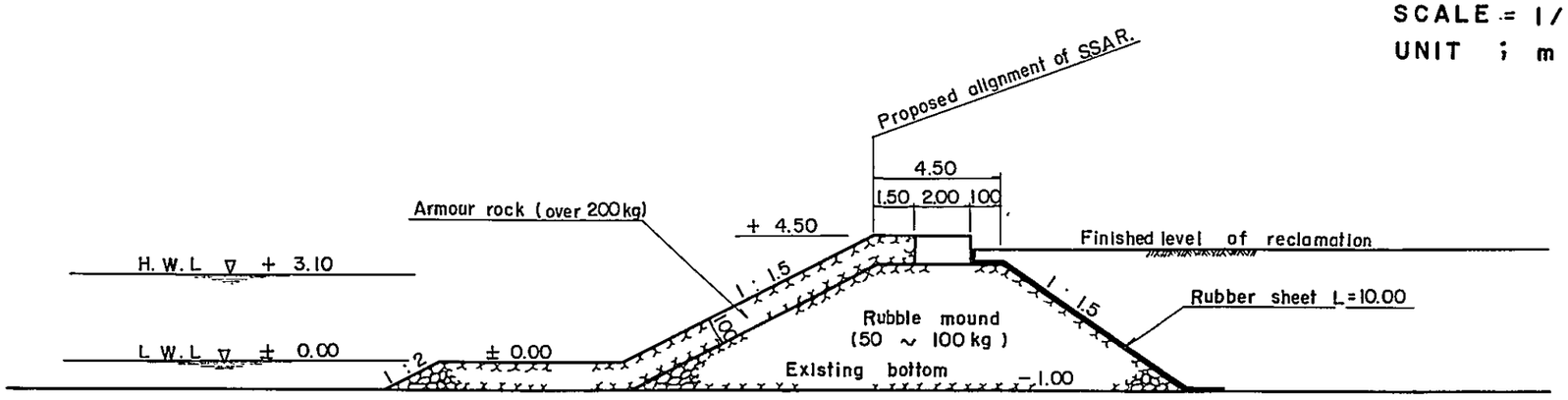
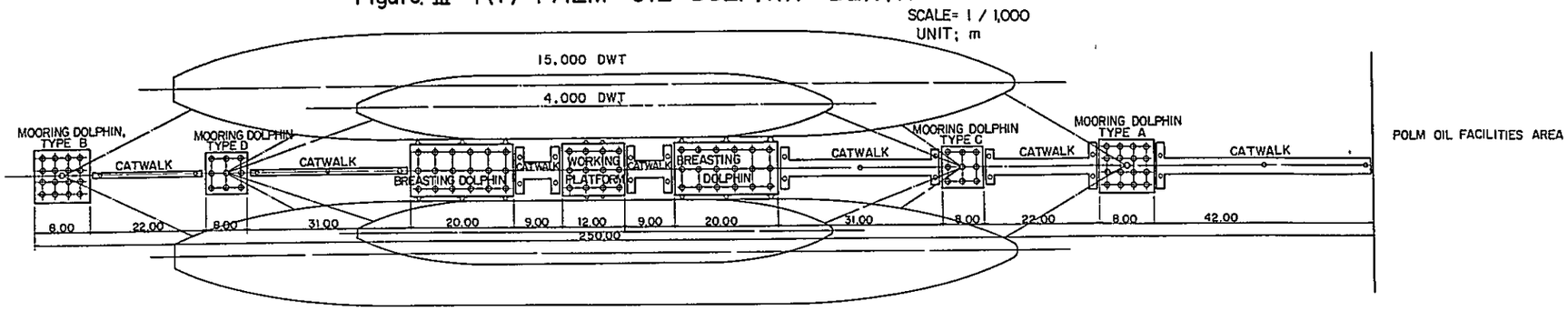
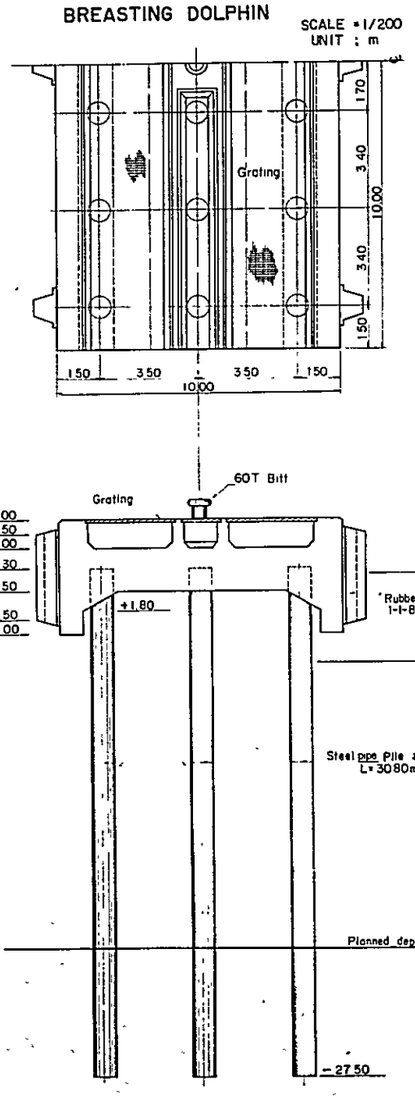


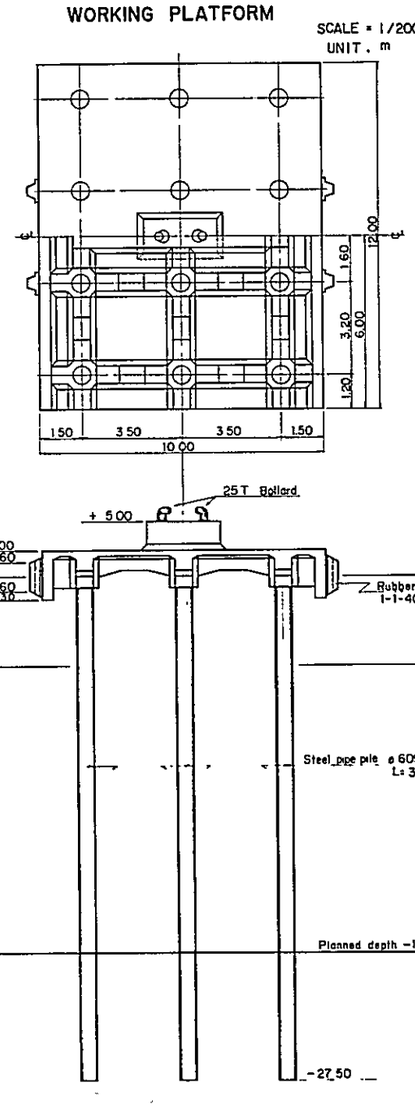
Figure. Ⅲ-1(f) PALM OIL DOLPHIN BERTH



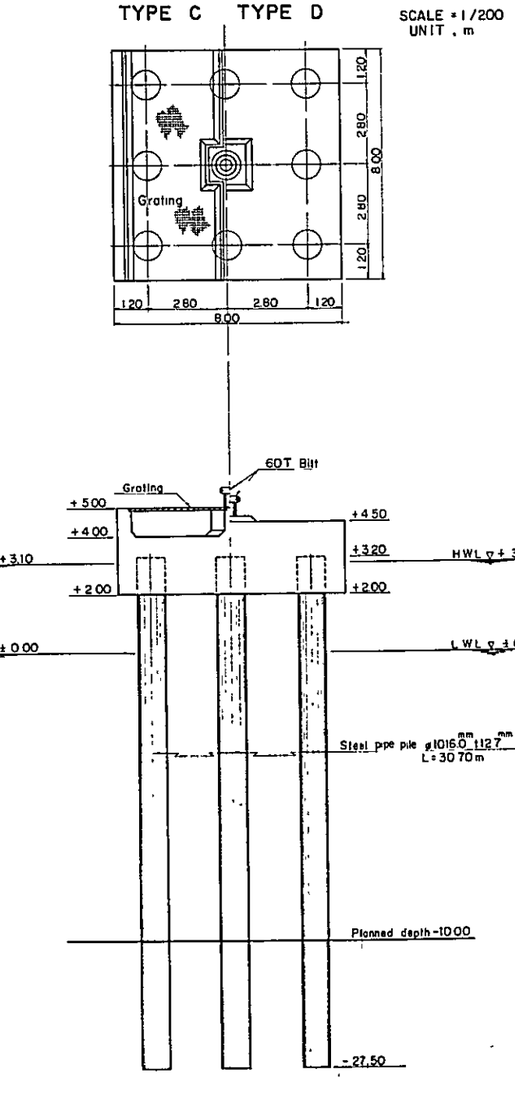
BREASTING DOLPHIN



WORKING PLATFORM



MOORING DOLPHIN, TYPE C MOORING DOLPHIN, TYPE D



MOORING DOLPHIN, MOORING DOLPHIN TYPE A, TYPE B

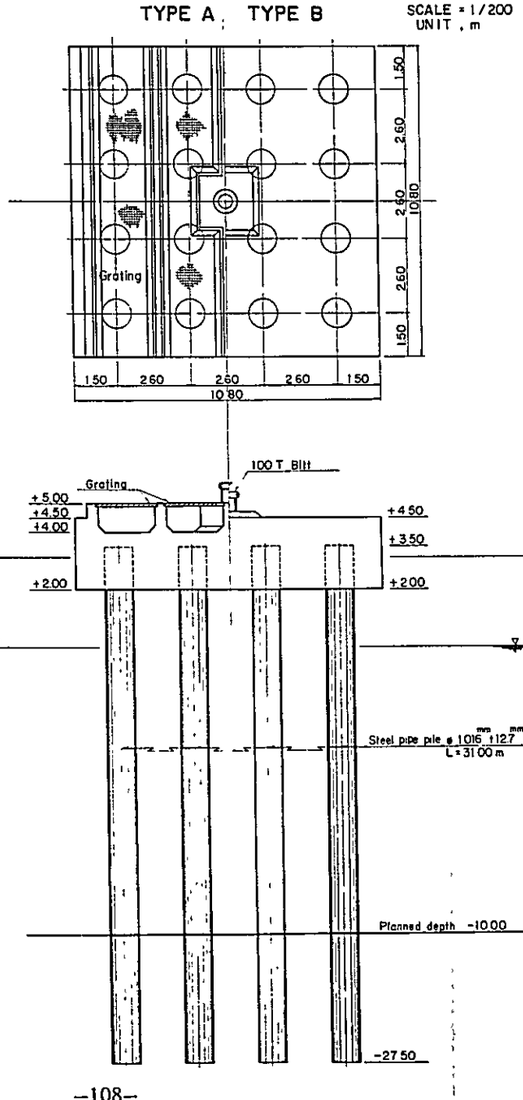


Figure. Ⅲ－1(g) STANDARD SECTION OF －10.0M SHEET PILE QUAY WALL

SCALE ; 1/200

UNIT ; m

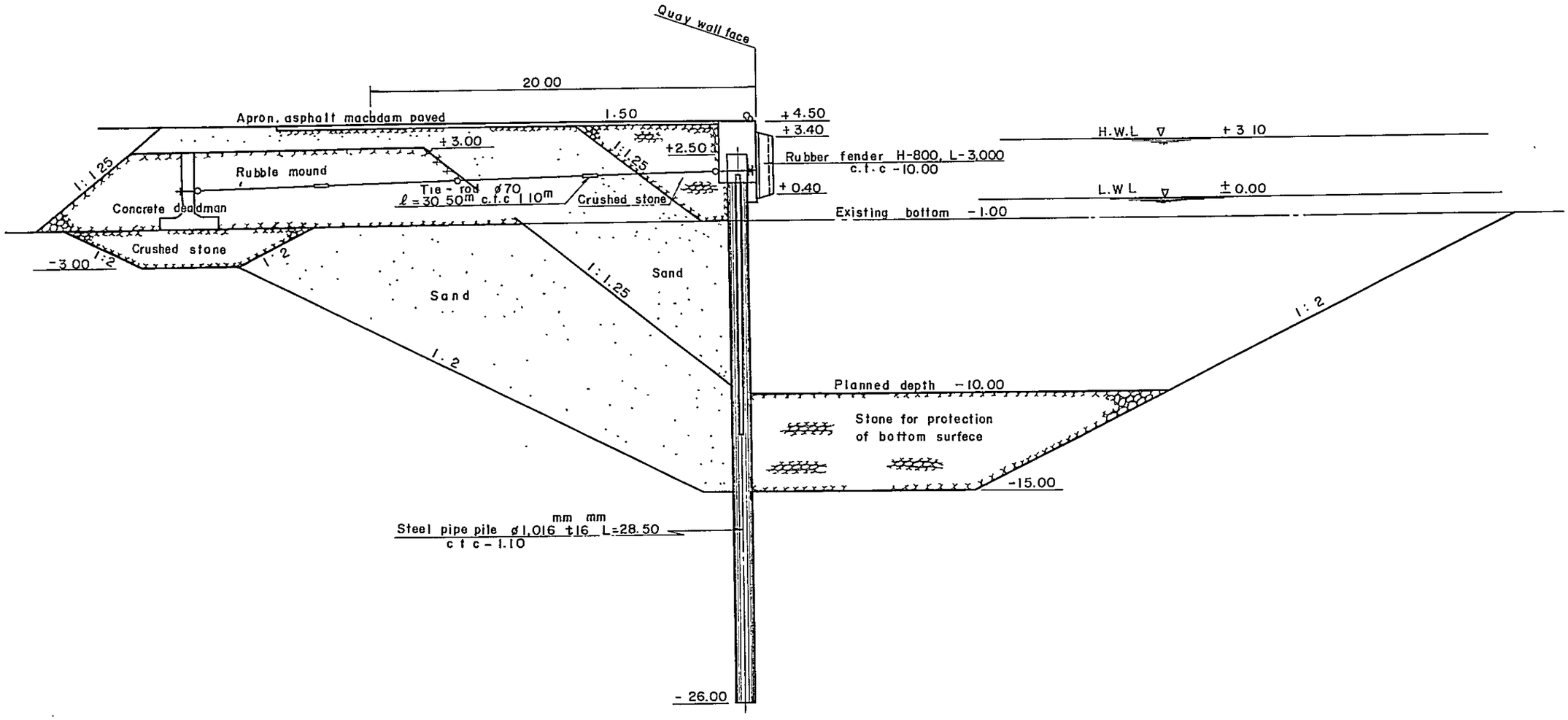


Figure. Ⅲ－1(h) STANDARD SECTION OF －7.5M SHEET PILE QUAY WALL

SCALE = 1/200

UNIT ; m

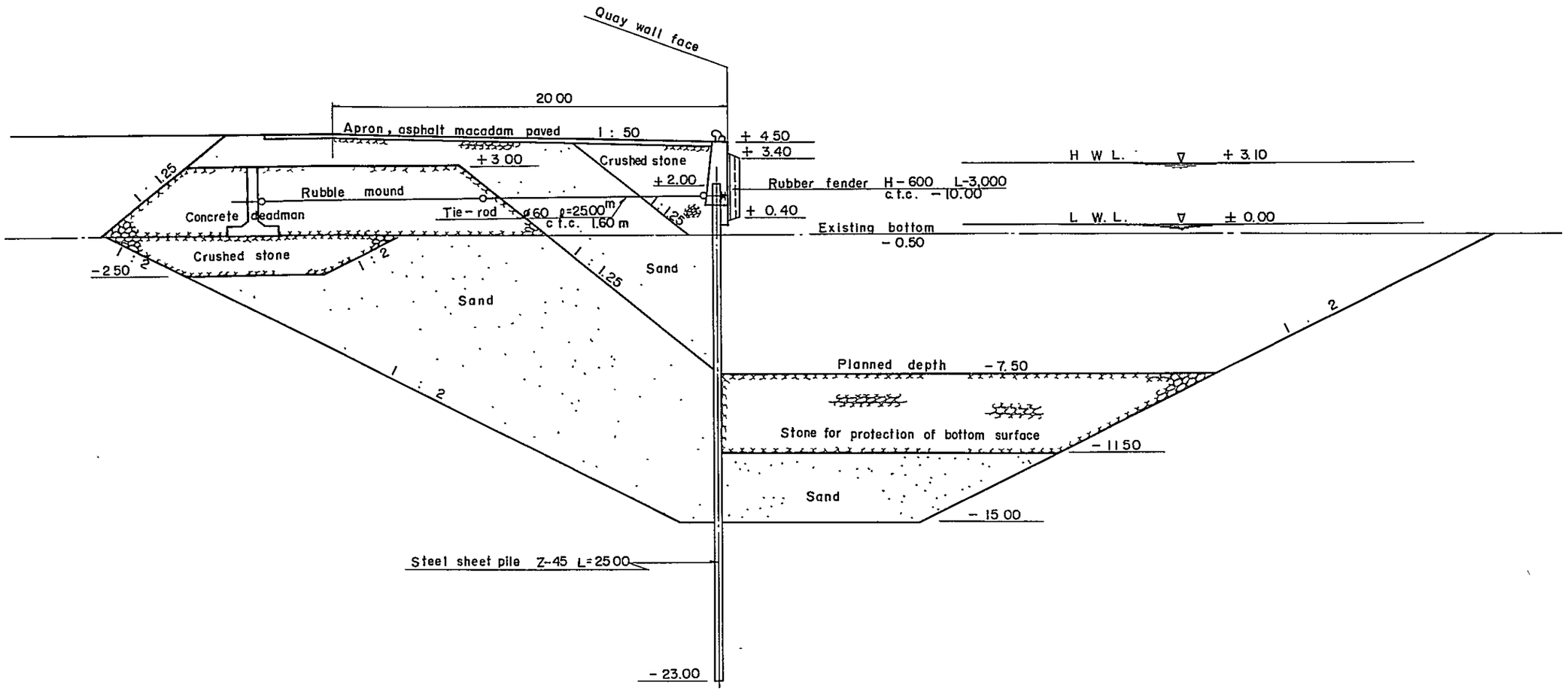


Figure. Ⅲ – 1 (i) STANDARD SECTION OF -6.0 M SHEET PILE QUAY WALL

SCALE = 1/200

UNIT ; m

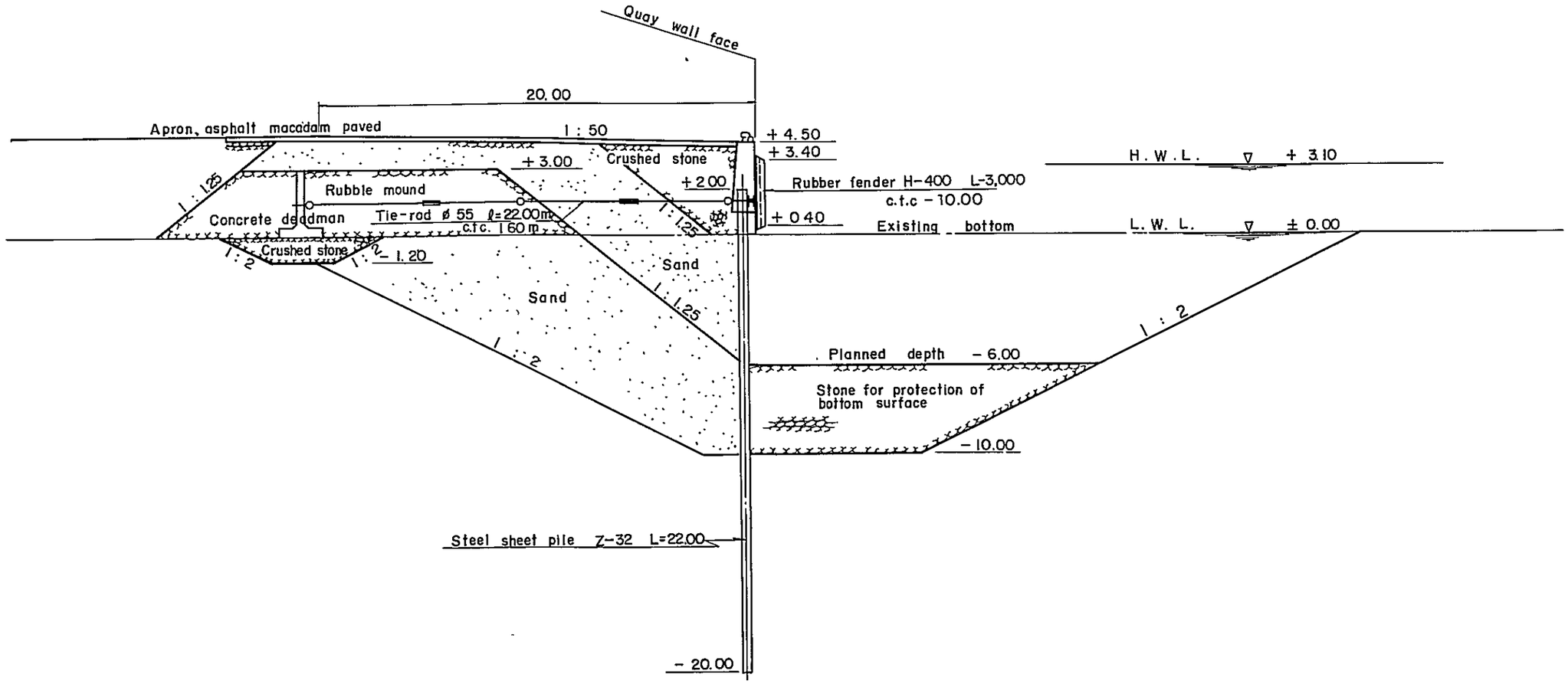


Figure. Ⅲ - 1 (j)

STANDARD SECTION OF -3.0 M QUAY WALL OF FISHERY PORT

SCALE = 1/100
UNIT ; m

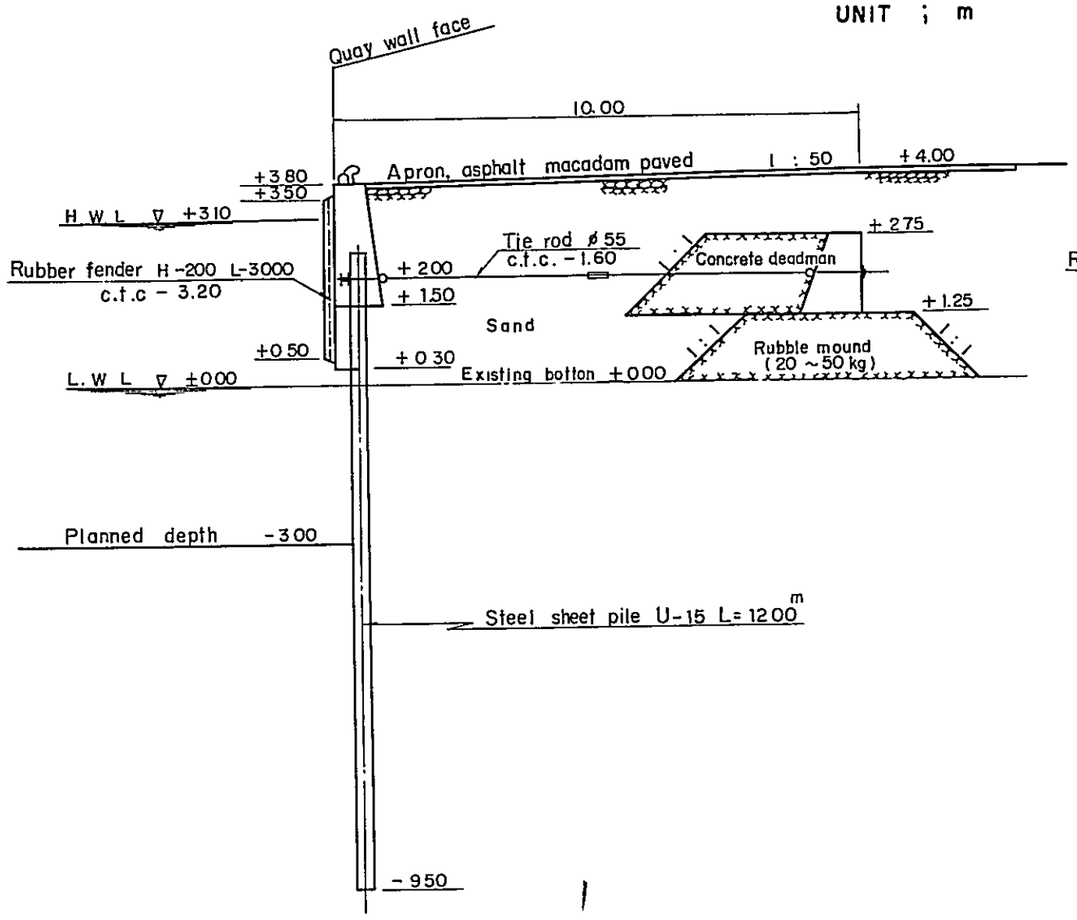


Figure. Ⅲ - 1 (k)

STANDARD SECTION OF -3.0 M QUAY WALL OF FISHERY PORT

SCALE = 1/100
UNIT ; m

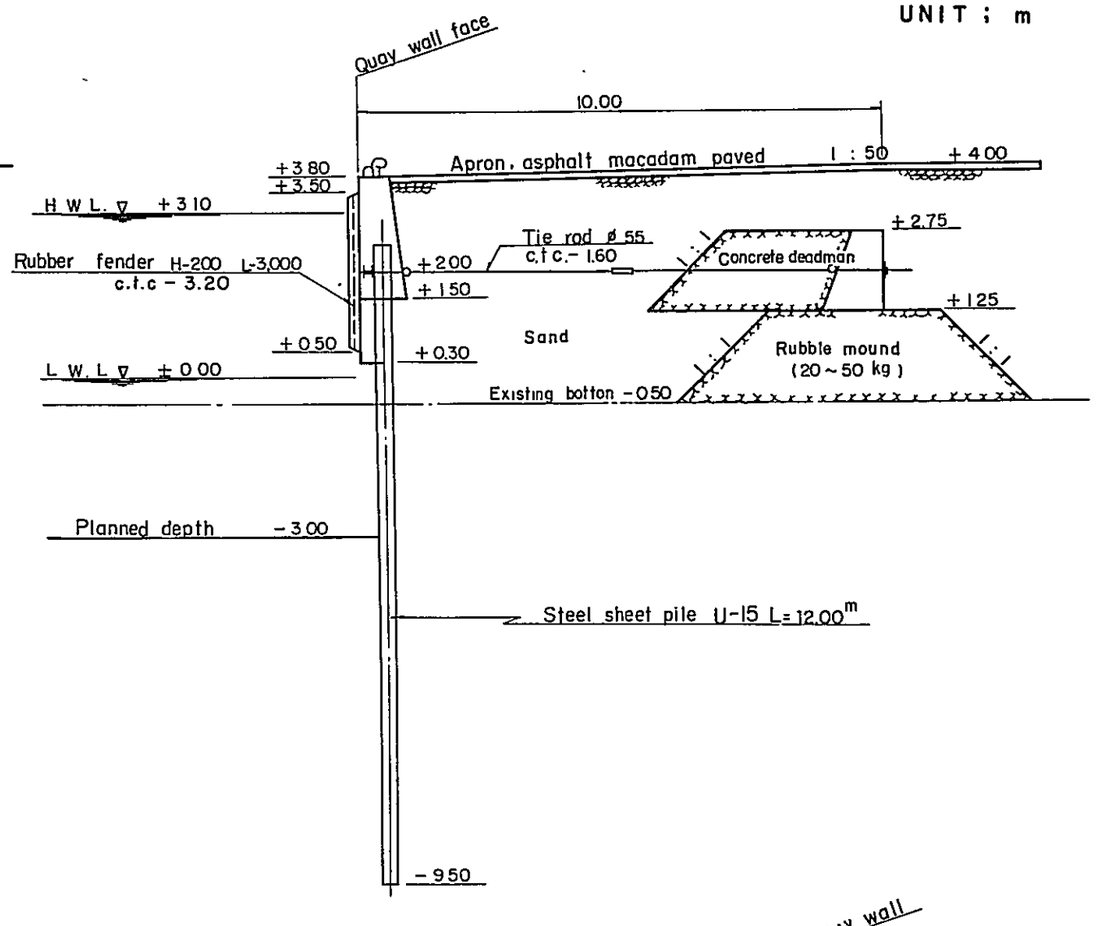


Figure. Ⅲ - 1 (l) STANDARD SECTION OF SLIPWAY

SCALE = 1/200
UNIT ; m

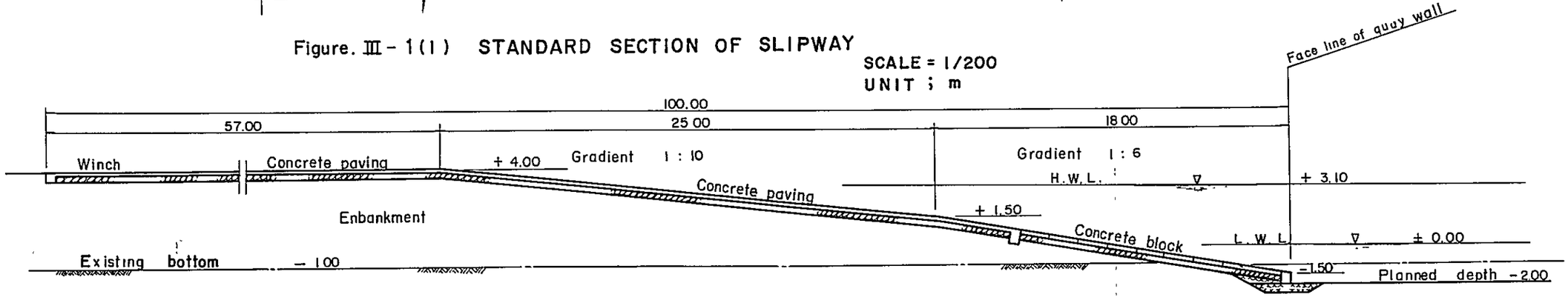
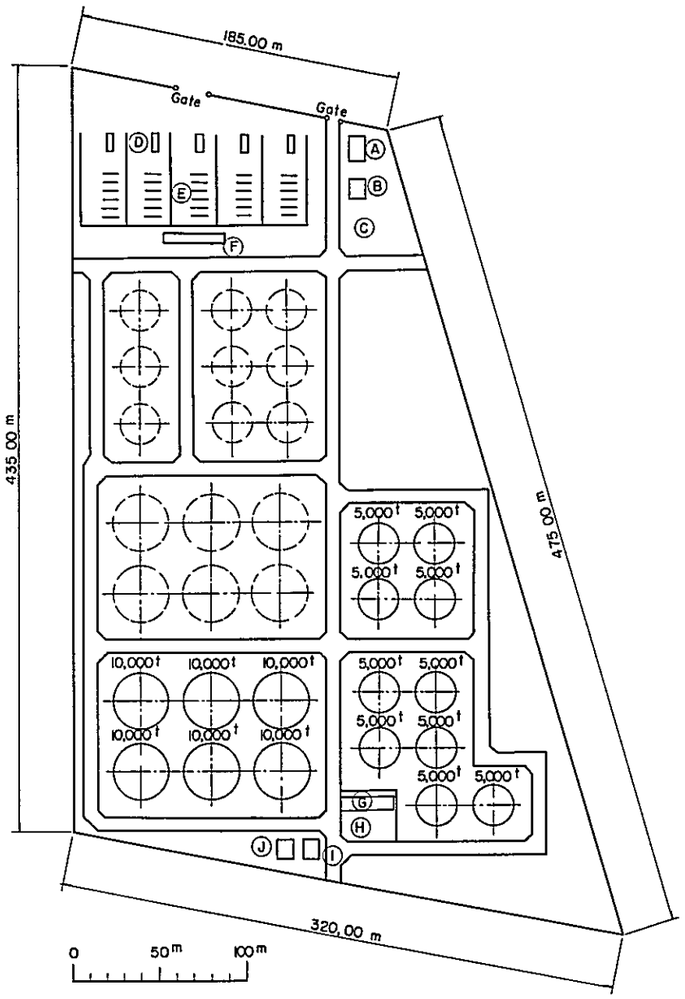


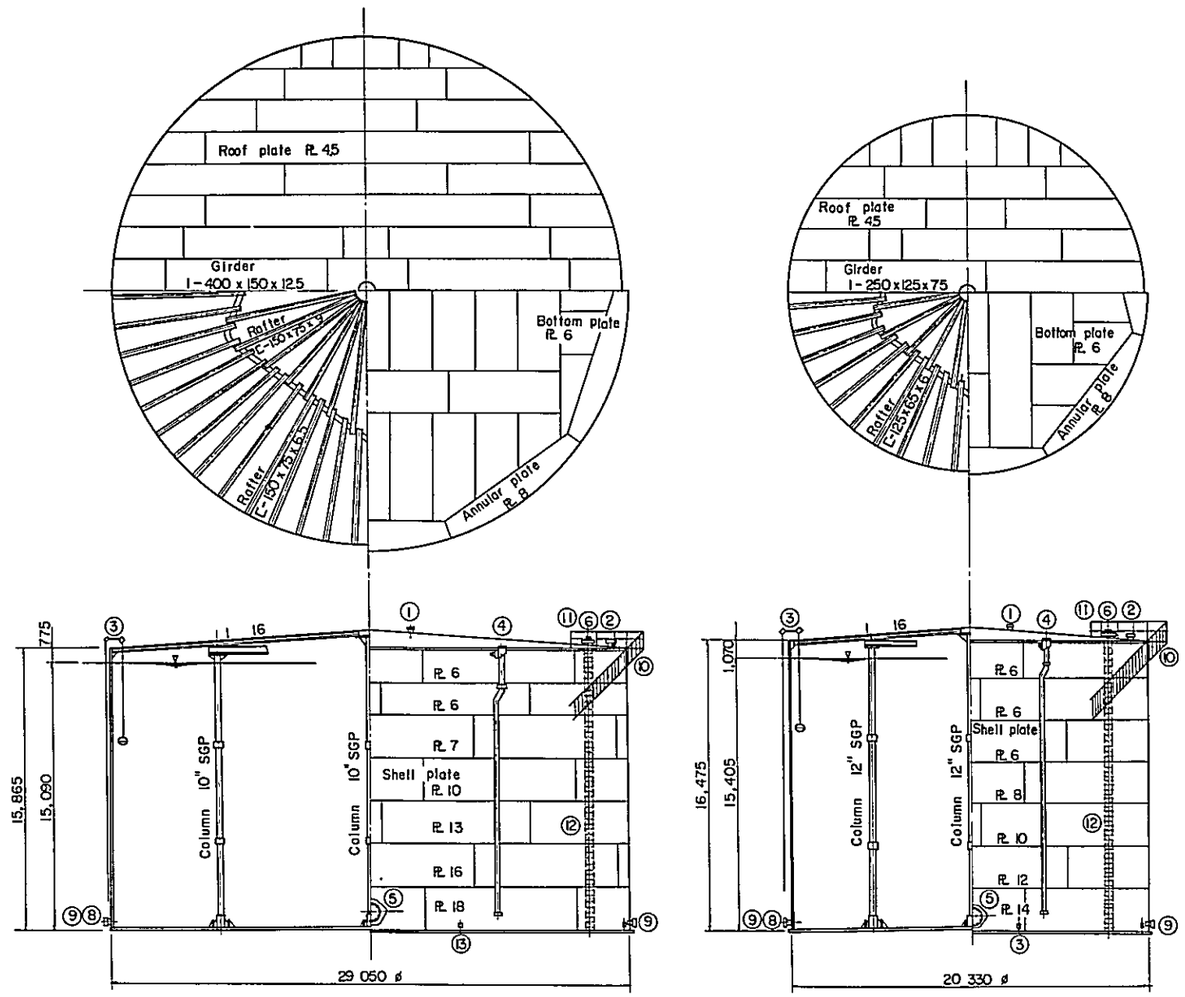
Figure Ⅲ-1(m) PALM OIL FACILITIES

PLOT PLAN OF PALM OIL TERMINAL



10,000 T C.R.T. GENERAL VIEW

SCALE = 1 / 300
UNIT ; mm



5,000 T C.R.T. GENERAL VIEW

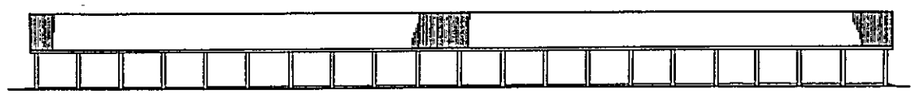
SCALE = 1 / 300
UNIT ; mm

Ⓐ	Main office	Ⓕ	Unloading pump room
Ⓑ	Sub station	Ⓖ	Loading pump room
Ⓒ	Parking area	Ⓗ	Flow mater area
Ⓓ	Truck scale	Ⓘ	Marine office
Ⓔ	Tank truck unloading station	Ⓙ	Boiler house

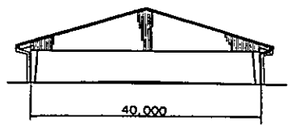
①	Free vent	⑥	Roof manhole	⑪	Handrail
②	Gauge hatch	⑦	Shell nozzle	⑫	Interior ladder
③	Level gauge	⑧	Drawoff nozzle	⑬	Grounding piece
④	Airform	⑨	Rress relief piping		
⑤	Shell manhole	⑩	Stairway		

Figure. Ⅲ - 1 (n) TRANSIT SHED IN COMMERCIAL PORT

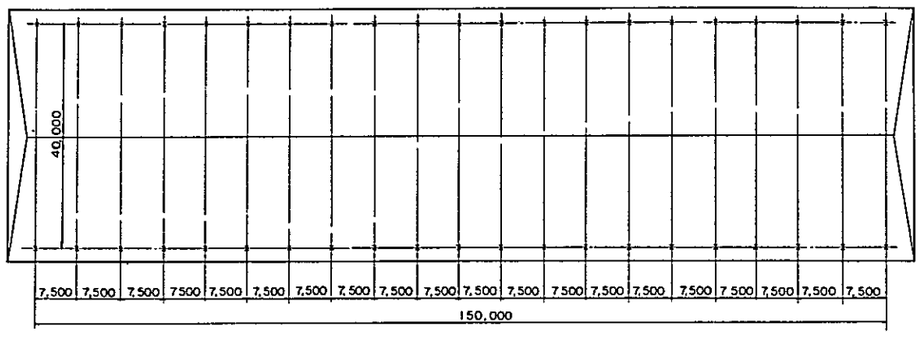
SCALE = 1 / 1,000
UNIT ; mm



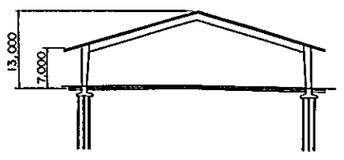
SIDE ELEVATION



END ELEVATION



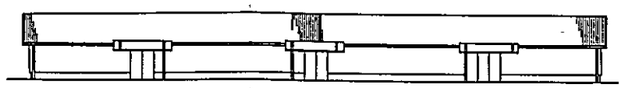
PLAN



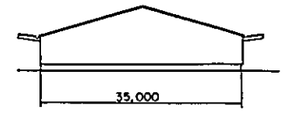
SECTION

Figure. Ⅲ - 1 (o)
WAREHOUSE IN COMMERCIAL PORT

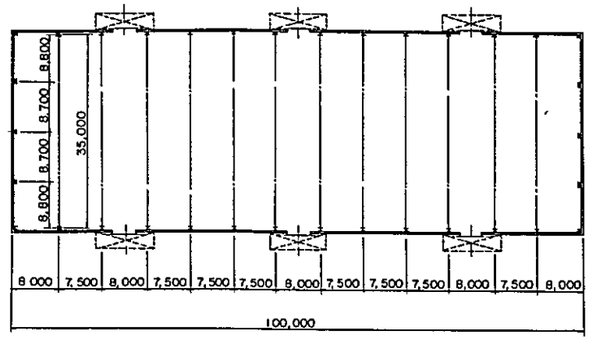
SCALE = 1 / 1,000
UNIT ; mm



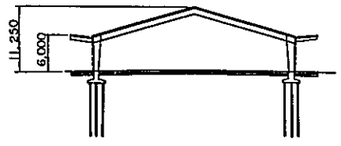
SIDE ELEVATION



END ELEVATION



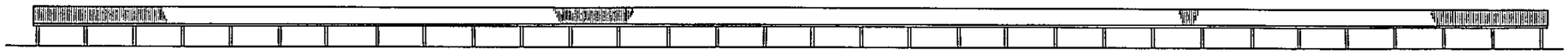
PLAN



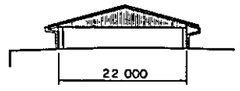
SECTION

Figure. Ⅲ - 1 (p) TRANSIT SHED IN FISHERY PORT

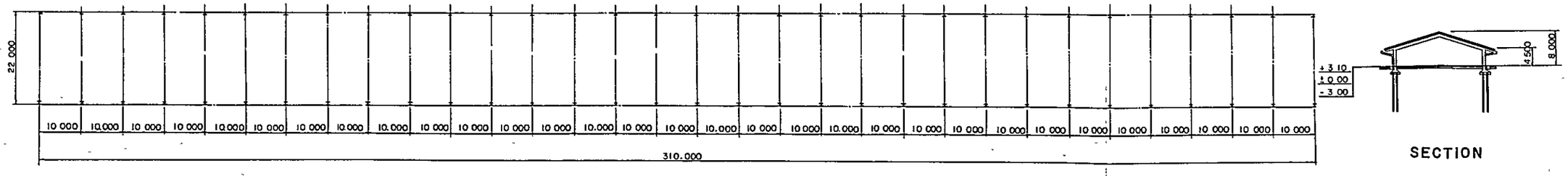
SCALE= 1 / 1,000
UNIT. mm



SIDE ELEVATION



END ELEVATION



PLAN

SECTION

of bulldozers and cranes will be required. These equipment are considered to be readily available in Malaysia. Concrete blocks are to be fabricated and placed immediately after banking of the main structure.

(2) Dredging

The volume of earth to be dredged during the first phase (up to 7.5 m in depth) and the second phase (up to 10.0 m in depth) is estimated to be 3.5 million m^3 for the former and 2.5 million m^3 for the latter, totaling 6 million m^3. Assuming that dredging is provided for 6 years starting in the latter half of 1975 and ending in the latter half of 1981, the volume of earth to be dredged annually is estimated at one million m^3 on the average. As it is considered very inefficient and uneconomical to use grab dredgers available in Malaysia, a fleet of 2,000 HP suction dredgers is to be brought from a foreign country.

(3) Reclamation by filling-up

Reclamation of the sea at the back of quay wall is to be carried out by providing temporary wooden fences. Although the plan calls for reclamation of the sea by filling dredged earth in principle, the soil in the dredging area is expected to have high tenacity. For this reason, reclamation of the area designated for early construction of land facilities is to be made with pit earth obtained from a nearby area.

(4) Pile driving

Though most of quay walls to be provided are the sheet pile type quay walls, inclusion of dolphins will make the type of piles more diversified for both steel sheet pile and steel pipe pile. For comparatively small pile driving, the drop hammer and the steam hammer, both of which are available in Malaysia, are to be used, and for piles with a large section and a long embedment, diesel hammers, brought in from foreign countries, are to be used. All pile driving operations are to be conducted in the sea and the flat vessels, on which hammers are installed, are to be procured in Malaysia.

(5) Concrete work

Materials required for concrete work such as cement, aggregate, reinforced bars and concrete forms are to be procured in Malaysia. However, because of the scale of work to be accomplished, it will be necessary to build a concrete plant at the site. Aggregate is to be obtained at the quarry, owned by Pahang State, about 5 miles from the site and transported to the site by trucks.

(6) Pavement

All aprons and roads are to be given asphalt acadam pavement. Aggregate required for pavement is to be obtained at the same quarry as the concrete work.

4-3-2 Construction Materials

Among major construction materials, those to be procured in Malaysia and those to be imported from other countries are shown in the following table.

Type of work	To be supplied locally	To be imported
Breakwater and groin	Stone, construction machinery, concrete, timber, concrete block	Sea mat Sand control sheet
Navigation channel and anchorage	Timber	A fleet of dredger
Mooring facilities	Stone, pile driving boat, concrete, replacement sand	Steel sheet pile, steel pipe pile, tie-rod, mooring post, pile hammer
Reclamation by filling-up (By pit earth)	Earth moving machinery	
Land grading	Earth moving machinery	
Pavement	Asphalt, aggregate, construction machinery, plant	
Buildings	Building construction materials, stone, concrete, timber, concrete pile	I-beam, machinery
Palm oil facilities	Construction machinery, concrete pile	Sheet steel and automatic welding machine

4-3-3 Others

Requirement for labour, power and water supply is considered to be sufficiently met within Pahang State.

4-4 Construction Schedule

The first phase of construction covers a period from 1972 to 1979 and the second phase from 1980 to 1984, totaling 13 years. However, since the scope of work for the second phase is extremely small as compared that for the first phase, a period of two years from 1980 to 1981 is considered sufficient for the second phase. Consequently, the construction period has been curtailed to 10 years from the originally planned period and a construction schedule has been worked out as shown in Table III-2. Work schedule for each stage is shown in Table III-2.

Table III-2 Construction Schedule

		I		II		III		IV		V		Remarks
		1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	
East revetment (230 m)												
East breakwater (820 m)												
Temporary access road (For construction of south breakwater)												
Commercial port revetment (750 m)												
South sand arresting revetment (400 m)												
South groin (1,250 m)												
Retaining wall (900 m)												
Commercial port inner breakwater (100 m)												
Boundary revetment (350 m)												
Dredging (6 million m^3)												
Commercial Port Mooring Facilities	Dolphin (-10.0 m)											
	-10.0 m (370 m)											
	- 7.5 m (130 m)											
	- 6.0 m (135 m)											
	- 4.5 m (150 m)											
	- 3.0 m (320 m)											
Fishing Port Mooring Facilities	- 3.0 m (320 m) (For landing)											
	- 3.0 m (990 m) (For mooring)											
	- 3.0 m (180 m) (For servicing)											
	Slip way (100 m)											
	Boat landing area (120 m)											
Reclamation by filling-up (pit earth)												
Leveling of ground												
Pavement (Apron and road)												
Oil palm facilities												
Commercial port land facilities												
Fishing port land facilities												

4-5 Calculation of Construction Cost

4-5-1 Basic Conditions

The basic conditions that were taken into consideration in calculating construction cost for the project are as follows.

(1) Construction materials, marine equipment, or machinery to be installed in each facility and related parts, which are not produced nor available in Malaysia, are to be imported from Japan.

(2) Calculation of construction cost does not include indemnity for area loss and compensation for removal of dwellings and for suspension of business.

(3) Escalation of labour cost, material cost and rise of prices of machinery during the construction period are not taken into consideration.

(4) Interest during construction is to be calculated on the basis of 10 year construction period and the rate is to be 4.5% for foreign currency and 6.0% for local currency in accordance with the ECAFE criteria for the computation of construction cost.

(5) Tenders are to be invited from all over the world for the work.

(6) No contingencies are to be considered for the computation of construction cost.

4-5-2 Estimated Construction Cost

Breakdown of the estimated construction cost are shown in Table III-2 through Table III-6.

In the estimation of construction cost, data on soils and wave height obtained from the results of the fishing port surveys made in 1968 and 1969 were used. These data, however, are not adequate for the design of this commercial port. It is absolutely necessary, therefore, to make another survey prior to the implementation of the project. The estimated construction cost shown in table, therefore, is highly subject to change by ±50%.

Table III-3 Estimated Construction Cost - Sheet 1

(In US dollars)

		Facilities	Unit cost: Local currency	Unit cost: Foreign currency	Unit cost: Total	First phase: Quantity	First phase: Local currency	First phase: Foreign currency	First phase: Total	Second phase: Quantity	Second phase: Local currency	Second phase: Foreign currency	Second phase: Total	Remarks
Breakwaters and groins	Common facilities	East sea wall	1,950	250	2,200	230m	448,500	57,500	506,000					
		East breakwater	3,970	250	4,220	820m	3,255,400	205,000	3,460,400					
		South groin	1,220	80	1,300	1,250m	1,525,000	100,000	1,625,000					
		South sea wall revetment	700	80	780	400m	280,000	32,000	312,000					
		Retaining wall	130	10	140	300m	39,000	3,000	42,000	600m	78,000	6,000	84,000	
		Boundary revetment	480	80	560	350m	168,000	28,000	196,000					
		Total					5,715,000	425,500	6,141,400		78,000	6,000	84,000	
	Commercial port	Commercial port revetment	500	70	570	750m	375,000	*52,500	427,500					
		Commercial port inner breakwater	470	30	500	100m	47,000	3,000	50,000					
		Total					422,000	555,000	477,500		0	0	0	
Navigation channel and anchorage		Dredging of anchorage (Commercial port)	0.4	0.6	1	2,880,000m3	1,152,000	1,728,000	2,880,000	1,020,000m3	408,000	612,000	1,020,000	Dredged earth is to be used for reclamation of sea. The ratio of local and foreign currency is 4:6.
		Dredging of anchorage (Fishing port)	0.4	0.6	1	658,000m3	263,200	394,800	658,000					
		Dredging of navigation channel	0.4	0.6	1	82,000m3	32,800	49,200	82,000	1,560,000m3	624,000	936,000	1,560,000	
		Total					1,448,000	2,172,000	3,620,000		1,032,000	1,548,000	2,580,000	
Mooring facilities	Commercial port	-10.0 m dolphin	264,000	556,000	820,000	2	528,000	1,112,000	1,640,000					
		-10.0 m quay	2,360	6,670	9,030	370m	873,200	2,467,900	3,341,100					
		- 7.5 m quay	1,890	4,610	6,500	130m	245,700	599,300	845,000					A 30 m access road
		- 6.0 m quay	1,290	2,710	4,000	135m	174,100	365,900	540,000					A 30 m access road included.
		- 4.5 m quay	750	1,280	2,030	150m	112,500	192,000	304,500					A 30 m access road included.
		- 3.0 m quay	580	840	1,420	150m	87,000	126,000	213,000					
		- 3.0 m quay	610	840	1,450	170m	103,700	142,800	246,500					
		Total					2,124,200	5,005,900	7,130,100		0	0	0	

Table III-3 Estimated Construction Cost - Sheet 2

(In US dollar)

		Facilities	Unit cost			First phase				Second phase				Remarks
			Local currency	Foreign currency	Total	Quantity	Local currency	Foreign currency	Total	Quantity	Local currency	Foreign currency	Total	
Mooring facilities	Commercial port	-3.0 m quay (Landing)	610	840	1,450	320m	195,200	268,800	464,000					
		" quay (Mooring)	580	840	1,420	530m	307,400	445,200	752,600					
		" quay (Mooring)	580	840	1,420	370m	214,600	310,800	525,400					
		" quay (Servicing)	610	840	1,450	180m	109,800	*151,200	261,000					
		Slip way	1,330	70	1,400	100m	133,000	7,000	140,000					
		Boat landing area	1,600	70	1,670	100m	160,000	7,000	167,000					
		Total					1,120,000	1,190,000	2,310,000		0	0	0	
Reclamation by filling-up (pit earth)		Reclamation for road (Commercial port)	0.94	0.06	1	175,800m3	165,300	10,500	175,800					
		Reclamation for road (Fishing port)	0.94	0.06	1	205,400m3	193,100	12,300	205,400					
		Reclamation for road (Access road)	0.94	0.06	1	54,800m3	51,500	3,300	54,800					
		Total					409,900	26,100	436,000					
Leveling of ground		Leveling of ground (Commercial port)	0.285	0.015	0.3	275,600m2	78,600	4,100	82,700	12,400	3,500	200	3,700	The ratio of local and foreign currencies is 19:1
		Leveling of ground (Fishing port)	0.285	0.015	0.3	273,600m2	78,000	4,100	82,100	436,000	124,300	6,500	130,800	
		Leveling of ground (Access road)	0.285	0.015	0.3	30,000m2	8,500	500	9,000					
		Total					165,100	8,700	173,800		127,800	6,700	134,500	
Pavement (Road and apron)		Pavement (Commercial port)	6.58	0.42	7	169,800m2	1,117,300	71,300	1,188,600					
		Pavement (Fishing port)	6.58	0.42	7	93,100m2	612,600	39,100	651,700					
		Pavement (Access road)	6.58	0.42	7	12,600m2	82,900	5,300	88,200					
		Total					1,812,800	115,700	1,928,500		0	0	0	
Commercial port Palm oil facilities		Leveling of ground	0.285	0.015	0.30	39,200m2	11,200	600	11,800					
		Pavement of roads	9	5	14	23,700m2	213,300	118,500	331,800					
		Oil tanks				One set	941,700	3,944,500	4,886,200					
		Total					1,166,200	4,063,600	5,229,800		0	0	0	

Table III-3 Estimated Construction Cost - Sheet 3

(In US dollar)

		Facilities	Local currency	Foreign currency	Total	Quantity	Local currency	Foreign currency	Total	Quantity	Local currency	Foreign currency	Total	Remarks
Buildings	Commercial port	Transit shed	14	21	35	18,000m^2	252,000	378,000	630,000					
		Warehouse	24	37	61	7,000m^2	168,000	259,000	427,000					
		Total					420,000	637,000	1,057,000		0	0	0	
	Fishing port	Shed at selling place	18	26	44	6,860m^2	123,500	178,400	301,900					Steel frame
		Fish-meal plant	23	123	146	2,175m^2	50,000	267,500	317,500					Steel frame, machinery included.
		Ice-making plant	148	346	494	2,700m^2	399,600	934,200	1,333,800					Reinforced concrete, machinery included.
		Cold storage facilities	74	125	199	2,480m^2	183,500	310,000	493,500					" "
		Total					756,600	1,690,100	2,446,700		0	0	0	
Utilities and others							208,000	347,000	555,000		0	0	0	
Grand Total							15,768,700	15,737,100	31,505,800		1,237,800	1,560,700	2,798,500	

Table III-4 Estimated Costs of Common Facilities, Commercial Port Facilities and Fishing Port Facilities

(In US dollar)

		First phase			Second phase			Remarks
		Local currency	Foreign currency	Total	Local currency	Foreign currency	Total	
Common facilities	Breakwaters and groins	5,715,900	425,500	6,141,400	78,000	6,000	84,000	
	Dredging of navigation channel	32,800	49,200	82,000	624,000	936,000	1,560,000	
	Banking of access road	51,500	3,300	54,800	0	0	0	
	Leveling of ground	8,500	500	9,000	0	0	0	
	Pavement	82,900	5,300	82,200	0	0	0	
	Security facilities, utilities and others	208,000	347,000	555,000	0	0	0	
	Total	6,099,600	830,800	6,930,400	702,000	942,000	1,644,000	
Commercial port facilities	Breakwaters and groins	422,000	55,500	477,500	0	0	0	
	Dredging of anchorage	1,152,000	1,728,000	2,880,000	408,000	612,000	1,020,000	
	Mooring facilities	2,124,200	5,005,900	7,130,100	0	0	0	
	Banking of road	165,300	10,500	175,800	0	0	0	
	Leveling of ground	78,600	4,100	82,700	3,500	200	3,700	
	Pavement	1,117,300	71,300	1,188,600	0	0	0	
	Palm oil facilities	1,166,200	4,063,600	5,229,800	0	0	0	
	Buildings	420,000	637,000	1,057,000	0	0	0	
	Total	645,600	11,575,900	18,221,500	411,500	612, 00	1,023,700	
Fishing port facilities	Dredging of anchorage	263,200	394,800	658,000	0	0	0	
	Mooring facilities	1,120,000	1,190,000	2,310,000	0	0	0	
	Banking of road	193,100	12,300	205,400	0	0	0	
	Leveling of ground	78,000	4,100	82,100	124,300	6,500	130,800	
	Pavement	612,600	39,100	651,700	0	0	0	
	Buildings	756,600	1,690,100	2,446,700	0	0	0	
	Total	3,023,500	3,330,400	6,353,900	124,300	6,500	130,800	
Grand Total		15,768,700	15,737,100	31,505,800	1,237,800	1,560,700	2,798,500	

Table III-5 Consolidated Construction Cost

(In US dollar)

	First phase			Second phase			Remarks
	Local currency	Foreign currency	Total	Local currency	Foreign currency	Total	
Common facilities	6,099,600	830,800	6,930,400	702,000	942,000	1,644,000	
Commercial port facilities	6,645,600	11,575,900	18,221,500	411,500	612,200	1,023,700	
Fishing port facilities	3,023,500	3,330,500	6,354,000	124,300	6,500	130,800	
Total	15,768,700	15,737,100	31,505,800	1,237,800	1,560,700	2,798,500	
Engineering and construction supervision	518,000	963,000	1,481,000	49,000	90,900	139,900	Approximately 5%
Interest during construction	3,703,300	2,699,900	6,403,200	293,200	278,400	571,600	Local currency: 24% Foreign currency: 18%
Grand Total	19,990,000	19,400,000	39,390,000	1,580,000	1,930,000	3,510,000	

(In US dollar)

Grand Total	42,900,000	100%
Local currency	21,570,000	50%
Foreign currency	21,330,000	50%

Table III-6 Estimated Construction Costs by Year (In US dollar)

Commercial Port	I		II		III		IV		V	
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
East sea wall	477					53				
East breakwater	1,047	349	1,340	670	145	73				
South groin					670	283				
Inner breakwater							52			
Boundary revetment						205				
Dredging				341	682	682	682	682	1,350	1,350
Dolphin				172	688	172	688			
-10.0m					351	1,399	351	1,399		
- 7.5m							710	177		
- 6.0m							226	339		
- 4.5m								320		
- 3.0m							159	323		
Sub-total	1,524	349	1,340	1,183	2,536	2,867	2,868	3,240	1,350	1,350
Reclamation of sea				52	111	52				
Leveling of ground					13	26	26	26	2	2
Pavement					191	393	393	393		
Palm oil facilities					1,369	1,369	1,370	1,370		
Land facilities						557	288	844		
Sub-total				52	1,684	2,397	2,077	2,633	2	2
Total	1,524	349	1,340	1,235	4,220	5,264	4,945	5,873	1,352	1,352

Fishing Port	I		II		III		IV		V	
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Temporary access road		203								
South sand arresting revetment				326						
South groin				283	465					
Retaining wall						44			88	
Boundary revetment						206				
Dredging				83	152	152	152	152		
-3.0m (Landing)				195	292					
-3.0m (Mooring)					134	537	537	134		
-3.0m (Servicing)							137	137		
Slip way								147		
Boat landing area								175		
Sub-total		203		887	1,043	939	826	745	88	
Reclamation of sea				63	118	63				
Leveling of ground					14	25	25	25	69	69
Pavement					106	203	203	203		
Land facilities					1,276		434	844		
Sub-total				63	1,514	291	862	1,072	69	69
Total		203		950	2,557	1,230	1,488	1,817	157	69

(Interest during construction not included)

PART IV

ECONOMIC ANALYSIS OF PORT CONSTRUCTION PROJECT

PART IV

ECONOMIC ANALYSIS OF PORT CONSTRUCTION PROJECT

CHAPTER 1. OUTLINE

1-1 General

The economic analysis of the proposed Kuantan Port Construction Project must be made from two different viewpoints. One is to determine what economic impact will be brought on the national economy by the construction of Kuantan Port, by taking a broad standpoint viewing the matter as the affair of the whole West Malaysia. This is a national economic analysis. The other is to study whether the port project is economically justifiable by limiting the subject to the management entity of Kuantan Port. This is the question of port management. As these stands are completely different from each other in concept, the two cannot be discussed on the same level. For this reason, the national economic analysis and the business analysis are taken up separately in this part. From the results of these analyses, it will be known that the Kuantan commercial port deserves investment from a standpoint of national economy but from the economic point of view, the port will soon face financial difficulties as long as the port is operated on the self-paying basis by means of the port authority system which is common in this country. Then, this part will see to what extent the financial position of the port management will be improved by government subsidies which might be granted as a step to save the port project from bankruptcy.

The new port will be divided functionally into commercial port and fishing port. Economic value of the two functionally divided ports is naturally different. The direct benefit derived from the construction of a fishing port is considered to be the increase in the national income resulting from the sale of the expected annual catch of 93,000 tons, but the benefits derived from the establishment of various marine product processing factories and marketing enterprises are also conceivable. These benefits, however, are closely related with the structural change of social economy and therefore can not be measured by econometric standards.

In making econometric analysis in this section, therefore, emphasis is placed on the commercial port area of Kuantan Port.

1-2 Method of Econometric Analysis

The factors used in the econometric analysis of the benefits derived from Kuantan Port are the benefit-cost ratio at 10% discount rate and the internal rate of return. The project life was considered to be 20 years from the start of the construction work.

If the benefit and cost for each year are discounted to the present value, the benefit-cost ratio may be expressed by the following formula.

$$Bo/Co = \frac{\sum_{i=1}^{n} \frac{Bi}{(1+r)^i}}{\sum_{i=1}^{n} \frac{Ci}{(1+r)^i}} \qquad (1)$$

where: Bo, Co = Benefit and cost in the year previous to the start of the work.

Bi, Ci = Benefit and cost in i year subsequent to the start of the work.

r = Discount rate

n = Project life

Bo/Co is determined uniquely when the annual benefit, Bi, and cost, Ci, discount rate, r and project life, n are provided.

On the other hand, the discounted present value of the project in the year previous to the start of the work may be defined as follows.

$$P_V = \sum_{i=1}^{n} \frac{Bi - Ci}{(1 + r)\, i} \qquad (2)$$

where: Pv = Present value of the project in the year previous to the work.

Bi, Ci = Benefit and cost in i year following the start of the work.

r = Discount rate

n = Project life

The internal rate of return expressed by R may be defined as the discount rate which results in the present value, Pv = 0.

That is:

$$0 = \sum_{i=1}^{n} \frac{Bi - Ci}{(1 + R)\, i} \qquad (3)$$

In a method using the internal rate of return to determine the relative importance of the project, interest rate does not have to be determined in advance. Furthermore, as evident from the above definition, the interest rate or depreciation is not considered for Bi and Ci. The project life was determined to be 20 years from 1972 to 1992. This decision was made from fear that the port facilities might become obsolete in face of technical innovation following the economic expansion of West Malaysia which is expected to last over a long period, though the service life of many of port facilities is considered to exceed 50 years.

CHAPTER 2. NATIONAL ECONOMIC ANALYSIS

2-1 Outline

In this Chapter the scope of economic analysis of Kuantan Port will be expanded to the whole West Malaysia to discuss the impact of Kuantan Commercial Port on the national economy.

The proposed site of Kuantan Commercial Port is situated about in the middle of the east coast of West Malaysia, where there have not been any significant port facilities in the past due to restrictions imposed mainly by natural environments during the North-East monsoon season. In the hinterland, however, regional development is in progress under such projects as the Jengka Triangle Scheme, the State of Pahang Scheme and the State of Trengganu Scheme. Besides, the Pahang Tenggara Scheme is being shaped up as a large scale regional development project. By these projects the development of the east coast, which lags far behind the west coast in economic activity, will be accelerated, bringing about the elimination of regional differences and effective utilization of untouched natural resources.

For the implementation of these projects, however, there must be a precondition that the means of transportation for delivery of equipment and materials required for the development work and for shipment of the products originating in the project area is equal to that on the west coast. The proposed Kuantan Commercial Port is situated almost in the center of the east coast and moreover it is designed to accommodate large vessels throughout the year. It may be said, therefore, that the proposed commercial port, in conjunction with the improvement of road network, will become the most effective means of transport for the development of the region.

On the basis of the above concept, the primary object of the proposed Kuantan Commercial Port can be said to be the improvement of transport conditions in the region. In this Chapter an econometric analysis of Kuantan Commercial Port will be attempted mainly for calculating the reduction in transport cost. For the benefit, the said reduction in transport cost plus the net profit calculated by deducting expenditure from revenue of Kuantan Port will be used. For the cost, on the other hand, construction cost of Kuantan Commercial Port will be used. In the following sections the bases used for benefit and cost calculation and the economic analysis made on these bases will be discussed.

2-2 Calculation of Reduction in Transport Cost

2-2-1 General

If a commercial port is not constructed in Kuantan, the cargo generated in the hinterland must be transported by other means.

In the case of tramper cargo, for example, they will probably be routed through either Singapore, Johore, Malacca, Port Swettenham or Penang. As the planning of hinterland was made by placing emphasis on transport cost, the transport cost through Kuantan Port should be lower than that by other routes as far as the cargo to be handled by Kuantan Port are concerned. This reduction in transport cost may be counted as one of the benefits derived from the construction of Kuantan Port. In calculating the reduction in transport cost, the

place of origin of tramper cargo was divided into six districts at first and then the volume of cargo was separately estimated for each district. For coastal cargo, it was considered that all cargo would originate in the district of Kuantan. Then, for individual cargo items classified by district, various transport means other than the use of Kuantan Port were assumed and the differences in transport cost between the case in which other means are used and the case in which Kuantan Port is used were obtained and totaled. The result is the reduction in transport cost which is being sought. The reduction in transport cost thus obtained is shown in Table IV-1. Details of calculation will be discussed in the following section.

Table IV-1 Reduction in Transport Cost Upon Construction of Kuantan Port

	Palm oil A (M$1,000)	Processed timber B (M$1,000)	Tapioca C (MR1,000)	Fertilizer D (M$1,000)	Misc. goods E (M$1,000)	Petroleum products F (M$1,000)	Total (M$1,000)	Total (M$1,000)
1975	-	-						
6	-	-						
7	3,407	-					3,407	1,136
8	4,376	3,779					8,155	2,718
9	5,347	3,736					9,083	3,028
1980	6,333	3,694	377	1,015		218	11,637	3,879
1	7,289	3,651	415	1,089		256	12,700	4,233
2	8,300	3,609	453	1,163		294	13,819	4,606
3	9,234	3,567	492	1,236		332	14,861	4,954
4	10,218	3,524	530	1,310		370	15,952	5,317
5	11,197	3,482	568	1,384		408	17,039	5,680
6	11,197	3,482	568	1,384		408	17,039	5,680
7	11,197	3,482	568	1,384		408	17,039	5,680
8	11,197	3,482	568	1,384		408	17,039	5,680
9	11,197	3,482	568	1,384		408	17,039	5,680
1990	11,197	3,482	568	1,384		408	17,039	5,680
1	11,197	3,482	568	1,384		408	17,039	5,680

If a port is not constructed in Kuantan District, the development of hinterland is not possible and the generation of cargo is not conceivable in certain cases. However, such an event was not taken into consideration for this analysis.

2-2-2 Volume of Cargo Generation by Item and District

For the estimation of the reduction in transport cost for tramper cargo handled by Kuantan Port, the hinterland was divided into six cargo generating districts and assumption was made that the cargo within each district would

generate in the center of the district as illustrated in the figure. With this method of estimation, a closer division of the hinterland may result in more precise computation of the reduction in transport cost. However, in comparison with the accuracy of other factors, the division of this degree is considered sufficient. These districts are almost identical in area and the boundary of each district is coincided with the district or state boundary. The volume of cargo expected to generate in 1980 and 1985 is shown in Table IV-2 by item and district.

The volume of cargo for the period prior to 1979 and for the 1981 - 1984 period was estimated by extrapolation and interpolation, respectively. The volume of cargo for the period after 1986 was considered to be the same as that for 1985.

Table IV-2 Volume of Tramper Cargo by Item and District (1980, 1985)

(In 1,000 tons)

		District 1	District 2	District 3	District 4	District 5	District 6	Total
Palm oil	1980	37	71	84	162	170	136	660
	1985	37	83	174	333	237	368	1,232
Processed timber	1980	48	32	48	91	43	102	369
	1985	37	25	50	94	44	197	356
Fertilizer	1980	4	8	9	17	17	15	70
	1985	44	8	14	26	19	28	99

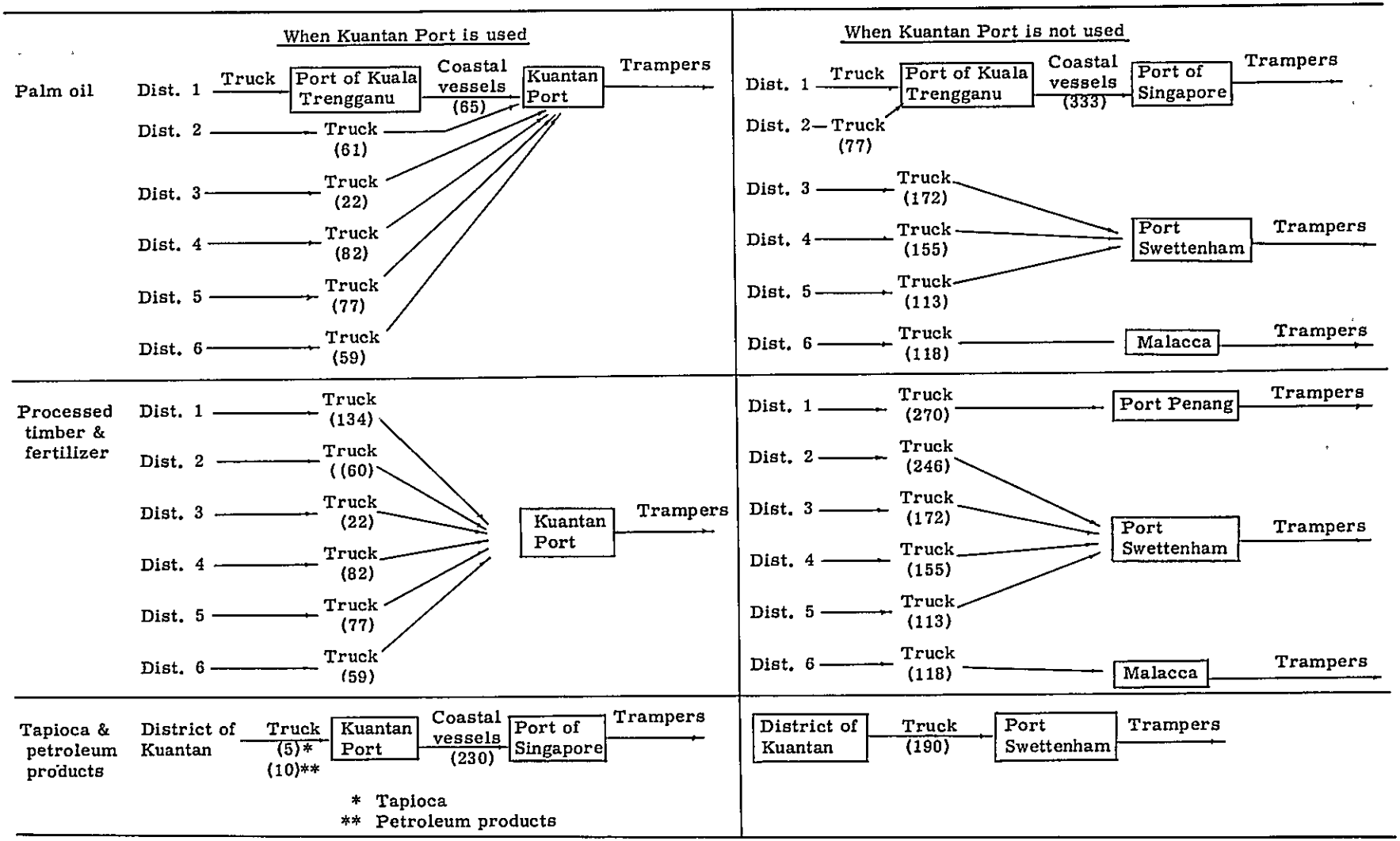
(Note) District 1: Districts of Besut, Kuala Trengganu, Ulu Trengganu and Marang, State of Trengganu.
District 2: Districts of Dungun and Kemaman, Ulu Trengganu
District 3: District of Kuantan, State of Pahang
District 4: District of Jenantut, State of Pahang
District 5: District of Temrloh, State of Pahang, within the hinterland
District 6: District of Pahang, State of Pahang, within the hinterland

As for coastal cargo, the hinterland is considered to be limited only to the district of Kuantan as mentioned in Section 4-1 "Forecast of Hinterland" and therefore, all cargoes for coastal vessels generate in the same area where tramper cargo is generated. The volume of these cargoes in 1980 and 1985 was already shown in Table I-23.

2-2-3 Method of Transportation

It was assumed that if the Kuantan Commercial Port is not constructed, its aforementioned item- and district-wise cargo handling volume would be handled by means that would incur the lowest total transport cost. The distance of land transport, which must be considered in selecting the method of transportation, was obtained by multiplying the bee-line distance by 30%. This was done because the road network in the hinterland of Kuantan Port is yet to be completed and it is very difficult to predict the total length of road network at this stage although it is advisable to use the road distance for the estimate. However, as the road between the port of Penang and Kuantan Port is expected to consist of mainly the existing road along the coast and the East-West Highway,

Table IV-3 Conceivable Method of Transportation



(Notes) 1. Figures in parentheses show mileage.
2. As sundry goods are small in volume, they can be handled by old facilities without new Kuantan Port.

the road distance was considered to be the one that detours through Kota-Bahru instead of the distance obtained by merely multiplying the bee-line distance by 30%. Table 4-3 shows the conceivable method of transportation for the case in which Kuantan Port is not used and for the case in which Kuantan Port is used. The table also shows the estimated transport mileage.

2-2-4 Unit Cost of Transport

Vehicles to be used for land transport were assumed to be 8-ton lorries for such bulky cargoes as palm oil and processed timber and the unit cost used was 10.9¢/ton.mile in accordance with the results of analysis of "Transport Development in West Malaysia, Annex B Road Transport." For other items, 5-ton lorries were assumed to be used because of the small quantity of these cargoes and the unit cost of 16.56¢/ton.mile obtained from the same source was used.

For sea transportation, the unit cost of 5¢/ton.mile, the same unit cost used in the Jengka Triangle Report, was adopted. As for port charges, only the expenses charged to the consignor were taken into consideration and the unit cost of 5$/ton was adopted.

2-3 Revenues of Kuantan Commercial Port

2-3-1 General

Revenues of a port are those derived from the facilities and services offered by it.

For the estimate on the revenue of Kuantan Commercial Port, the unit cost was first obtained on the basis of examples of Port Swettenham and the cost so obtained was multipled by the volume of cargo to be handled. For palm oil, the staple cargo item for this port, however, a separate rate was considered and the unit cost based this rate was adopted. As a result, the revenue of Kuantan Commercial Port for each year is estimated to be as shown in Table IV-4 below.

Table IV-4 Revenues of Kuantan Commercial Port

	Revenue (M$1,000)	Revenue (M$1,000)
1972	-	
3	-	
4	-	
5	-	
6	-	
7	5,751	1,917
8	11,670	3,890
9	13,592	4,531
1980	17,536	5,845
1	19,618	6,539
2	21,738	7,246
3	23,764	7,921
4	25,859	8,620
5	27,941	9,314
6	27,941	9,314
7	27,941	9,314
8	27,941	9,314
9	27,941	9,314
1990	27,941	9,314
1	27,941	9,314

2-3-2 Per Ton Revenue

The per ton revenue was determined on the basis of examples of Port Swettenham so that Kuantan Port may be placed under the same condition as Port Swettenham which is considered to be the most likely competitor for Kuantan Port. As for palm oil for export, the primary cargo item at the port, the per ton revenue was estimated by calculating the rent of palm oil facilities, which was set high enough to cover the cost of construction for palm oil facilities. The estimated per ton revenues are shown in the following table.

Table IV-5 Estimated per ton Revenues of Kuantan Commercial Port

(Unit: M$/ton)

Description of cargo	Per ton revenue
Processed timber, tapioca, fertilizer, sundry goods	110
Palm oil (Export)	19.9
Palm oil (Import)	10.2
Petroleum products	1.20

(a) Per ton revenues recorded by Port Swettenham

The per ton revenues recorded by Port Swettenham in 1966 and 1967 are shown in Table IV-6. In this table, however, the per ton revenues for the items suffixed by (1) were obtained by dividing the total revenue for these items by the volume of cargo handled at the pier of Port Authority and those for the items suffixed by (2) were obtained by dividing the total revenue for these items by the total volume of cargo.

Table IV-6 Per ton Revenue of Port Swettenham

(Unit: M$/ton)

Items		1966	1967
Landing and shipping	(1)	6.34	6.24
Storage	(1)	0.71	0.81
Services to ships	(2)	0.87	0.71
Wharfage	(1)	1.96	1.99
Tug hire	(2)	0.43	0.41
Crane hire	(1)	0.33	0.29
Rents	(2)	0.33	0.27
Sundry items	(2)	0.08	0.08

Based on the above table, the per ton revenues of Kuantan Commercial Port are estimated as follows.

Table IV-7 Estimated per ton Revenues of Kuantan Commercial Port

Items	Revenue per ton
Landing and shipping	6.30 M$/ton
Storage	0.80
Wharfage	2.00
Crane hire	0.30
Service to ships	0.80
Others	0.80
Total	11.00

The above per ton revenues, however, are applicable only to processed timber, tapioca, fertilizer and sundry goods.

The per ton revenue for palm oil will be discussed separately in the following section.

For petroleum products which will be handled by separate facilities, only the services to ships and others shown in the above table were considered. In other words, 1.60 M$/ton is the per ton revenue.

(b) Calculation of rent of palm oil facilities

On the condition that the facilities for landing and shipping palm oil such as pipe lines are to be owned by the management entity of Kuantan Port and that the operation of the facilities is to be undertaken by port service firms, the rent of 7 M$/ton is sufficient to realize profits as the benefit-cost ratio (earning rate) for the 10 year period beginning at the initial year of construction will be B/C = 1.22 and the internal rate of return will be 19.6 if a discount rate of 10% is adopted (Table IV-8).

Table IV-8 Benefit-cost Ratio of Palm Oil Facilities

	(A)	(B)	(C)=(A)x(B)	(D)=(C)-3	(E)	(F)=(D)-(E)				
	Volume of palm oil 1,000tons	Rent of facilities M$/ton	Revenue M$1,000	Benefit US$1,000	Investment in facilities US$1,000	Net benefit US$1,000	At 10% discount rate Benefit US$1,000	Cost US$1,000	Net benefit at 19% discount rate US$1,000	Net benefit at 20% discount rate US$1,000
1972										
1973										
1974										
1975										
1976					1,369	-1,369		850	-573	-550
1977	318	7	2,226	742	1,369	- 627	419	773	-221	-210
1978	430	7	3,010	1,003	1,370	- 367	515	703	-109	-103
1979	545	7	3,815	1,272	1,370	- 98	594	639	- 24	- 23
1980	660	7	4,620	1,540	-	1,540	654		322	299
1981	775	7	5,425	1,808	-	1,808	698		317	294
1982	891	7	6,237	2,079	-	2,079	729		307	280
Total							3,608	2,965	19	- 15

Benefit-cost ratio at 10% discount rate : 5,868 - 2,965 =

Internal rate of return : $19 + \frac{19}{19 + 15} = 19.56 = 19.6\%$

2-3-3 Annual Cargo Handling Volume

From the construction schedule the mooring facilities put in use each year are expected to be as shown in Table IV-9 below.

Table IV-9 Number of Mooring Facilities in Use

Year	For palm oil		For general cargo					For petroleum
	-10m	-7.5m	-10m	-7.5m	-6.0m	-4.5m	-3.0m	-5.5m
1976	Berth	Berth	Berth, m	Berth	Berth m	m	m	
7	2							
8	2		1 (185)					
9	2	1	1 (185)	1 (130				
80	2	1	2 (180)	1 (130)	1 (130)	150		2
1	2	1	2 (370)	1 (130)	1 (130)	150	320	2
2								
3								
4								
5								
6								
7								
8								
9								
90								
1								

The actual cargo handling volume of Kuantan Port is estimated as shown in Table IV-10. The volume of each cargo item shown in the table was obtained on the basis of the volume of cargo for 1980 and 1985 obtained in C Chapter 4, Part II, with each cargo item extrapolated for the years prior to 1980 and subsequent to 1985 and interpolated for the 1980 - 1985 period. Data thus obtained were used as the basis for estimation while taking into consideration the number of mooring facilities in use shown in Table IV-13.

Table IV-10 Volume of Cargo Handled at Kuantan Port

(In 1,000 tons)

Year	Shipping	Landing	Processed timber	Tapioca	Fertilizer	Sundry goods	Petroleum products
	A	A'	B	C	D	E	F
1975	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	318	37	-	-	-	-	-
8	430	37	366	-	-	-	-
9	145	37	364	-	-	-	-
80	660	37	364	75	70	28	82
1	775	37	361	83	76	29	87
2	891	37	361	90	82	30	92
3	1,002	37	359	98	88	31	98
4	1,117	37	359	105	93	32	101
5	1,232	37	356	113	99	33	110

2-4 Expenditure of Kuantan Commercial Port

2-4-1 General

Like the revenue discussed in Section 2-3-2, the total expenditure was obtained by calculating per ton expenditure first on the basis of the record of Port Swettenham and then, by using the following method.

Table IV-11 Estimated per ton Expenditure of Kuantan Commercial Port

(Unit: M$/ton)

Item	Expenditure per ton
Palm oil, processed timber, fertilizer, tapioca, sundry goods	7.50
Petroleum products	1.10

The annual expenditures may be obtained by multiplying per ton expenditure shown above by the volume of cargo to be handled annually (Table IV-10). Results of this calculation are shown in Table IV-12 below.

Table IV-12 Expenditures of Kuantan Commercial Port

Year	Expenditure (M$1,000)	Expenditure (M$1,000)
1977	2,663	888
8	6,248	2,083
9	6,095	2,365
80	9,345	3,115
1	10,303	3,434
2	11,284	3,761
3	12,220	4,073
4	13,188	4,396
5	14,146	4,715
6	14,146	4,715
7	14,146	4,715
8	14,146	4,715
9	14,146	4,715
90	14,146	4,715
1	14,146	4,715

2-4-2 Per Ton Expenditure

Like the per ton revenue, the per ton expenditure was also estimated on the basis of the record of Port Swettenham. For palm oil, for which a specific operating method (facilities are to be leased to service lending firms) is contemplated, the operating expense was considered to be the same as for other cargo. In other words. no such expenses as personnel expense, fuel cost, and rapairs were considered necessary specially for palm oil.

The per ton expenditure by item obtained on the basis of the record of Port Swettenham is shown in Table IV-13. In this table, the figures suffixed by (1) are the values obtained by dividing the expenditure by the volume of cargo to be handled at the quay of Port Authority and those suffixed by (2) represent the values obtained by dividing the expenditure by the total volume of cargo.

Table IV-13 Per ton Expenditure of Port Swettenham

(Unit: M$/ton)

Items		1966	1967
Working expenses	(1)	5.25	5.30
Engineering maintenance	(1)	0.73	0.64
Administration and accounts	(1)	0.36	0.37
General charges	(1)	0.55	0.48
Others	(2)	0.56	0.52

On the basis of Table IV-13 shown above, the per ton expenditure of Kuantan Commercial Port by item was estimated as shown in Table IV-14 below.

Table IV-14 Estimated per ton Expenditure of Kuantan Commercial Port

(Unit: M$/ton)

Items	Expenditure per ton
Working expenses	5.30
Engineering maintenance	0.70
Administrative and accounts	0.40
General charges	0.50
Other	0.60
Total	7.50

The figures shown in the above table are the per ton expenditures applicable to palm oil, processed timber, tapioca, fertilizer, and sundry goods.

For petroleum products, which will be handled by separate facilities, only "general charges" and "Others" shown in the above table were adopted, and the expenditure was estimated to be M$10/ton.

2-5 Cost of Construction for Kuantan Commercial Port

The cost of construction for commercial port is considered to be that contained in the construction schedule, Chapter 4, Part II, minus interest during construction and the cost of construction for fishing port.

Table IV-15 Cost of Construction for Kuantan Commercial Port

(In US$1,000)

1972	1,524
1973	349
1974	1,340
1975	1,235
1976	4,220
1977	5,264
1978	4,945
1979	5,873
1980	1,352
1981	1,352

2-6 National Economic Analysis

In making a national economic analysis of Kuantan Commercial Port, the internal rate of return was first obtained by setting the project life at 20 years from 1972 to 1991. For the expenditure, the cost of construction for Kuantan Commercial Port was adopted. Because the analysis was made by means of the internal rate of return, interest during construction was disregarded.

For the benefit, the reduction in transport cost as compared with the case in which the port is not constructed and the cost of construction for other ports, which was used as the incidental expense, were adopted. No estimate was made on the maintenance and management expenses since they were considered to be the same amount as incurred at other ports.

From the present value as of 1971, the benefit-cost ratio at the discount rate of 10% was 2.23.

The discount rate (Internal rate of return) which makes the benefit equal to the cost was 24.8%. (Table IV-16).

Table IV-16 National Economic Analysis of Kuantan Commercial Port

December 21, 1970

Year	Investment cost US$1,000 (1)	Transport cost savings US$1,000 (2)	Revenue US$1,000 (3)	Expenditure US$1,000 (4)	Net profit US$1,000 (5)=(3)-(4)	Benefit US$1,000 (6)=(2)+(5)	Net benefit (7)=(6)-(1)	Cost 10% discounted (8)	Benefit 10% discounted (9)	Net benefit 24% discounted (10)	Net benefit 25% discounted (11)
1972	1,524						-1,524	1,385		-1,229	-1,219
1973	349						- 349	288		- 227	- 223
1974	1,340						-1,340	1,007		- 703	- 686
1975	1,235						-1,235	844		- 522	- 506
1976	4,220						-4,220	2,620		-1,439	-1,383
1977	5,264	1,136	1,917	888	1,029	2,165	-3,099	2,971	1,222	- 852	- 812
1978	4,945	2,718	3,890	2,083	1,807	4,525	- 420	2,538	2,322	- 93	- 88
1979	5,873	3,028	4,531	2,365	2,166	5,194	- 679	2,740	2,423	- 121	- 114
1980	1,352	3,879	5,845	3,115	2,730	6,609	5,257	573	2,803	758	706
1981	1,352	4,233	6,539	3,434	3,105	7,338	5,986	521	2,829	696	643
1982		4,606	7,246	3,761	3,485	8,091	8,091		2,836	759	695
1983		4,954	7,921	4,073	3,848	8,802	8,802		2,805	666	605
1984		5,317	8,620	4,396	4,224	9,541	9,541		2,764	582	525
1985		5,680	9,314	4,715	4,599	10,279	10,279		2,707	506	452
1986									2,461	408	362
1987									2,237	329	289
1988									2,034	265	231
1989		Same	Same	Same	Same	Same	Same		1,849	214	185
1990									1,681	175	148
1991									1,528	139	119
Total	27,454	69,631	111,707	57,520	54,587	124,218	96,754	15,488	34,499	309	- 73

Benefit-cost ratio, when 10% discounted $B_o/C_o = 34,499/15,488 = 2.23$

Internal rate of return $R = 24 + \frac{309}{309 + 73} = 24.81 = 24.8$

It is generally said that the internal rate of return of 17 ~ 18% depicts the soundness of a project and therefore, this project may be said to have a very high national economic value.

This analysis lacks consideration for the cost of road construction. However, the road must be built in proportion to the progress of the development of the region and Kuantan Port was considered to be under the same condition as other ports as far as overland transportation is concerned. Therefore, the lack of consideration for the cost of road construction is not considered detrimental to the analysis.

CHAPTER 3. BUSINESS ANALYSIS OF PORT MANAGEMENT

In this Chapter the discussion will be limited to the management entity of Kuantan Commercial Port to study whether the port is economically justifiable or not.

The cost to be adopted for analysis is the investment for the construction of Kuantan Commercial Port. The benefit to be used is the net profit obtained by deducting expenditure from revenue. Details of factors for benefit and cost have already been discussed in Chapter 3. The benefit-cost ratio at the discount rate of 10% is 0.97 as shown in Table IV-17. The internal rate of return which makes the benefit equal to the cost is 9.6%.

This shows clearly that the management of the proposed Kuantan Commercial Port will be very difficult if based on the self-paying basis which is generally practiced in this country. In other words, when the construction and operation of the port are financed by borrowings, redemption of borrowings and the payment of interest will pose a serious problem and the survival of the port as an enterprise will not be possible.

Table IV-17 Management Analysis for Kuantan Commercial Port

December 21, 1970

Year	Investment cost US$1,000 (1)	Revenue US$1,000 (2)	Expenditure US$1,000 (3)	Net profit US$1,000 (4)=(2)+(3)	Net benefit US$1,000 (5)=(4)-(1)	Cost 10% discounted (6)	Benefit 10% discounted (7)	Net benefit 9% discounted	Net benefit 10% discounted
1972	1,524				-1,524	1,385		-1,398	-1,385
1973	349				- 349	288		- 294	- 288
1974	1,340				-1,340	1,007		-1,035	-1,007
1975	1,235				-1,235	844		- 875	- 844
1976	4,220				-4,200	2,620		-2,743	-2,620
1977	5,264	1,917	888	1,029	-4,235	2,971	581	-2,525	-2,391
1978	4,945	3,890	2,083	1,807	-3,138	2,538	927	-1,717	-1,610
1979	5,873	4,531	2,365	2,166	-3,707	2,740	1,010	-1,860	-1,729
1980	1,352	5,845	3,115	2,730	1,378	573	1,158	634	584
1981	1,352	6,539	3,434	3,105	1,753	521	1,197	740	676
1982		7,246	3,761	3,485	3,485		1,221	1,351	1,221
1983		7,921	4,073	3,848	3,848		1,226	1,368	1,226
1984		8,620	4,396	4,224	4,224		1,224	1,378	1,224
1985		9,364	4,715	4,599	4,599		1,211	1,376	1,211
1986							1,101	1,263	1,101
1987							1,001	1,158	1,001
1988							910	1,063	910
1989							827	975	827
1990							752	894	752
1991							684	821	684
Total	27,454	111,707	57,120	54,587		15,488	15,030	575	- 458

Benefit-cost ratio when 10% discounted $B_o/C_o = 15,030/15,488 = 0.97$

Internal rate of return $R = 9 + \frac{575}{575 + 458} = 9.56 \fallingdotseq 9.6$

CHAPTER 4. SUBSIDIES

4-1 Need for Subsidies

As previously discussed in Sections 2-5 and 3-4, it is evident that the management of the proposed Kuantan Commercial Port, if not supported by subsidies, will soon confront financial difficulties despite its great value from the standpoint of national economy. Table IV-18 shows again the benefit-cost ratio at the discount rate of 10% and the discount rate (Internal rate of return) when the benefit and the cost are balanced.

Table IV-18 National Economic Value of Kuantan Commercial Port and Financial Difficulties in Its Management

Description / Case	Benefit/cost at 10% discount	Internal rate of return
From the standpoint of national economy	2.23	24.8%
From the standpoint of port management	0.97	9.6%

Conversely speaking, if the port project is abandoned only for reasons of financial difficulties, the loss will be incalculable from the standpoint of national economy.

The success in the management of a port is dependent on its management system and the results of analysis shown in the table above result from the presumptive adoption of the port authority system widely adopted on the self-paying basis in this country. Beside the port authority system, there are such other cases in which the central government provides the principal facilities and transfers them to the port authority only at the stage when these facilities produce profits or the government grants subsidies to the port authority for the management of the port. The combination of these two cases is also conceivable.

Adoption of any of these means will contribute to the improvement of financial position of the port management after all and help make this project of high national economic value a success.

The difficulty in maintaining the management of Kuantan Commercial Port on a self-paying basis is mainly due to the severity of natural environments surrounding the port. To be more specific, an enormous investment required for construction of large scale breakwaters and for dredging work pressures upon the financial position of port management. As the mooring facilities, land, transit shed, and palm oil facilities bring returns themselves, they should not be included in the category to be covered by subsidies. Consequently, subsidies are to be considered only for outer and basin facilities such as breakwaters, groins, navigation channel and anchorage.

4-2 Improvement of Port Management with Subsidies

In order to make an econometric study to select facilities of Kuantan Commercial Port for the coverage by subsidies, the method which uses the

internal rate of return was adopted. When the pre-investment conditions of Kuantan Commercial Port are compared with those of other ports in West Malaysia, the greatest burdens on the financial position of Kuantan Port will probably be the east breakwater and the south groin, followed by dredging and the east sea wall.

As other facilities are able to bring direct returns or they are similar to those found at other ports, there is no need to consider subsidies for them. In studying the port management with consideration given to subsidies, the following four cases were considered.

Table IV-19 Facilities to be Covered by Subsidies

Case	Facilities to be covered by subsidies
1	East breakwater
2	East breakwater, south groin
3	East breakwater, south groin, dredging
4	East breakwater, south groin, dredging, east sea wall

Though the variation in the extent of subsidies for these cases (100% coverage or 50% coverage, for example) is conceivable, it will be sufficient for the feasibility study to consider only the case of 100% coverage.

Table IV-20 shows the benefit derivable from the inclusion of subsidies in the revenue shown in Table IV-17, for the above-mentioned four cases.

Table IV-20 Benefits Brought to Kuantan Commercial Port by Inclusion of Subsidies

December 21, 1970

Year	East Breakwater US$1,000 (1)	South Groyne US$1,000 (2)	Dredging US$1,000 (3)	East Revetment US$1,000 (4)	Net Profit US$1,000 (5)	Case 1 US$1,000 (1)+(5)	Case 2 US$1,000 (1)+(2)+(5)	Case 3 US$1,000 (1)+(2)+(3)+(5)	Case 4 US$1,000 (1)+(2)+(3)+(4)+(5)
1972	1,047			477		1,047	1,047	1,047	1,524
1973	349					349	349	349	349
1974	1,340					1,340	1,340	1,340	1,340
1975	670		341			670	670	1,011	1,011
1976	145	670	682			145	815	1,497	1,497
1977	73	283	682	53	1,029	1,102	1,385	2,067	2,120
1978			682		1,807	1,807	1,807	2,489	2,489
1979			682		2,166	2,166	2,166	2,848	2,848
1980			1,350		2,730	2,730	2,730	4,080	4,080
1981			1,350		3,105	3,105	3,105	4,455	4,455
1982					3,485	3,485	3,485	3,485	3,485
1983					3,848	3,848	3,848	3,848	3,848
1984					4,224	4,224	4,224	4,224	4,224
1985					4,599	4,599	4,599	4,599	4,599
1986									
1987									
1988									
1989									
1990									
1991									
Total	3,624	453	5,769	530	54,587	58,211	59,164	64,933	65,463

Table IV-21 shows the result of an analysis in case 1 as an example of port management with consideration given to subsidies.

The summary of the benefit-cost ratio and the internal rate of return at the discount rate of 10% are shown in Table IV-22.

Table IV-22 Analysis of Port Management with Consideration given to Subsidies

Case	Benefit-cost ratio at the discount rate of 10%	Internal rate of return
1	1.15	13.2%
2	1.19	14.1%
3	1.37	19.3%
4	1.40	21.1%

Judging from Table IV-22, the port management in Case 1 and Case 2 is not necessarily considered very profitable but that in Case 3 and 4 is considered highly promising. The extent of coverage and the amount of subisides for each case are shown below.

Table IV-23

	Coverage	Total amount of subsidies (US$1,000)
Case 1	13.2%	3,624
Case 2	14.8%	4,077
Case 3	35.8%	9,846
Case 4	37.7%	10,376

(Note) The total amount of subsidies do not include interest duting construction.

Table IV-21 Analysis of Port Management in Case I

Year	Investment cost US$1,000 (1)	Benefit US$1,000 (2)	Net benefit US$1,000 (3)	Cost 10% discounted US$1,000 (4)	Benefit 10% discounted US$1,000 (5)	Net benefit 13% discounted US$1,000 (6)	Net benefit 14% discounted US$1,000 (7)
1972	1,524	1,047	- 477	1,385	952	- 422	- 418
1973	349	349	-	288	288	-	-
1974	1,340	1,340	-	1,007	1,007	-	-
1975	1,235	670	- 565	844	458	- 347	- 335
1976	4,220	145	-4,075	2,620	90	-2,212	-2,116
1977	5,264	1,102	-4,162	2,971	622	-1,999	-1,896
1978	4,945	1,807	-3,138	2,538	927	-1,334	-1,254
1979	5,873	2,166	-3,707	2,740	1,010	-1,394	-1,300
1980	1,352	2,730	1,378	573	1,158	459	424
1981	1,352	3,105	1,753	521	1,197	516	473
1982		3,485	3,485		1,221	909	825
1983		3,848	3,848		1,226	888	799
1984		4,224	4,224		1,224	862	769
1985		4,599	4,599		1,211	831	735
1986					1,101	735	644
1987					1,001	651	565
1988					910	576	496
1989					827	510	435
1990					752	451	381
1991					684	399	335
Total				15,488	17,806	79	- 439

Benefit-cost ratio, when 10% discounted $B_o/C_o = 17,806/15,488 = 1,15$

Internal rate of return $R = 13 + \frac{79}{79 + 439} = 13.2$

CHAPTER 5. REDEMPTION PLAN FOR COMMERCIAL PORT

For the guidance of the Malaysian government in working out a redemption plan in the implementation of this project, tow alternative redemption plans have been worked out. Of the two plans, the one is for the case in which part of the construction cost is covered by the subsidies from the national treasury and the other is for the case in which no such subsidies are considered.

5-1 Capital Investment to be Redeemed

Table IV-24 shows the cost of construction for the proposed commercial port by currency and year. The following table shows the capital investment to be redeemed under Plan I and Plan II both of which evisage the provision of subsidies for the construction of the east sea wall , east breakwater, south groin and dredging.

(In US$1,000)

Year	Plan I			Plan II		
	Local currency	Foreign currency	Total	Local currency	Foreign currency	Total
1972	0	0	0	1,404	120	1,524
73	0	0	0	328	21	349
74	0	0	0	1,260	80	1,340
75	104	120	224	870	365	1,235
76	908	1,815	2,723	1,947	2,273	4,220
77	1,561	2,612	4,173	2,214	3,050	5,264
78	1,512	2,751	4,263	1,785	3,160	4,945
79	1,805	3,386	5,191	2,078	3,795	5,873
80	2	0	2	542	810	1,352
81	2	0	2	542	810	1,352

5-2 Annual Depreciation for Commercial Port Facilities

The amount of annual depreciation for port facilities may be obtained by the following formula.

$$\text{Annual depreciation for facilities} = \frac{\alpha_i}{(1+i)^n - 1} \times \text{cost of construction for the facilities}$$

where: n : Service life

i : Interest rate on the borrowings to be redeemed, $i = 5\%$

α : Percentage of the cost to be redeemed in the total cost of construction for the facilities

$a = i/(1+i)^n - 1$ obtained by establishing service life for each facility is shown in the table below.

Table IV-24 Cost of Construction for Commercial Port by Currency

To be covered by subsidies	Facilities	1972			1973			1974			1975			1976			1977			1978			1979			1980			1981		
		Local currency	Foreign currency	Total	Local currency	Foreign currency	Total	Local currency	Foreign currency	Total	Local currency	Foreign currency	Total	Local currency	Foreign currency	Total	Local currency	Foreign currency	Total	Local currency	Foreign currency	Total	Local currency	Foreign currency	Total	Local currency	Foreign currency	Total	Local currency	Foreign currency	Total
◎	East revetment	420	57	477													46	7	53												
◎	East breakwater	984	63	1,047	328	21	348	1,260	80	1,340	630	40	670	136	9	145	68	5	73												
◎	South groin													630	40	670	266	17	283												
	Inner breakwater																			49	3	52									
	Boundary revetment																176	29	205												
◎	Dredging										136	205	341	273	409	682	273	409	682	273	409	682	273	409	682	540	810	1,350	540	810	1,350
	Dolphin										55	117	172	220	468	688	55	117	172	220	468	688									
	-10.0 m quay													91	260	351	364	1,035	1,399	91	260	351	364	1,035	1,399						
	- 7.5 m quay																			206	504	710	51	126	177						
	- 6.0 m quay																			72	154	226	108	231	339						
	- 4.5 m quay																						118	202	320						
	- 3.0 m quay																			65	94	159	132	191	323						
	Reclamation by filling-up										49	3	52	104	7	111	49	3	52												
	Leveling of ground													12	1	13	24	2	26	24	2	26	24	2	26	2	0	2	2	0	2
	Pavement													180	11	191	369	24	393	369	24	393	369	24	393						
	Palm oil facilities													301	1,068	1,369	301	1,068	1,369	301	1,069	1,370	301	1,069	1,370						
	Land facilities																223	334	557	115	173	288	338	506	844						
	Total	1,404	120	1,524	328	21	349	1,260	80	1,340	870	365	1,235	1,947	2,273	4,220	2,214	3,050	5,264	1,785	3,160	4,945	2,078	3,795	5,873	542	810	1,352	542	810	1,352
Total excluding subsidies		0	0	0	0	0	0	0	0	0	104	120	224	908	1,815	2,723	1,561	2,612	4,173	1,512	2,751	4,263	1,805	3,386	5,191	2	0	2	2	0	2
Subsidies		1,404	120	1,524	328	21	349	1,260	80	1,340	766	245	1,011	1,039	458	1,497	653	438	1,091	273	409	682	273	409	682	540	810	1,350	540	810	1,350

	Service life (year)	$a = i/(1+i)^n-1$	α (%)
East sea wall	∞		
East breakwater	∞		
South groin	∞		
Inner breakwater	∞		
Boundary revetment	∞		
Dredging	∞		
Dolphin	50	0.004777	100
-10.0 m quay wall	50	0.004777	75
-7.5 m quay wall	50	0.004777	75
-6.0 m quay wall	50	0.004777	75
-4.5 m quay wall	50	0.004777	100
-3.0 m quay wall	50	0.004777	100
Reclamation by filling-up	∞		
Leveling of ground	∞		
Pavement	20	0.030242	100
Palm oil facilities	30	0.015055	80
Land facilities	30	0.015055	80

The amount of annual depreciation for each facility is shown in the table below.

(In US$1,000

Facilities	Cost of construction to be redeemed	$a = i/(1+i)^n-1$	Annual redemption for each facility
Dolphin	1,720	0.004777	8.22
-10.0 m quay wall	2,625	"	12.54
-7.5 m quay wall	665	"	3.18
-6.0 m quay wall	425	"	2.03
-4.5 m quay wall	320	"	1.53
-3.0 m quay wall	482	"	2.03
Palm oil facilities	4,382	0.015055	65.97
Land facilities	1,351	"	20.34
Pavement	1,370	0.030242	41.43
Total			158

As the service life of the majority of facilities to be constructed during the 1972 ~ 1976 period is considered infinite, the annual depreciation was considered only for the period after 1977. The amount of annual depreciation under Plan I and that under Plan II are equivalent.

5-3 Annual Maintenance Cost for Commercial Port Facilities

As the majority of the facilities have an infinite service life, there naturally arises the requirement for appropriation of their maintenance expenses. For this project, the annual maintenance cost for all the facilities was determined to be 5%. The annual maintenance cost for Plan I and Plan II is shown in the table below.

(In US$1,000)

	Cost of construction for the facilities which require maintenance	Coefficient	Annual maintenance cost
Plan I	16,578	0.005	83
Plan II	27,454	0.005	137

It was considered that appropriations for annual maintenance cost would be made after 1972.

5-4 Repayment of Borrowings

Repayment of borrowings was considered to be the sum obtained by deducting the annual redemption and annual maintenance cost from the annual revenue of the port. The annual repayment amount during the 1972 ~ 1991 period under Plan I and Plan II is shown in the table below.

(In US$1,000)

Year	Port Revenue	Plan I		Plan II	
		Deduction	Repayment	Deduction	Repayment
1972		- 83	-83	-137	-137
73		"	-83	"	-137
74		"	-83	"	-137
75		"	-83	"	-137
76		"	-83	"	-137
77	1,029	-241	788	-295	734
78	1,807	"	1,566	"	1,512
79	2,166	"	1,925	"	1,871
1980	2,730	"	2,489	"	2,435
81	3,105	"	2,864	"	2,810
82	3,485	"	3,244	"	3,190
83	3,848	"	3,607	"	3,553
84	4,224	"	3,983	"	3,929
85	4,599	"	4,358	"	4,304
86	4,599	"	4,358	"	4,304
87	4,599	"	4,358	"	4,304
88	4,599	"	4,358	"	4,304
89	4,599	"	4,358	"	4,304
1990	4,599	"	4,358	"	4,304
91	4,599	"	4,358	"	4,304

In the table the repayment for the five year period from 1972 to 1976 is shown in negative values both under Plan I and Plan II. The repayment in such a case was considered as the investment instead.

5-5 Plan for Repayment of Borrowings

Plans for repayment of borrowings were worked out for both Plan I and Plan II on the following conditions.

(1) Interest rate

Interest rate was determined to be as follows.

	Interest on foreign currency borrowing	Interest on local currency borrowing
Plan I	7.5%	6.0%
Plan II	7.5%	0%

(2) Allocation of repayment to local currency and foreign currency

Allocation of repayment to local currency and foreign currency was determined on the following proportion.

	Repayment in foreign currency	Repayment in local currency
Plan I	70%	30%
Plan II	60%	40%

From the two repayment plans, the following results were obtained.

	Year in which foreign currency repayment is completed	Year in which local currency repayment is completed
Plan I	1985	1986
Plan II	1990	1988

Plan for Repayment of Borrowed Money

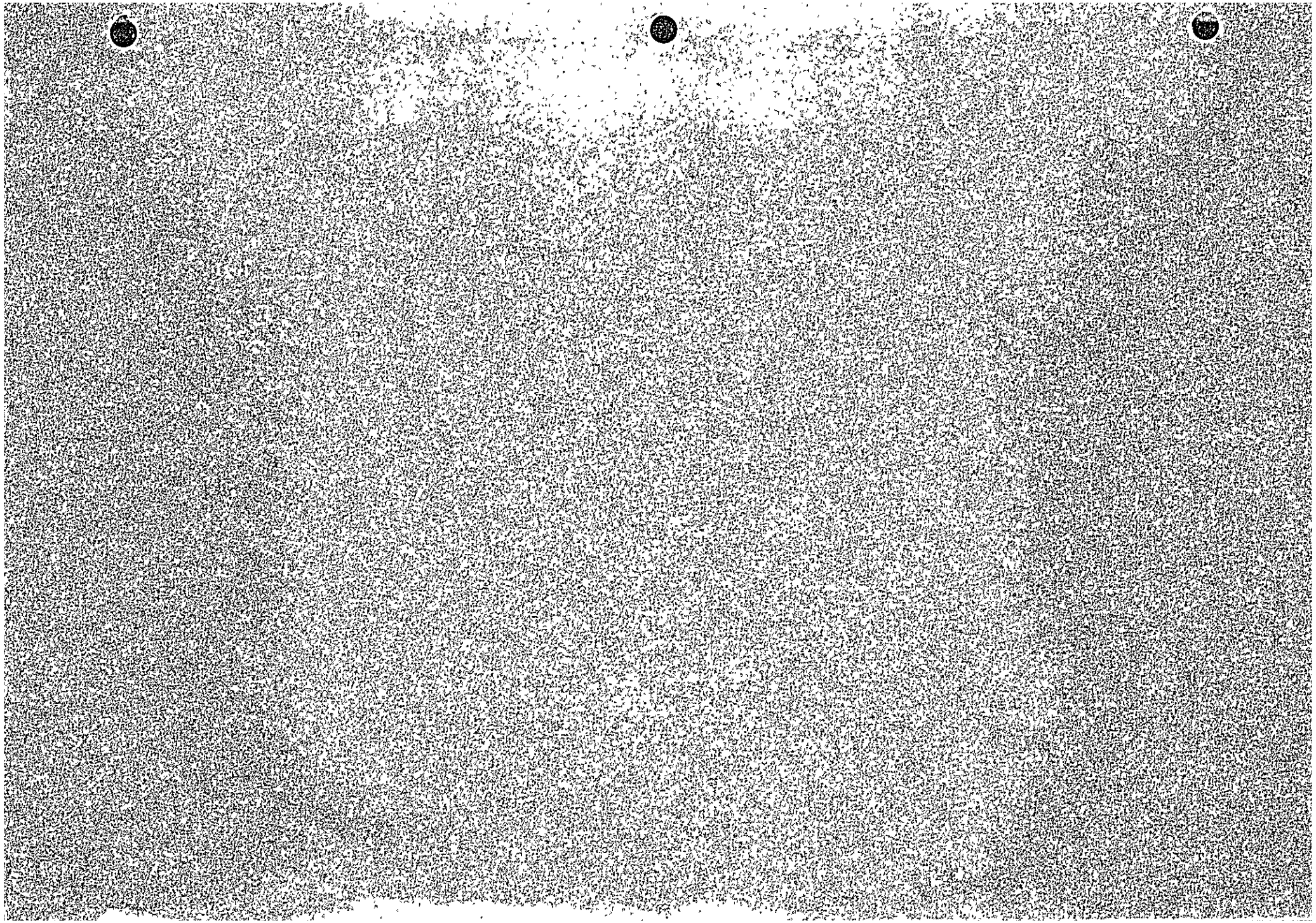
(Unit: US$1,000)

Year	Estimated nett revenue	Foreign currency					Domestic currency				
		Amount invested	Amount repaid			Balance	Amount invested	Amount repaid			Balance
			Interest (7.5%)	Principal	Total			Interest (6%)	Principal	Total	
1972		53				57	30				32
1973		53				118	30				66
1974		53				184	30				102
1975		173				384	134				250
1976		1,868				2,421	938				1,259
1977	788	2,612	377		552	4,858	1,561	169		236	2,753
1978	1,566	2,751	571		1,096	7,084	1,512	256		470	4,051
1979	1,925	3,386	785		1,348	9,907	1,805	351		577	5,630
1980	2,489		743		1,742	8,908	2	338		747	5,223
1981	2,864		668		2,005	7,571	2	314		859	4,680
1982	3,244		568		2,271	5,868		281		973	3,988
1983	3,607		440		2,525	3,783		239		1,082	3,145
1984	3,984		284		2,789	1,278		189		1,195	2,139
1985	4,358		96		1,374	0		128		1,307	960
1986	4,358							58		1,018	0
1987	4,358										
1988	4,358										
1989	4,358										
1990	4,358										
1991	4,358										

Plan for Repayment of Borrowed Money

(Unit : US$1,000)

Year	Estimated nett revenue	Foreign currency					Domestic currency				
		Amount invested	Amount repaid			Balance	Amount invested	Amount repaid			Balance
			Interest (7.5%)	Principal	Total			Interest (0%)	Principal	Total	
1972		192				206	1,469				1,469
1973		93				321	393				1,862
1974		152				508	1,325				3,187
1975		437				1,016	935				4,122
1976		2,345				3,613	2,012				6,134
1977	743	3,050	500		446	6,717	2,214			297	8,051
1978	1,512	3,160	741		907	9,711	1,785			605	9,231
1979	1,871	3,795	1,013		1,123	13,396	2,078			748	10,561
1980	2,435	810	1,065		1,461	13,810	542			974	10,129
1981	2,810	810	1,097		1,686	14,031	542			1,124	9,547
1982	3,190		1,052		1,914	13,169				1,276	8,171
1983	3,553		988		2,132	12,025				1,421	6,750
1984	3,929		902		2,357	10,570				1,572	5,178
1985	4,304		793		2,582	8,781				1,722	3,456
1986	4,304		659		2,582	6,858				1,722	1,734
1987	4,304		514		2,582	4,790				1,722	12
1988	4,304		359		2,582	2,567				12	0
1989	4,304		193		2,582	178					
1990	4,304		13		191	0					
1991	4,304										



Errata

Page	Line	Error	Correct
9	1	Shown in Fig. I-3.	Shown in Fig. I-3 & III-1(a)
10	14	$ 189,000.	US$ 189,000.
119	11	5,715,000	5,715,900
	14	555,000	55,500
124	1	(In US dollar)	(In US$ 1,000)
128	13	(MR 1,000)	(M$ 1,000)
129	12 from bottom	Table I-23.	Table I-25.