SONGKHLA PORT CONSTRUCTION PROJECT

THAI KINGDOM

FEASIBILITY REPORT

January 1968

Government of Japan

PREFACE

The Japanese Government at the request of the Government of Thailand decided to undertake an investigation into the Songkhla Port Construction Project, and placed the task in the hands of the Overseas Technical Cooperation Agency, a Governmental body exclusively in charge of the implementation of overseas technical cooperation activities.

In view of the importance of the proposed construction project of Songkhla Port in the economic and regional development of the Kingdom, a team of ten expert engineers headed by Mr. Hiroji Otao, Former Vice-President of the Transport Technical Research Institute of the Japanese Ministry of Transport.

The mission of this team was to carry out the investigation from both technical and economical standpoints into the improvement and expansion of Songkhla Port, and to propose a plan for the said project.

Thanks to the unsparing cooperation and assistance of the authorities of the Thai Government, the investigation works were successfully completed and we are now quite ready to present its report.

Let me allow, in conclusion, to avail myself of this opportunity to express my gratitude to the authorities of the Thai Government, the Japanese Embassy in Bangkok, the Ministry of Transport of our Government for their kind assistance and support extended to the team in the perfomance of this investigation works.

January 1968

Shinichi Shibusawa
Director General
The Overseas Technical Cooperation Agency

FOREWORD

It is my greatest pleasure to be able to present a fruitful report of efforts, which I owe to the close cooperation of many excellent experts, governmental officials and the people concerned of both nations.

The Survey Team has come to a conclusion that the nature of Songkhla is rather favourable to carrying out of the first stage of the proposed plan and that its investment will meet today's requirement viewed in the light of practicability. Upon the completion of new port facilities, we convinced that the economical activity in the region will begin to show a rapid turn for the better and its particular connection with Bangkok Port will definitely contribute to the industrial development of Thailand.

The report consists of four parts. In the summary, which is the first part, I hope you will grasp the gist of the whole matter, and detailed explanations on each theme in the following three parts. Various reference data and informations of the survey team are appended at the end of this report.

We are expecting the materialization of the plan at the earliest possible data with appropriate design of each proposed facilities furnished by responsible engineers and also their successful completion brought by experienced capable groups according to reasonable process of port and harbour construction works.

Let me allow to express my hearty thanks, on this occasion, on behalf of all the members of the survey team to those persons who provided us every convenience in Bangkok and Songkhla.

January 1968

Hiroji Otao,
Chief
The Songkhla Port Development Survey Team

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PART I. SUMMARY

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Chapter 1. Survey Procedure

Section 1. Essentials of Research

In studying the fesibility of Songkhla Port Development Plan, the survey team focused their attention on the following points to get an exact conclusion.

(1) Waht social and economic role is the port city fulfilling today or will be fulfilled if the port had been improved, in Southern Thailand and in the whole kingdom alike ?

In brief, can the area of Songkhla and Haad Yai combined be reasonably considered as the most important and vital regional area in respect to current economic status and future prospect, is Southern Thailand ?

(2) How are the limits of the hinterland of each port city of today and tomorrow to be judged ?

To put it otherwise, whether is it appropriate to start the improvement work first on Songkhla in Southern Thailand or not, as judged Songkhla has most strong and large environment in comparison with the other port cities with their own hinterlands ?

(3) It is possible to expect future industrial development in terms of geographical conditions ?

The prospective increasing of cargo, comming out of new industry and arrangement of port facilities has close connection each other and free flat spare land is required first of all as one of basic conditions of their realization.

To build a harbour for larger ships means that the port city itself will become a big entre-pot of cargo. A wide space of plain land is required so that the port will be able to display her function more efficiently in the future. The possible development of agriculture in the hinterland and the expansion of the port city itself require also adequate plain land for the aim attainment. Is there enough free area or be possible surface to get the land by reclamation not only arround the wharf where many new establishments will come to gather but in the suburbs where the light industry not say heavy industry will spring up upon the completion of the new port ?

(4) Can we be sure of relative easiness in terms of natural conditions in the construction of a port, or can the initial investment in new port facilities be made as small as possible for its efficiency and against naintenance cost needed ?

As the conclusion of analytical investigation, let the team convinced that Songkhla satisfies nearly all those fundamental elements of requirements.

Section 2. Brief Survey.

(1) Prominent Position of Songkhla

The Kingdom of Thailand lies in the tropical zone in the central part of the Indochina Peninsula. The Kingdom has a shape of an elephant-head, and its nose trunk stretches from north to south, dividing the Indian Ocean from the South China Sea. The Kingdom joins Malaysia in the middle of the Malay Peninsula.

On the coast at the northern end of the Gulf of Thai, the Maeklong Chao Phya River and the Bang Prakong River, which run through Thailand from north to south, pour into the gulf with their mouths adjacent to one another, and their waterways in land are working like so many blood pipes nourideing the human body.

Even in the large isolated district without any coast line, the North-Eastern part of Thailand, the shape of which makes us imagine a bigear of an elephant, there flows a big branch of the International River Mekong, which opens its big mouth into the South China Sea, allowing the navigation of ocean ships to some extent upstream. Because all parts of Thailand are gifted with inland navigation, to build a big entry -port, that means port construction for ocean ships, is the most urgent and cheapest investment for instant effect on the transportation arrangement for industrialization and modernization, it is believed. Situated at the tip of the elephant's long nose, 700km equally from all river mouths and with a large lake within its boundary, Songkhla seems to have a perfect location for building a modern port.

In Thailand with 2,000km. of its coast line, only Bangkok Port on the Chao Phraya River can serve ocean liners going up about 30km. from the river mouth. A small volume of foreign trade goods are transferred to other places by small boats through this port at present - - - the port itself is nearly choking owing to the shortage of wharves. If Songkhla Port should begin to display her function actively like the nose of an elephant does, its effect will be shared by the whole of Thailand through the river mouths , and then gradually to all of Asia by sea as if the body of the elephant effected by elephant nose.

(2) The Right Time to Start

As almost all of the regions in Thailand are fitted for the cultivation of rice, which is a staple food, the country is still capable of exporting a large quantity of rice, Thailand can enjoy a priviledged position so long as it remains a first-stage agricultural nation which contents itself with a self-supplying economy within a limited area.

The affairs in and out of the country, however, do not allow her to remain so. The recent rapid development of Thailand toward social and economic modernization has brought about heavy transportation of goods and passengers, urging improvement of means of transportation to meet the present and future demand in the region.

Having reached such a point after the steady progress in industrialization, in particular, Thailand has come to require import cargo of manufactured and highly-processed goods in large quantities from other countries in exchange for its agricultural products, so that one deep harbour Bangkok only cannot deal with them any more, giving rise to an urgent need of another new port to cooperate with Bangkok Port.

(3) Competence of a New Port.

With the above preliminary knowledge, the Songkhla Port Survey Team reached their destination. We hoped that the place would have the conditions that would promise potential elements for development not only as a junction between land and sea transport---- that is, as a place where goods stop a while to be transferred, but also as an important base for the industrialization of the region.

Frankly speaking, we had much doubt as to whether we could hope for a suitable topography of Songkhla, that is, natural conditions convenient for building a new port with ease, and an adequate hinterland including a big lake to allow future development, say, creation of new kinds of exportable goods. However, the place looks undeveloped at present. If there are good shallow basins with an abundant water supply and power sources, we can look forward to the future development by a good project making use of today's excellent port construction engineering. In fact, all the members of our survey team were satisfied with nature in Songkhla although there are some ambiguities to be clarified in the future before realizing the second stage of our project. As we stood facing the spot where new port facilities might be biult, we visualised many bigger foreign ships together with small coast liners berthing alongside the new port quaywall and a large number of barges occupying the waterway between new and old wharves. With the completion of a new deep quaywall, Songkhla will become a sister port of Bangkok, by taking on the function of freight transmission by dint of her adequate position on the South China Sea.

Our first impression after a trip through the area was its natural beauty fitted as a resort and tourist spots, as well, and we have been convinced that the new port will be built at a relatively low cost, bringing with it marvellous benefits.

(4) Port Planning Survey

As a site for port construction, we intuitively came to the conclusion that two spots should be taken into consideration---one is on the side facing the open sea and the other is inside, within the waterway leading to the lake. For lack of important basic survey and reliable data covering a long period---which is usually the case with a new port project planned in a hurry---it seemed very dangerous sometimes to try to put forward a proposition for a project involving a concrete cost estimation and exact illustrations unless we are supported by several new surveys for confirmation.

According to our experience, such a configuration as we have seen here is very often so complicated and diversified in terms of soil conditions of sea-bottom and drift sand which will have a fatal effect on the project itself and cost estimation, to say nothing of mortal but severe burdens which will persist for a long time after construction work is started.

After careful comparative examination of the present port capacity, natural conditions, construction costs, reliability of the construction time schedule, various considerations for future development, and investment efficiency of port facilities, we reached a conclusion that something like Fig. -25 was the most desirable for the first stage of construction work, based upon which our recommendation was made. The first stage includes construction of a new port entrance and a new pier inside the waterways with a proper, deep and wide basin.

When the port entrance for ocean liners is completed, it will benefit not only liners that visit Songkhla, but also existing piers and the city itself developed near the lake. On the contrary, construction of a port at a site facing the outer sea, exposed to strong wind in winter and with unfavourable soil conditions of the sea-bed, involves precarious movements of drift sand along the beach. It was concluded that it would not be too late to consider the construction outside facing the open sea in the future when an increased volume of cargo needs its construction and when experience and techniques obtained from the first stage construction work will be available.

(5) Various Matters.

Arrangement of berths by types of ships taking into consideration conveniences in manoeuvering larger ships, the number and the kind of groups of each type of incoming and outgoing ships and the quantity and kind of cargo, utilization of spare land of the port area according to function, and other matters relevant to future expansion.

Even the best-equipped port cannot become active with the fundamental wharf facilities alone---there should be active business, manipulation of cargo collection and distribution, daily management and operation of the port and services necessary for maritime transportation, all functioning in good working order. Port planning is also inseparable from modernization of a city.

It is proposed that when the construction work is underway, survey and collection of necessary data should be furthered and due consideration should be given to various uses of land on a large scale and planning for a port city itself capable of modern functions should be worked out, all in harmony so as not to produce frintions among them.

For your reference, a perspective plan of a future city of Songkhla with its topographic conditions utilized to the maximum is added here by way of an example.

It is advised that a port construction office staffed with powerful experts be established at Songkhla prior to the commencement of work, so as to attain a fruitful result from the investment in the project.

Chapter 2. Background of Songkhla Port

Section 1. Economic Affairs in the Hinterland.

The core of industry in Southern Thailand is agriculture, of which rice is dominant. In southern Thailand at present, production and consumption of rice are in equilibrium. In the near future, however, increased volume in production would surpass local consumption in the provinces of Nakhon Si Thammarat and Phattalung, giving rise to a regional transport problem. Some new kind of products suitable to special conditions should be investigated and encouraged, for example, copra, olive, maize, tapioka, tea, sugar, tabaco, cofee, etc. for export.

Rubber is an important export material in Southern Thailand. Effort for structural reform of the industry should be made to expect an explosive increase in production. In forestry, the chip industry is expected to develop by planned afforestation in the future. The fishing industry has been flourishing, earning important foreign exchange through the export of prawns, but is handicapped by the transportation circumstances which still remain in poor order.

As for the mining industry, manganese, silica, and tin are already being developed to some extent. Effort is being made to confirm unexplored mineral deposits, and a bright outcome is in sight. In the manufacturing industry, sophisticated processing of goods produced in the region or the manufacturing of consumer goods for daily needs aiming at their self-sufficiency should be strived for. Failing this, transportation costs alone due to outside procurement would mean a substantial loss in the national economy and retard economic development of Thailand as a whole. The urban area around Songkhla is marked by a high accumulation in terms of economic and social achievement in Southern Thailand and has a wide sphere of influence. The level of production is also quite high in the district. With active efforts towards modernization, its role as the core of development in Southern Thailand is increasingly important.

Section 2. Impact of The Port Construction and its Future.

Through it has very favorable geographical conditions for economic exchange by sea, Southern Thailand has no modern port within in its boundary, Improvement and expansion plans of other ports than Songkhla present difficulties in terms of natural environment. The port of Songkhla with 250,000 t. of cargo handled annually and ships of the 1,000 - 2,000 G.T. class coming in and out of the port annually, is the second largest port in Thailand. It has already established its position firmly in the transportation system of the country.

The role played by the port will become increasingly important as the economic development of Thailand progresses.

From the international trade viewpoint, Songkhla enjoys favorable conditions, showing possibility for development into a transit port.

As Bangkok port is located on the river and on the head of the Gulf of Thai, the port of Songkhla is expected to function as a supplementary port of Bangkok port. Moreover, the lake of Songkhla behind Songkhla port adds another merit to this port.

With small investment, the shore of Songkhla lake will be connected with the port by simple local shipping service. Therefore, a large production area behind the port will become practical.

By disregarding a route via the lake, the port will have a wide area under its influence to be utilized for less costly transport service.

At present, however; due to the inadequate communication system and unsatisfactory condition of Songkhla port, the sphere of influence of the port is actually confined to two cities, Songkhla and Haad Yai, though, considering the railway rates, its hinterland covers about half of Southern Thailand.

The potential range of influence is expected to become actual in the near future. In 1980, the volume of cargo handled is estimated to register nearly 900,000 t. and larger ships are expected to increase in proportion.

Chapter 3. Natural Conditions

The neighbouring area of Songkhla is endowed with favorable natural conditions in general. Annual precipitation is around 2,000 mm, with intensive rainfall for 3 months during Oct.-Dec. which accounts for nearly 60%.

A flood may accompany heavy rainfall, but in making the most use of the idle water of Songkhla Lake, there is little danger of the navigable route being filled up with a vast amount of mud and sand discharge.

Heavy rain conditions in a special year, however, may be such as might bring about bad drainage and innundation on land, and on the other hand, the water level of the water ways affected by the lake water is maintained higher than sea level for days. During the northeastern storm season from Nov. to Feb., winds are 10-13 knots, disturbing the coast.

A wind with a maximum velocity of more than 50 knots per second is known to have blown in the past, which was caused by tropical atmospheric pressure, which visits this area once every several years. Such a strong wind, however, rarely attacks the area and when it does, its duration is relatively short. Consequently, it dose not seem to hamper realization of the port project.

As a result of long-term observation, tide range is estimated to be around 1.40 m.

A tidal current flows diagonal to the coast line, and is not of a nature which will hamper navigation of ships. The current of the waterway has been observed to be of about 2 knots at spring tide. Under normal conditions, inflowing and outflowing in the water-way alternate according to the tidal range. But during the rainy season when the water level of Songkhla Lake rises, the current flows oneway toward the open sea. As a result of observations and hydrologic calculations, it is known that the current runs at the maxi-mum speed of 5 knots in some ports with a maxium discharge of 4,000 m^3/s in a special year. Such data should be checked and made perfect with precipitation statistics taken at many spots around the lake.

No accurate record of wave heights was obtained in the present survey. Considering the natural conditons enumerated in the above and the marine chart, however, wave heights of 2.0 - 3.0 m. along the coast will be a safe estimation.

Topography around the city of Songkhla is protuberant. Considering that the beach line is changing every year, it is thought that there is a movement of a substantial amount of drift sand.

But the area with a conspicuous movement of fine sand is the zone from the beach-line up to the depth of 3.0 m. Rocks, reefs, and small islands off the shore lie in such a way as to protect the navigable passage and a new port-entrance from drift sands. Their role in retarding the effect of moving sand should be remembered.

The soil of as simple composition, the survey result disclosed along the waterways in the port would have no adverse effect on construction of port facilities, but near the open sea, the soil is composed alternately of hard and soft layers and special care should be taken in constructing breakwaters and other structures.

Chapter 4. Plan for Facilities

With the exception of the fishery pier, the godowns, cargo handling machines and quay etc in Songkhla port are not equiped with any modern facilities at the present time. It is urgently necessary to improve and turn it into modern port but gradual modernization of these facilities, however, would only cause fruitless friction between them with much waste requiring a longer period for attainment of the planned aim. Even if a new port entrance is completed, making it possible for ships to enter the port, drastic change can not promptly be started on the part of the old district. Because the development of there old facilities has been inseperably related to that of the old city of Songkhla and its' around natural conditions. If a new port-extrance is built and a new wharf is to be build at a new site, however, the existing facilities, as they are now, will also benefit in their own way and the new wharf can start fulfilling its modern function at once. It goes without saying that the best way is for the new and the old to combine to accommodate incoming and outgoing ships and to facilitate their cargo handling.

In studying the new facility plan, what claimed our tearm's special attention is to workout a plan that will make it possible to materialize a new construction work stage by stage in conformity with the growth of economy. Care was taken also to prepare a project that can be realized with lesser difficulties in respect to natutal conditions. All the time we strived to make a plan to gain maximum investment effect with minimum compensation to the old without causing suspension of the port function that may give rise to resistance, and with as small costs of construction as possible.

With these considerations in mind, the first stage plan was made, which consists of construction of a new wharf on the same side of the waterway as, the existing Songkhla Port facilities and the opening of a new port entrance. The new port entrance is to be separated from the present entrance with large sand bars in front of it and is to be connected with the sea by a channel which consists of two structures a training dike and a breakwater. The route leading further off shore is to be dredged as a nevigable way for larger ships.

The first stage work is to consolidate the foundation of the port, enable it to accommodate ships, and to make sucure further development in the second and subsequent stages. If the port had grown into a transit port, another a breakwater, a berthing basin and a wharf are to be constructed in the area facing the open sea, for the accommodation of ships and temporary storing of cargo adopting a system of free zone to foreign cargo for an example.

By that times, surveyed data sufficient enough to help materialize the above plan will be available and local economy will have grown enough to afford the work.

Development of an industrial zone and agriculture in close association with Songkhla port can be taken up for consideration in line with gradual development of the port. Because the first stage plan is a scale to serve as a bridgehead of the plan for tomorrow's economic development, it should therefore be carried out at one time on account of the immediate needs of today, but tomorrow's also. If necessity for sub-division arises due to finance of any other obstacles, however, the first stage can be sub-divided in such a way that the first sub-stage is to undertake construction of facilities to cover all internal trade cargo and a half of external trade cargo, that is, a port with the depth of - 5.5 m. should be completed in the first sub-stage, the rest will be left to be completed in the second sub-stage.

The first sub-stage, however, will leave intact the obsolete operation of loading and unloading by the use of lighters for some cargo. By the seconds sub-stage omission due to the development of Songkhla will be retarded and the investment officiency will be cut down to the far bellow.

Port facilities to be completed in the first stage, consist mainly of a - 5.5 m wharf with 5 berths, and a 8.0 m wharf with 2 berths and to connect them, another wharf with a berth of - 5.5-8.0 m in depth and a 260 m - long lighters' wharf of - 2.0 m with another wharf of 150 m long connection walls. To help their function efficiently will be arrenged were be some buoys, wharf equipment a wide basies of - 8.m deep, a for turning place of entered ships.

For the use of the port, additional facilities such as a sufficient number of sheeds and warehouses, port roads and railways, government offices concerned, water-works, and illumination facilities are necessary. The plan contains not all but rather the lowest limit capable of operating the wharf on land side.

Further for greater efficiency a pecentage of stevedores and those people who are charged with port management and operation should be near the wharf area ready to meet urgent business and emergencies, sites will have be prepared and secured as soon as possible for building offices to conduct business relative or indispensable to marine and land transport service.

Structure which requires the greatest care in carrying out the project is the entrance which consists of a training dike and a breakwater.

Any fault in the three steps "the location, the design and the execution of the work, any mistake during each step might cause severe damage, high cost and dismissal' of new port favour. Knowing the key of new port success depends on the degree of completed condition of these structures, so you are bound to be careful and carry out the survey of channel depth and structure itself as soon as had the flood attached or once a year at least for good maintenance aften the structure has been constructed. The first stage plan of the new port is explained in the interim report and illustrations are shown is Fig. 24.

Chapter 5. Management and Operation of the Port

The patterns of port management, being influenced by historical and social background of respective countries, are differnet in every countries.

In the present report, the benefit ratio of Songkhla port was estimated on the basis of the system of Bangkok Port and various charges imposed there.

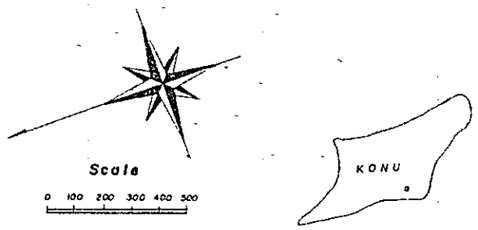
A sum of 17,400,000 U.S. Dollars is required for the construction of port facilities in the first stage is expected to yield 1.35 times the investment, even under severe terms of loan.

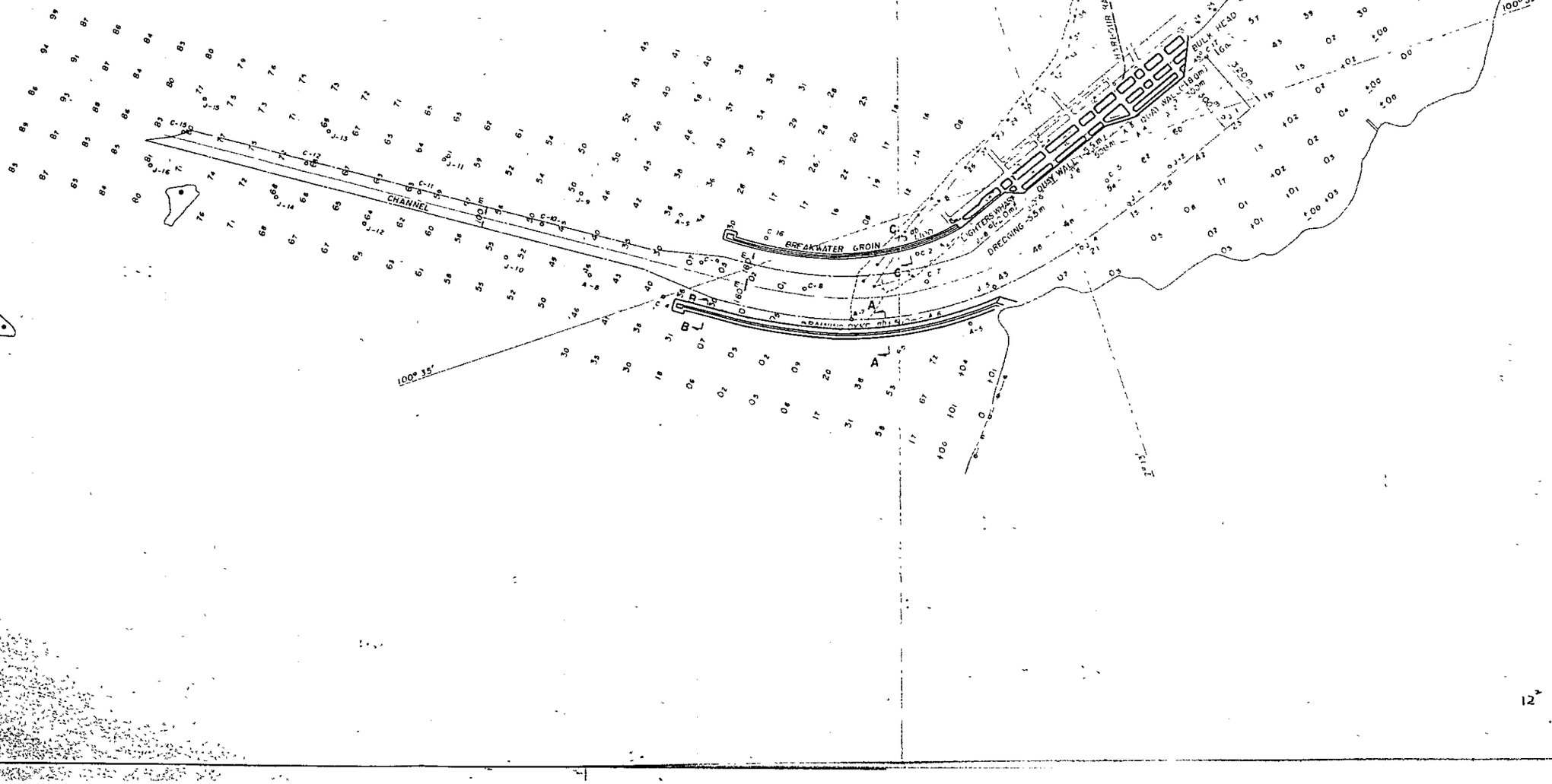
As sources of funds for refundment are calculated : creation and improvement of land adjacent to the wharf and its lerd or sale, revenues including port dues, demurrage, and landing charges, rents or charges for wharves and sheds, hires or fees for tug boats, ferry boats, cargo handling machines and instruments, fees for personnel services, such as offer of labor required for maneuvering of ships, handing of cargo, and various procedures, water and electricity and charges for water, electricity and telephone, and tax on individuals and enterprises receiving benefits from the port.

Government offices closely related with operation and management of the port which need to be established by the time the first stage work is completed are ; The port and harbour bureau which organize with general port affairs, construction works wharf control and planning and investigation, a customs office, branch offices of the health & sanitation office ; (quarantine, animal and plant inspection, an infectious disease hospital, etc.), the public safety office, (maritime and port police, fire control, gate-keeping, etc.). It is desired for smooth operation of port activities that business of various lines such as loading and unloading (stevedores, heavers, longshoremen), warehouse and transportation, various service establishments (shipping, domestic and oversea communication agencies, suppliers of water, oil, and fresh food stuff, financial institutions such as banks, pilots, tug and ferry boats), ship building and repair for larger ship and retailers are to get ready to enlarge or start their operation. Preparation along this line is recommended.

PORT OF SONGKHLA
GENERAL PLAN

stage I





PART II. THE SPHERE OF INFLUENCE OF SONGKHLA PORT

Fig. 1. Regional Division of Thailand.

PART II. THE SPHERE OF INFLUENCE OF SONGKHLA PORT

Chapter 1. The Background of Southern Thailand

Section 1. Present State of Southern Thailand.

Thailand is divided into four districts, as shown in Fig. 1, namely, Central, Northern, North-Eastern, and Southern Thailand, each with its own particular characteristics.

Central Thailand, which has the capital of Thailand, Bangkok, is a district of a high density both in economic and social terms. Nothern Thailand is generally mountainous and its main industry is agriculture and forestry, which are under strong influence of monsoons. North-eastern Thailand is the most densely populated district of the four and subsists on basin; agriculture.(see Table-1)

Southern Thailand extends over 600km from Chumpon Province, which borders on Bruma, to the Malaysian borders. It is connected with Central Thailand by a highway and a railway by air and by sea, and with Malaysia by two railways and three highways as well as by air and by sea. With agriculture as its mainstay, this district has long been known for its rubber plantations. In recent years, mineral products such as tin have come into the limelight as promising industry. Inter-communication with Malaysia is very brisk. Comparatively speaking, this district enjoys economic abundance.

In those regions of Southern Thailand which border on Burma, the part lying between the border line which runs through the Bilautaung Range (about 2,000m in altitude) and the seacoast is the narrowest. Via this narrow section, Central Thailand is connected with those regions of Southern Thailand that face the Indian Ocean, the fact responsible for land transport facilities remaining undeveloped.

Enjoying economic and social stability as it has for centuries, this district falls behind others, in its positive effort for development.

Malaysia's economic influence is markedly strong on the western region of Southern Thailand. The prosperity of Kantan and Trang seems to owe much to Malaysia. In Malaysia, major cities have developed on the western coast. Penang (population, 700,000) with a free port has attained a greater economic prosperity than was expected of its population.

Section 2. Examination of the Topography and the Foundation of Industry.

Mountain ranges in Southern Thailand generally run towards the western coast. While the western coast is full of indentations with many scattered island, the eastern and yellowish brown. Roads and railways run through the land a little to the east connecting Malaysia with the continental part of Thailand.

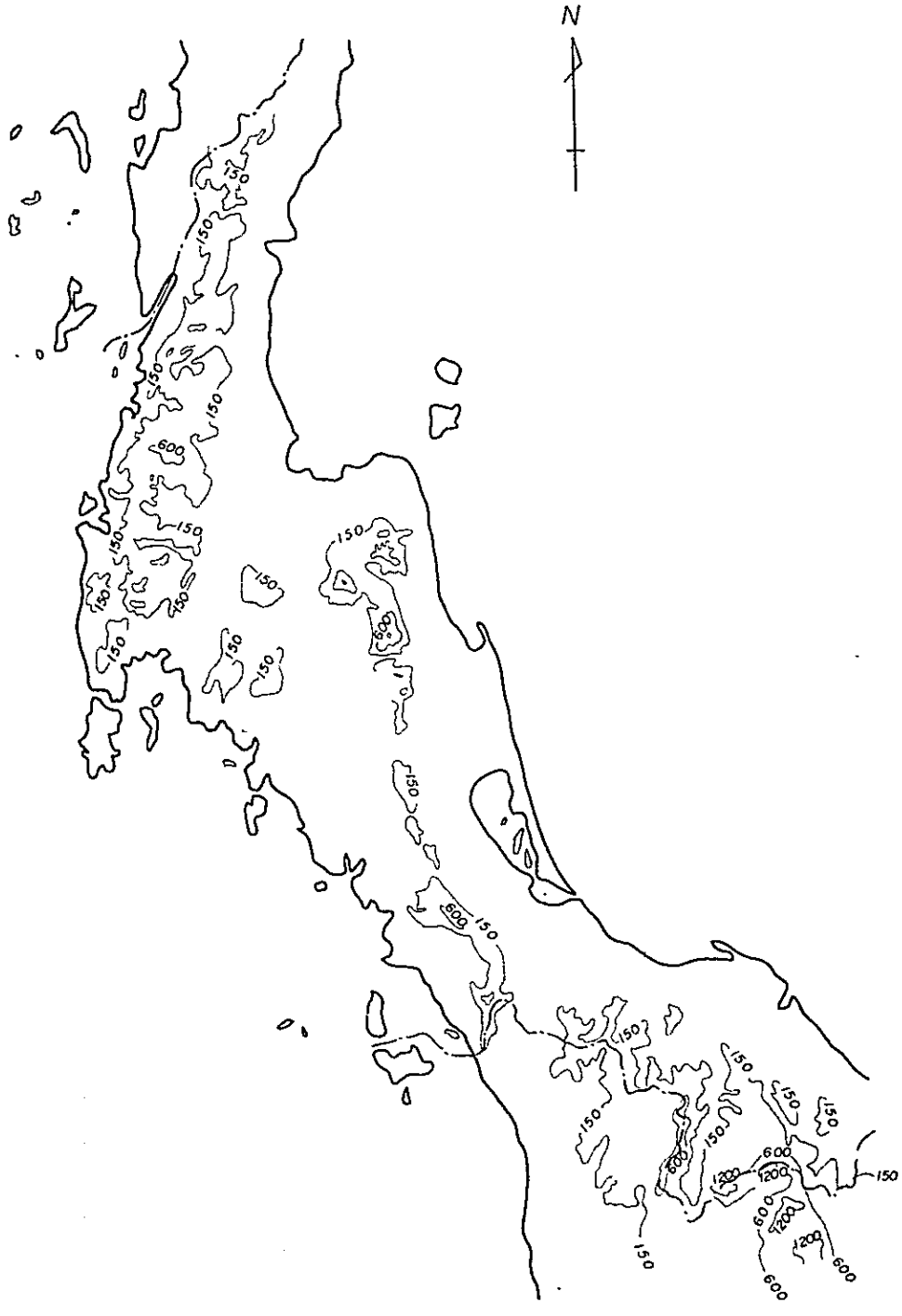
For industrialization of this part of the land, however, there is no need for constructing a dam to harness the river water, only if good underground water is obtainable. As for electricity, highly efficient thermalelectricity may well answer the purpose.

Out of the sea-site, new development can be made by carrying out dredging and reclamation, making it possible to construct a port and at the same time to create land sites for factories, as exemplified by many similar cases in Japan.

Viewed thus, there seems to be no fault in the physical environment of Southern Thailand that should allow the district to be left out in the second development programme as being far from the object of the programme.

Already a suitable site for construction of a dam has been found near the Malaysian border. If it is easy to construct a port at Songkhla, it and its vicinity should be the place to take the lead in the modernization of Thailand. All member of the survey team take up this place willingly as the first candidate for development as a port town with potential for an industrial port.

Fig. 2. Rough Leveling of Southern Thailand.



Section 3. What is Expected of Southern Thailand.

The other three districts while bordering one another but each with its own characteristics, form one continental district topographically, Southern Thailand, connected with Central Thailand by a narrow strip of land, stretches down the peninsula far into the south. What part South Thailand can play in accordance with the objectives of the second five-year programme for economic and social development now under way in Thailand, should be a problem worthy of study from the geographical, topographical and economic standpoints.

The first six-year development programme of Thailand has been crowned with remarkable success in many fields, but more effect will be expected, especially in Southern Thailand, in the way of contribution in this connection.

Southern Thailand would rather be regarded, in terms of transportation, as an island isolated from the continental part. Its geographical position lead an enormous amount of capital investment such as roads and railways in past time, which constitutes the foundation of industry in the continental districts. Lying as it does between the Indian Ocean and the South China Sea, however, it is in a position to connect the two seas by the shortest route. Its position is quite similar to that of Japan, which in post-war years reaped most conspicuous results in its post-war insustrial development by means of a processing trade.

It requires a vast amount of capital and a long period of time to realize over-all development and improvement of the continental districts, Southern Thailand, it should be noted first of all, becouse of its position is very advantageous to sea transportation, is not only well situated but posses necessary factors alike in turning its key spots into land suitable for factory sites in a short time and concentratedly by depending upon external trade and thus to make them important bases to start a long-term development of the continental districts.

By way of setting an example of materializing the above idea at a possible cost, there ought to be an attempt at constructing a port somewhere in Southern Thailand. For a site, a place which opens wide for sea transportation would most appropriate, somewhere on the Gulf of Siam, on the eastern coast.

Table－1 Economic and Social Situation of South Thailand

(1) Land Area

Item / Region	Area (Km^2 and %)	
Whole Kingdom	514000 Km^2	100.0 %
Central Region	103579	20.1
Northeast Region	170226	33.2
North Region	170006	33.1
South Region	70189	13.6

(2) Population

Region	(A) Population of 1947		(B) Population of 1960		(B)/(A)	Population Dnnsity (Persons / km^2)	
						1947	1960
Whole Kingdom	17,422,689	% 100.0	Persons 26,257,916	% 100.0	1.51	34.0	51.1
Central Region	5,428,397	31.1	8,271,302	31.5	1.52	52.5	80.0
Northeast Region	6,210,281	35.5	8,991,543	34.3	1.45	36.6	52.7
North Region	3,693,211	21.2	5,723,106	21.8	1.55	21.7	33.7
South Region	2,110,800	12.2	3,271,965	12.4	1.55	30.1	46.6

(3) Agriculture

Item / Region	Agricultural Labours and Their Ratio in whole Population (1960)		Agricultural Households (1960)
		%	
Whole Kingdom	19,589,705	74.5	3,410,309
Central Region	4,531,489	54.8	789,632
Northeast Region	7,940,607	88.4	1,300,460
North Rogion	4,532,679	79.1	833,856
South Region	2,584,930	79.3	486,361

(4) Rice Production

Item / Region	Rice Production						1964/1960 of Rice Production		
	(C) (1960) Harvested area of	(D) 〃 of (1964)	(E) (1960) Production of	(F) 〃 of (1964)	Unit Productivity (G) 1960	(H) 1964	(D)/(C) Harvested area	(F)/(E) Production	(H)/(G) Unit productivity
	1,000 Rai	1,000 Rai	1,000 Ton	1,000 Ton	Kg/Rai	Kg/Rai			
Whole Kingdom	35,270	37,469	7,835	9,625	222	257	1.06	1.23	1.16
Central Region	11,942	11,981	2,874	3,430	240	286	1.00	1.19	1.19
Northeast Region	13,870	14,417	2,295	2,634	165	190	1.04	1.17	1.15
North Region	6,761	7,874	2,026	2,660	300	338	1.16	1.31	1.13
South Region	2,691	3,197	40	841	238	264	1.19	1.32	1.11

(5) Other Production

Item / Region	Rubber Production 1963	Tin Production 1964
	Ton	Ton
Whole Kingdom	133,879	21,635
Central Region	7,775	464
Northeast Region	—	—
North Region	—	—
South Region	126,098	20,693
not classitied	6	478

(6) Land Use and Coast Line

Item / Region	Land Use (1963)					Coastal Line Length		
	Paddy field Cropped or Harvested	Copse	Plateau	Wood	Others	Gulf of Thai	Indian Sea	Total
	%	%	%	%	%	KM	KM	KM
Whole Kingdom	75.6	12.3	0.8	8.5	2.8	1,874.8	739.6	2,614.4
Central Region	83.4	8.0	0.7	4.6	3.3	941.8	0	941.8
Northeast Region	82.6	2.1	0.6	12.4	2.3	0	0	0
North Region	86.8	3.7	0.3	5.9	3.3	0	0	0
South Region	33.4	52.5	2.1	9.2	2.8	933.0	739.6	1,672.6

(7) Municipialization

Item / Region	Municipal Population (I) 1960	Municipal Population (J) 1963	Municipal Ratio (I)／(B) of (2)	Municipal Growing Ratio (J)／(I)
	Persons	Persons	%	
Whole Kingdom	3,273,865	3,863,216	12.5	1.18
Cetlral Region	2,265,092	2,745,507	27.4	1.21
Northeast Region	312,175	345,165	3.5	1.11
North Region	367,335	399,213	6.4	1.09
South Region	329,263	371,331	10.1	1.13

(8) Education

Item / Region	Primary+Secondary (K) 1962	Primary+Secondary (L) 1964	Private School (M) 1964	Educational Ratio (K)／(B) of (2)	Educational Growing Ratio (L)／(K)
	1,000 Persons	1,000 Persons	1,000 Persons	%	
Whole Kingdom	3,676	4,106	772	13.9	1.12
Central Region	1,040	1,182	508	12.6	1.14
Northeast Region	1,333	1,435	81	14.8	1.08
North Region	831	955	96	14.6	1.15
South Region	473	534	87	14.5	1.13

Chapter 2. Outline of the Economic Situation of Southern Thailand and Its Future.

Section 1. Agriculture.

In Southern Thailand, the acreage under cultivation is very limited and more than half of the whole area remains forested with miscellaneous trees. As if to make good this unsatisfactory situation, the fishing industry is thriving.

Statistical figures by provinces are given in Table 2. (page-25). As is clear from Tables 1 and 2, the land productivity of Southern Thailand is one the average almost equals with that of the whole of Thailand, but productivity per man of the agricultural population is far below that of the whole of Thailand. The per-family average acreage under cultivation, which is about 6% of the total average of Thailand, differs widely from province to province ranging from 2.11 rais to 11.05 rais. Since the per-family acreage under cultivation is relative to per-man productivity, there is every hope of expecting for rapid improvement of its agriculture by expansion of the acreage under cultivation and improvement of productivity.

(1) An estimation of the production and consumption of rice in each province has been, caluculated and is shown in Fig. 3, according to which two provinces, Nakhon Si Thammarat and Phatthalung, show a large surplus of production over consumption, while the rest show an approximately balanced production and consumption, though with some shortage of production.

Yet it is clear that for Southern Thailand as a whole, production and consumption of rice are well balanced.

Method of Estimating Rice Consumption

(1) The output of rice *unhulled) of Thailand as a whole in 1963 was 9,856,000 tons, of which 2,148,000 tons were exported, the balance 7,708,000 tons being for home consumption. This 7,708,000 tons divided by the estimated population of 29,953,000 worked out 258kg., which was the consumption of rice (unhulled) perman of population. Actually, an allowance of 670,000 tons must be made for seeds, feeds and loss in transit, and a further 34% loss must be calculated in getting cleaned rice. Thus per-man consumption of 115.1kg. was obtained. But here we have taken for per-man consumption the above 258 kg., that is, production less exports, and by the number of population of each province, the estimated consumption of rice of each province has been calculated. Fortunately, even in the case of provinces where production is short of consumption, the shortage is very small. With improvement in agricultural technique and positive use of fertilizer, each province will be able to establish a self-suffiency system and as a result, there will be no need for transporting surplus rice from Nakhon Si Thammarat and Phatthalung to other provinces.

(2) Next in importantance to rice in Southern Thailand is rubber, which accounts for 92% of the national total in the number of rubber plants planted and 94% of the nation's total production of rubber. But at present plants are now too aged to expect anything but a gradual increase in out-put.

With the cooperation of the United Nations, the Government of Thailand has been making efforts to select a suitable variety of plants and to improve plantation technique. If prices are to be expected to rise in the near future, increased production will also be expected.

Here, as in rice, the question is the limited acreage of plantation per family, which is now proving a deterrent to re-planting. Replantation means a great loss in income over a period of 8 to 10 years, which is the time required for a rubber plant to begin its yield. A large scale of management and disposal of aged plants is essential, as in the case of rice.

(3) Coconuts and palms, though not valued as cash-earning plants, are fit for planting in the tropical zone and their planned increased production, along with that of olive plants and other oil plants, may be recommended as oil crops. Study of some measures for encouragement in planting maize, tapioca and kaoliang as feed crops and sugar canes and jute for exports may well be worthwhile, provided suitable sites are found.

(4) Forestry and Livestock Industry.

Nothing worthy of note is found about the forest industry in Southern Thailand. Teak wood is an exclusive product of Nothern Thailand. In Southern Thailand, forests seem to be left to grow by themselves, without being tended.

There now seems to be a move to make old rubber plants into chips to fill a shortage of forest resources in Japan.

Since this district is favoured with climate and physical conditions conducive to fast growth, it will be worthwhile to study selection and planting of suitable kinds of plants in such places as will be convenient for carriage, thus finding a new source of cash earnings.

Apart from hogs, the keeping of which is a taboo for the Islamite, the raising of other kinds of livestock and poultry may be encouraged as a source of income for farmers who are living developing circumstances

Table 2. Statistics on Agriculture of Southern Thailand

	Population (a) (persons)	Agricultural Population (b) (persons)	Ratio of (b) to (a) (%)	Total Number of Households (c) (households)	Total Number of Agricultural Households (d) (households)	Ratio of (d) to (c)	Acreage of Land (Rai)	Acreage of Land Under Cultivation (Rai)	Rice Acreage (Rai)	Production of Rice (ton)	Per Unit Production (Kg/Rai)	Average Acreage Under Cultivation * (kg/household)	Average Production ** (ton/household)	Production Per-Head of Farming People (190) (kg/person)
Chumphon	175,284	139,101	79.4	32,943	26,565	80.6	602,662	171,063	133,546	27,140	203	4.53	1.17	207
Ranong	37,628	22,596	60.0	6,953	4,228	60.8	60,880	19,079	14,784	3,661	252	3.36	0.60	94
Surat Thani	324,784	269,743	83.0	59,489	49,265	82.8	1,360,428	441,535	275,070	83,931	305	5.28	1.60	171
Phang-nga	93,119	67,663	72.7	16,214	11,561	71.3	365,942	65,851	55,789	16,904	303	4.37	1.20	182
Nakhon si Thammarat	730,401	614,691	84.2	128,813	107,657	83.6	2,520,113	1,210,051	937,656	247,936	264	8.43	2.25	365
Phuket	75,652	36,522	48.3	12,309	5,916	48.1	148,694	13,602	13,023	3,161	243	2.11	0.52	81
Krabi	93,895	84,912	90.4	17,299	15,597	90.2	506,370	121,317	91,661	23,144	252	5.81	0.95	222
Phatthalung	233,844	213,954	91.5	43,626	40,022	91.7	857,382	447,875	473,664	148,795	314	11.05	2.53	443
Trong	240,463	193,682	80.6	43,177	34,694	80.3	984,494	186,505	161,370	40,745	252	3.84	0.97	211
Satun	69,639	57,367	82.4	13,479	11,048	82.0	240,406	76,426	71,296	12,151	170	7.72	1.43	239
Songkhla	500,285	370,552	74.1	96,913	73,016	75.3	1,677,051	580,856	512,500	130,260	254	5.03	0.99	258
Pattani	281,587	219,537	78.0	59,239	46,673	77.1	572,440	205,030	256,131	55,647	217	5.05	1.21	145
Yala	149,348	106,220	71.1	30,384	21,891	72.0	651,527	74,639	78,000	23,634	303	3.23	0.69	123
Narathiwat	266,038	188,390	70.8	55,817	39,228	70.3	764,087	169,598	122,659	24,077	196	3.35	0.68	120
Total (Southern Thailand)	3,271,965	2,584,930	79.0	616,655	486,361	78.9	11,321,474	3,783,427	3,197,149	841,186	263	6.01	1.45	246
Total (Thailand)	26,257,916	19,589,705	74.6	4,616,654	3,410,309	73.9	69,630,959	52,637,052	37,469,247	9,624,631	257	10.35	2.35	400

* Rice Acreage in 1960 Total Number of Agricultural Households in 1961 (Rai/household)

** Production in 1961 Total Number of Agricultural Households in 1960 (t/household)

Fig. 3. Output & Consumption of Rice in Southern Thailand by Province.

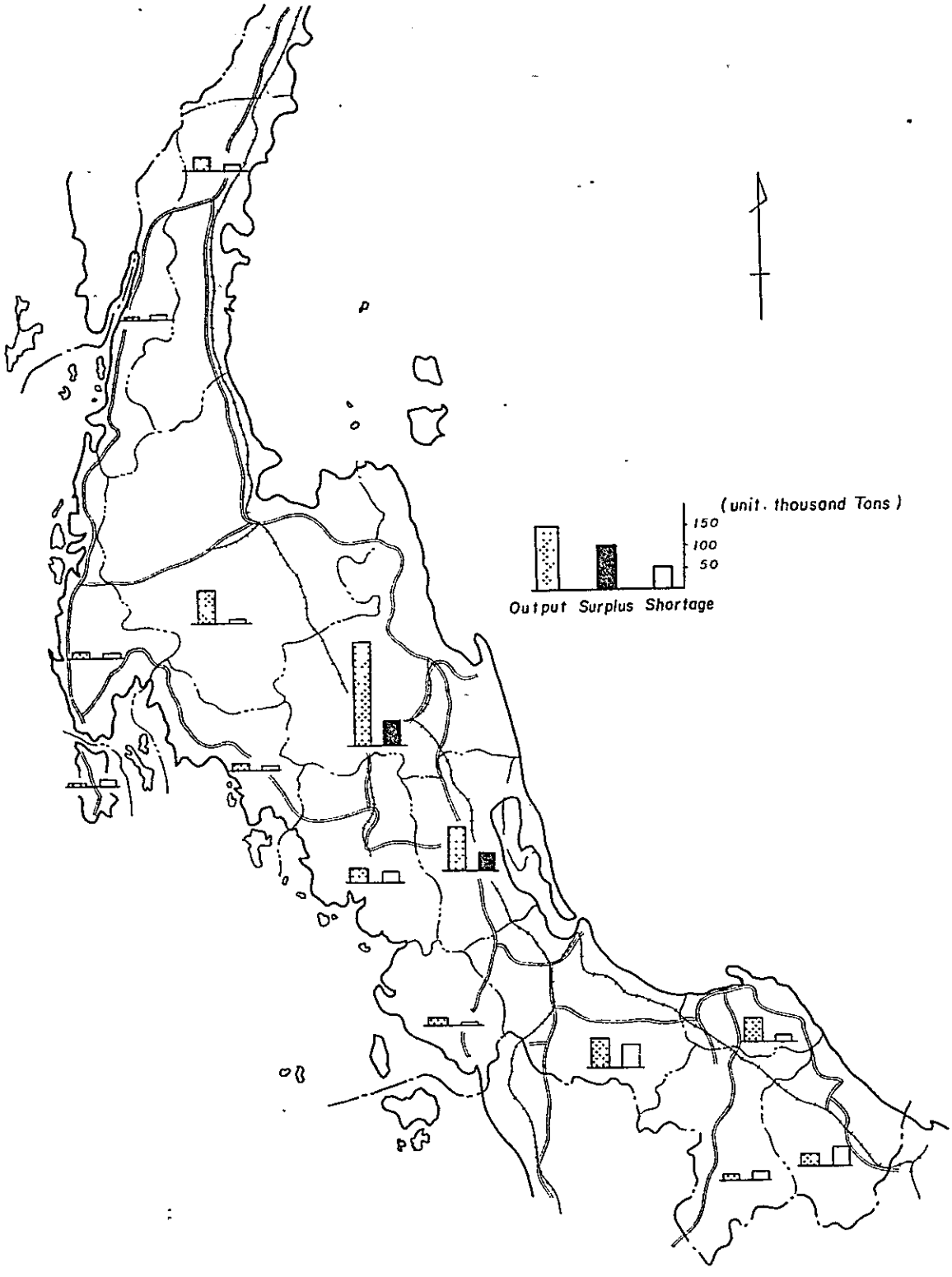
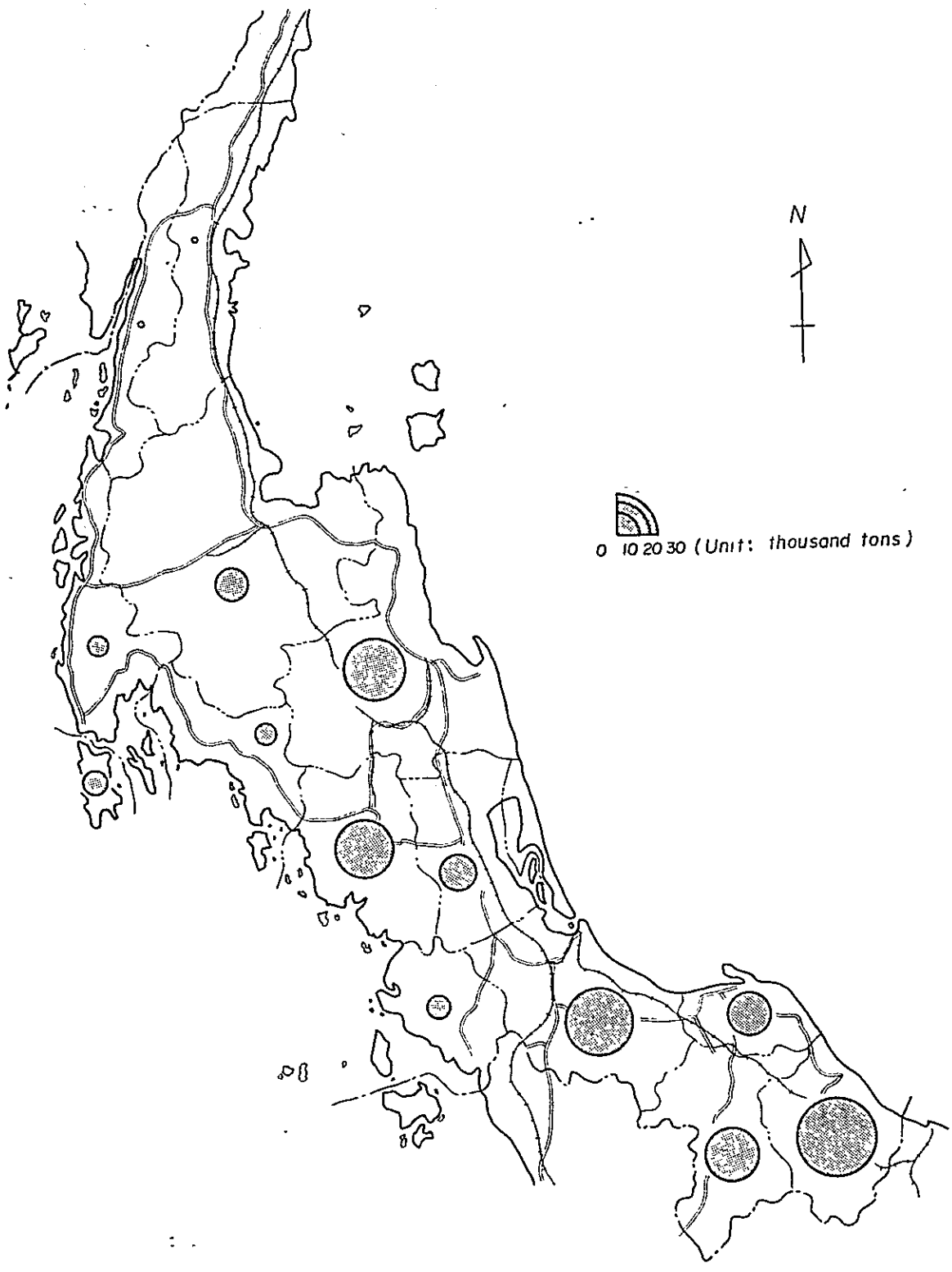


Fig. 4. *Output of Rubber in Southern Thailand by Province*



Section 2. Fishery

Coastal fishing is so primitive that setting a fixed net on a shoal is the only means of fishing. The fish market is very limited. The fishing-boat base has no ice manufacturing plant or refrigerating facilities nor is there any transport means to carry fish to other places. Along the coast of the Gulf of Siam, when a northeastern or eastern wind is blowing, high waves often stop fisherman from going out. On the western coast, fishing boats are too small to withstand the monsoons.

It is only recently that investigation into fishing grounds in the Gulf of Siam was started. Problems concerning the fishing industry, including fishing ports are to be solved in the future.

Fresh-water fishing has seen much development in the Lake of Songkhla and lobsters, prawns and other aquatic animals are caught in such a large quantity that some of them are now exported. Fish processing still remains at a primitive stage. Fish farming is a problem for the future.

The annual catch of lobsters and prawns, which stood at only 600 tons in 1960, has in recent years grown to 1,200-1,300 tons of medium-sized and 4,500 tons of smaller ones, in addition to a catch of larger ones, though small in quantity. Such large catches were attained with full consideration given to preventing reckless fishing and conservation of resources. It is expected that some 5,000 to 6,000 tons annually will be possible in the future.

Lobster and prawn breeding was once tried but ended in failure, showing that it was not for a private enterprise to undertake They are now left to grow by themselves. As for their market, large ones go to Bangkok and Japan and smaller ones are mostly for home consumption. Processing of various forms is now being studied, such as freezing, pasting, and drying in the sun. Some hope is held for shellfish.

What should be noted about the fishing industry is that fish caught over a large extent of fishing grounds are landed at Songkhla Port. In general hauls are landed at the nearest ports. But Songkhla Port has cold storage facilities, an abundance of ice and a lot of dealers, and in addition, it is the best fishing port on the eastern coast. This is reflected in the fact that almost all hauls in the waters between Nakhon Si Tharammat and Songkhla were landed at Songkhla.

Due to insufficient shipping service for export and poor port facilities, most catches are currently passing through Penang. This is because the shipping system of Songkhla is less developed than that of collection.

It would be difficult, however, to realize prompt improvement of these facilities. Prawns and lobsters are so expensive that a small waste in freightage will not affect their ultimate price of sale. A round-about way of transport will not affect their quality, either. Hence they tend to turn to better facilities for transport. To utilize the Port of Songkhla for these goods is one of the objectives of the Port Construction Programme, and our report is being prepared with that in mind.

Section 3. Mining

Southern Thailand abounds in mineral resources, such as tin, antimony, lead, manganese and other non-ferrous metal deposits. Above all, rich deposits of tin ore are found on Puhket Island and in other places, turning out a total of about 30,000 tons annually and holding third place in world production of refined tin.

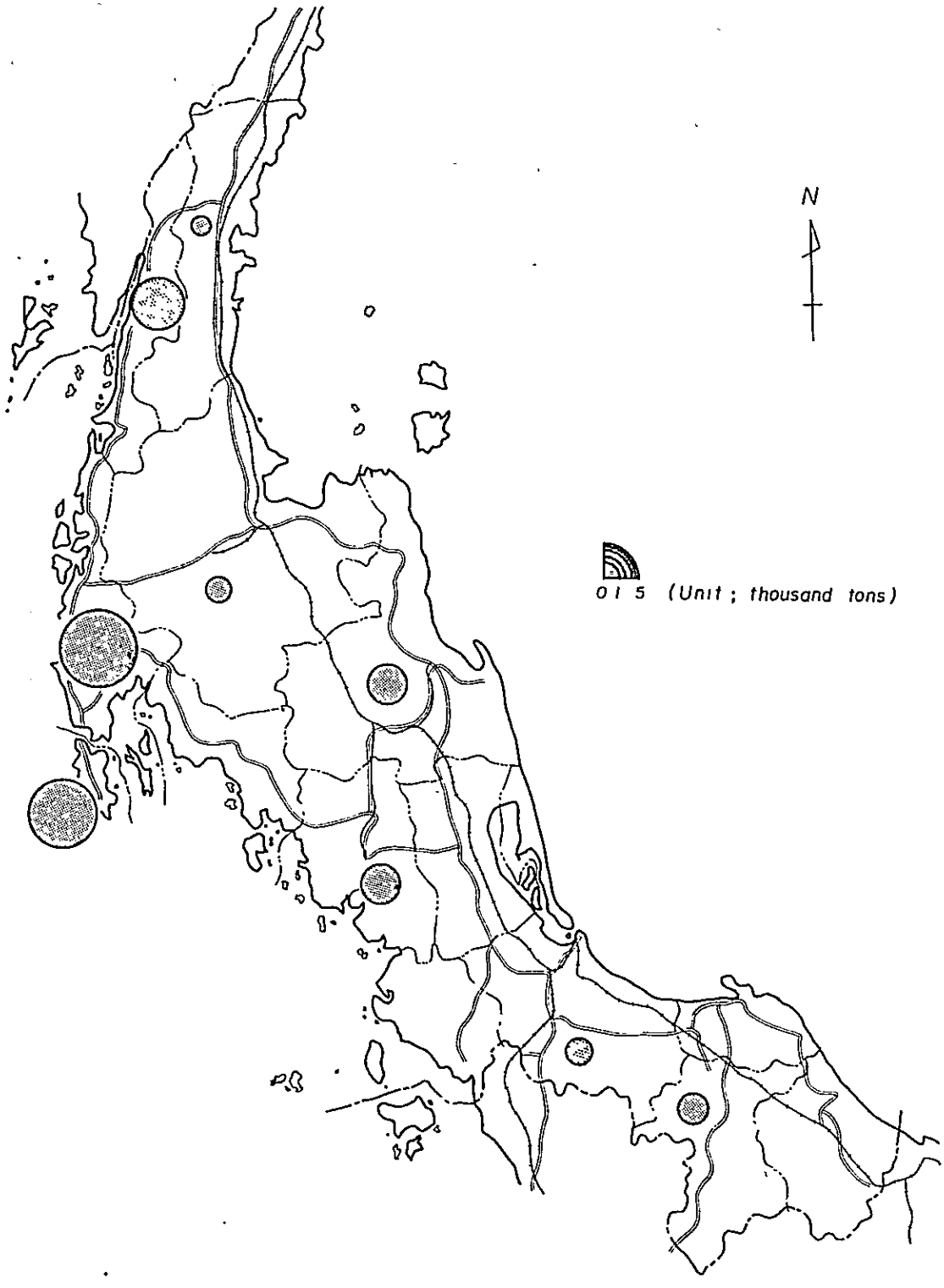
Except for tin and manganese, however, Southern Thailand is rather backwards, prospecting operations being carried out mainly in Northern and Northeastern Thailand.

Around Songkhla, the most advanced on the basis of quantity produced is silica. Deposits of silica are found along the coast between Songkhla and Yana and are estimated at 15,000,000 to 30,000,000 tons, and currently 10,000 to 20,000 tons of silica are turned out annually. Silica is shipped to Bangkok, where it is forwarded to the interior region to glass foundries. As is clearly seen from its reserves, silica is one of the hopeful mineral resources and positive effort will be made for increased production in the future.

Second to silica in the quantity of production is manganese. Its deposits are found at a point about 60 km inward from Songkhla and are estimated to amount to about a million tons. The quantity now being mined runs at 5,000 to 10,000 tons annually, the all-time high attained being 3,000 tons a month. With the present mining capacity, an annual production of up to 100,000 tons may be expected, but its market is confined almost only to Japan and the quality is not always up to the standard (currently priced at U.S.$ 13/t), the fact which accounts for the present small quantity produced.

New deposits of tin and barite have been found in this region, foretelling rich underground resources in the region.

Fig. 5. Output of Tin in Southern Thailand, by Province



Section 4. Manufacturing Industry.

The proportion of the national output of the manufacturing industry to the national gross product is about 12%. The Government of Thailand, with a lively interest in the development and modernization of the national economy, is going ahead with its measures for the promotion of the manufacturing industry as constituting the most important part. By way of bringing up private industries, the Government has taken a policy of adopting the government management system where an enterprise is a pioneer in a branch of industry and, when it is able to stand on its own, of transferring it to private management.

Most industries in Thailand are located around Bangkok. In Southern Thailand, tin refining, rubber processing, shipbuilding, machine repairing, and foodstuff manufacturing are dominant industries, and that mainly to meet the local demand.

Looking back on the past development of industry, there were two kinds of development ----one prompted by the urge to process in a higher degree such natural resources as tin and rubber for export and the other prompted by the necessity to fill the demand of the local inhabitants, such as foodstuff.

Future development conceivable should reasonably be along the line of new exploitation of local underground resources, such as aiming,. at a higher degree of processing silica and manganese, at planting and processing oil plants, fiber crops and feed plants, and at cutting down timber or making it into chips.

Improvement of the living standards and high-pitched economic activity should naturally call for development of the foodstuff industry, fiber industry, construction material manufacturing industry, repair and assemblage of vehicles, large-scaled shipbuilding industry, electric machine manufacturing industry, etc. As industrialization progresses, there will be the organization of the processing trade system, importing raw materials and exporting finished goods in return.

Section 5. Construction Industry and Others

With its agriculture, forestry and fishery industries, and mining and related industries promising great development in the future, Southern Thailand, and especially Songkhla and its vicinity, is bound to see a large increase in demand in the construction industry as those industries continue to develop.

Even within a rather limited scope of this team's field investigation, construction interests were seen thriving, building hotels in Haad Yai and dwellings in Songkhla, as was clearly seen in the structure of the borrowers of Haad Yai Branch of the Bank of Bangkok.

Roads and ports have a great deal to do with economic and social development, and yet these means and facilities which constitute the foundation of national activities cannot be said to be in a satisfactory condition in Southern Thailand. The future holds great demand in this field of construction industry.

Consolidation of roads and ports will naturally bring with it activities in commerce and banking business, to say nothing of development of transport and communication services, and a large increase in demand for water and electricity will follow.

Songkhla's supply capacity of water currently stands at 1,200m^3/ day and that of electricity at 1,200KW at the maximum, both short of demand. Increase in quantity and improvement in quality are the pressing needs at present.

City planning should be established and the administrative organization should be enlarged in order to forestall confusion in cities which may accompany expansion of urban-areas.

Fig. 6. (1) Provincial Population and its Density in Southern Thailand.

Population Density in 1947

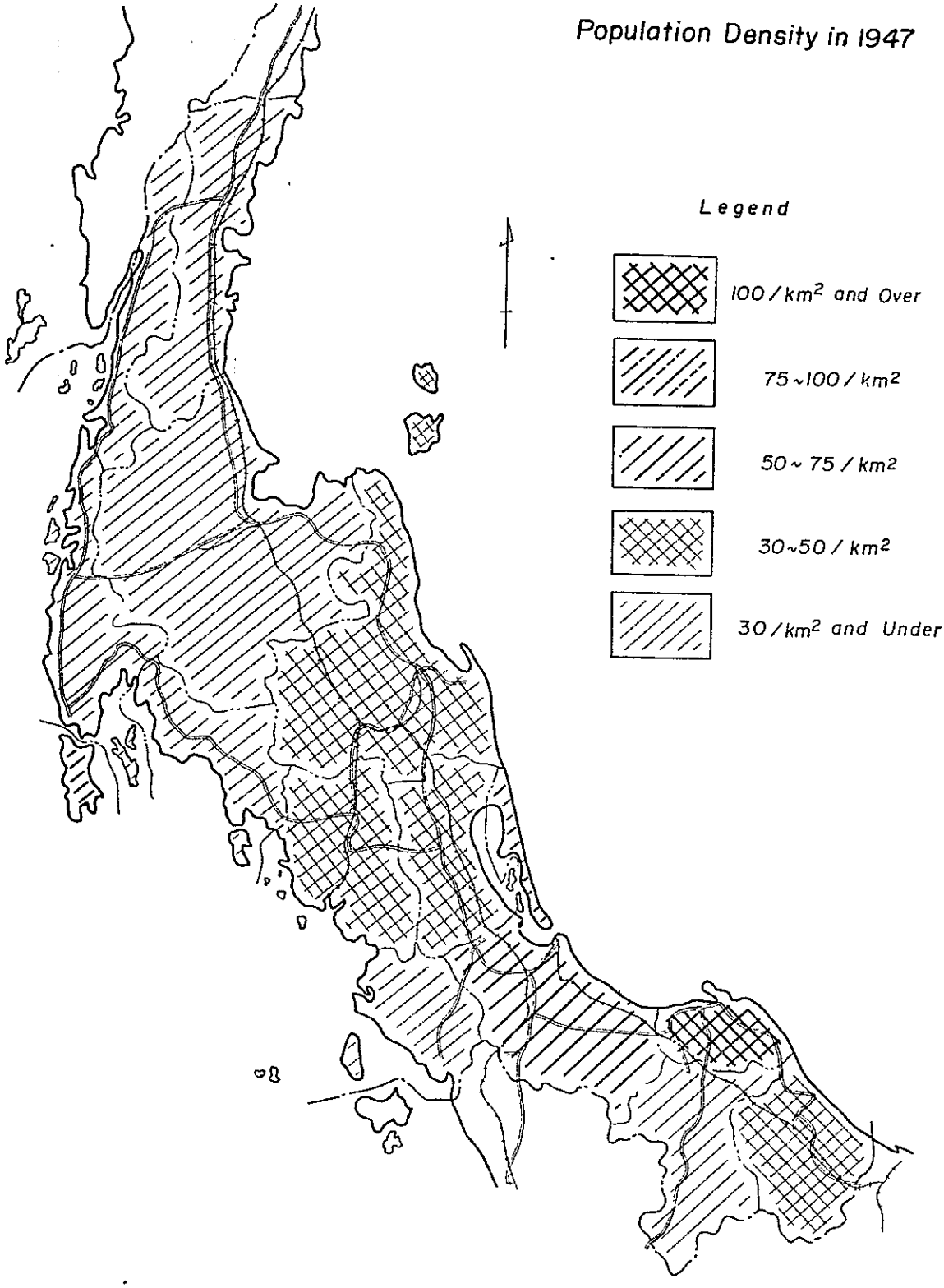


Fig.6.(2) Population Density in 1960

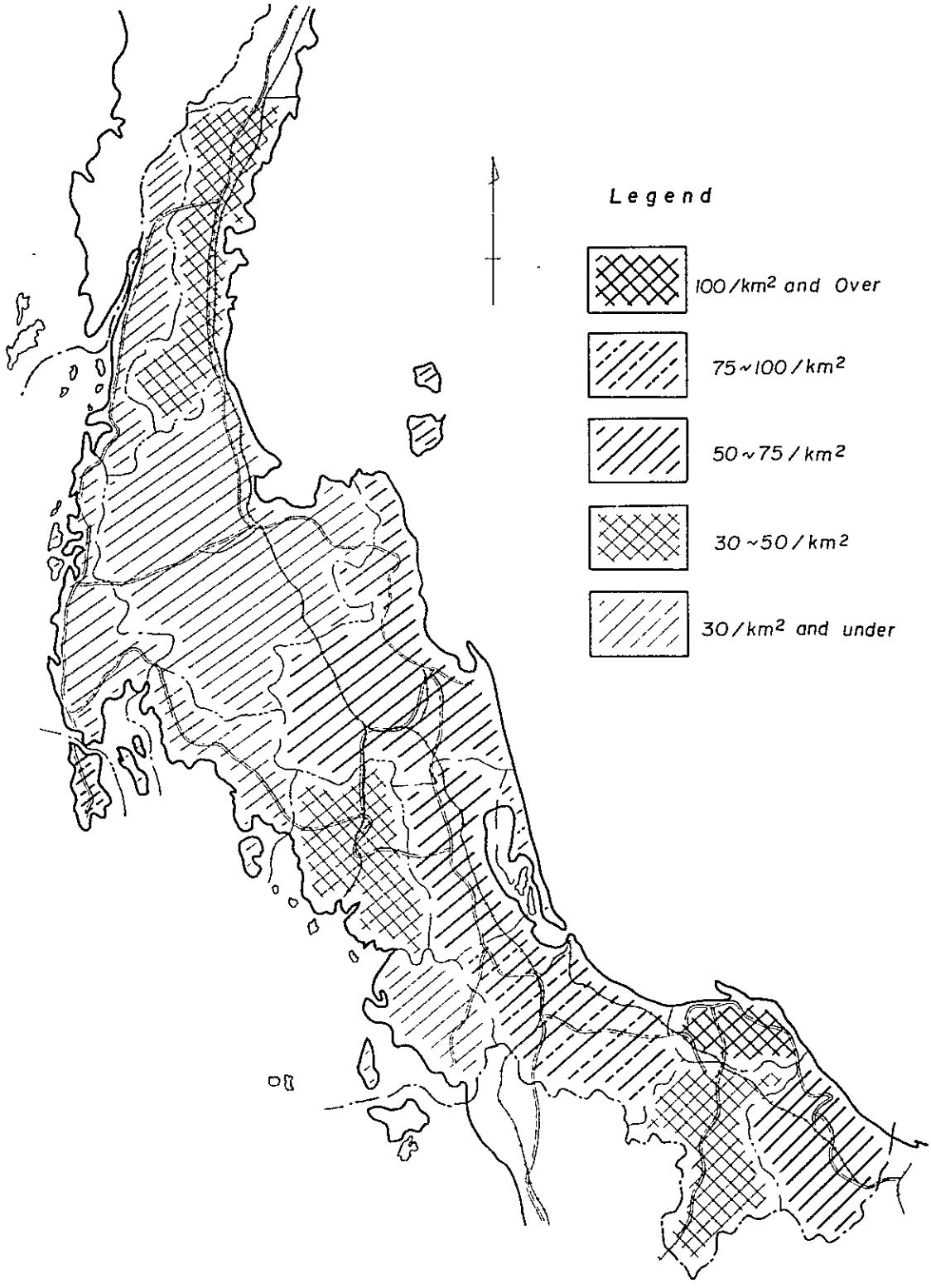


Fig. 6.(3) Population by Province, in 1960

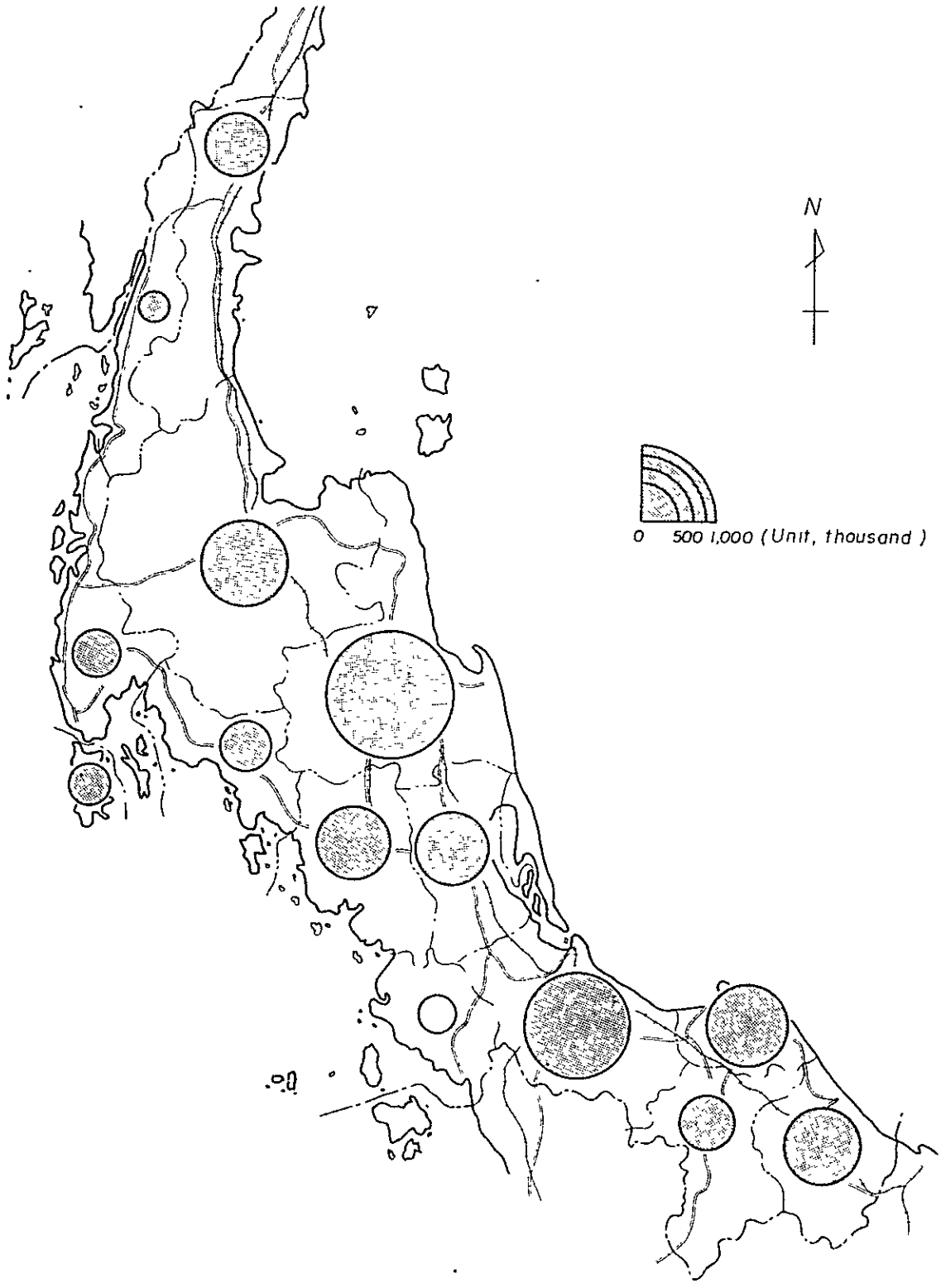


Fig. 6. (4) Population Growth by Province

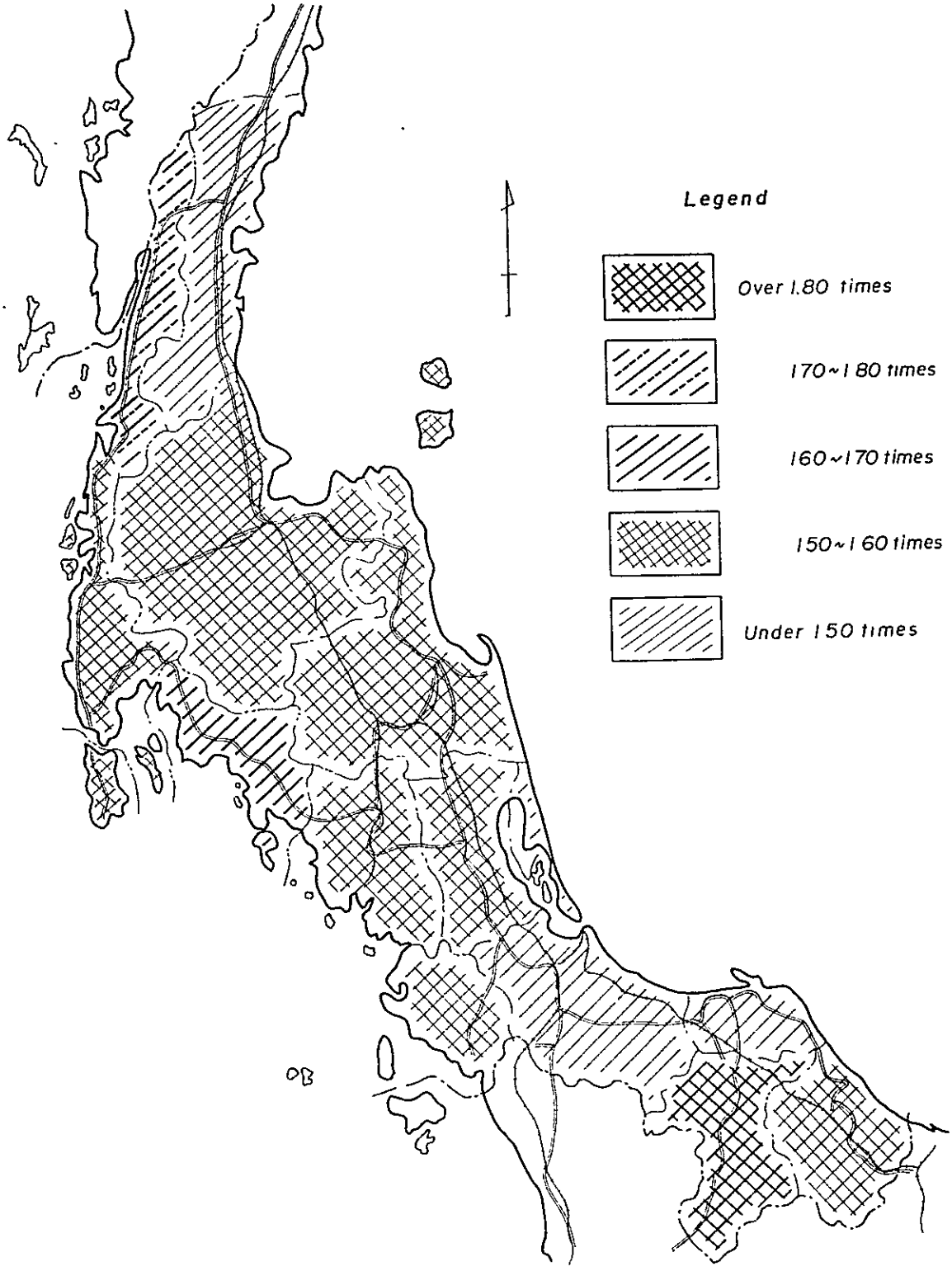
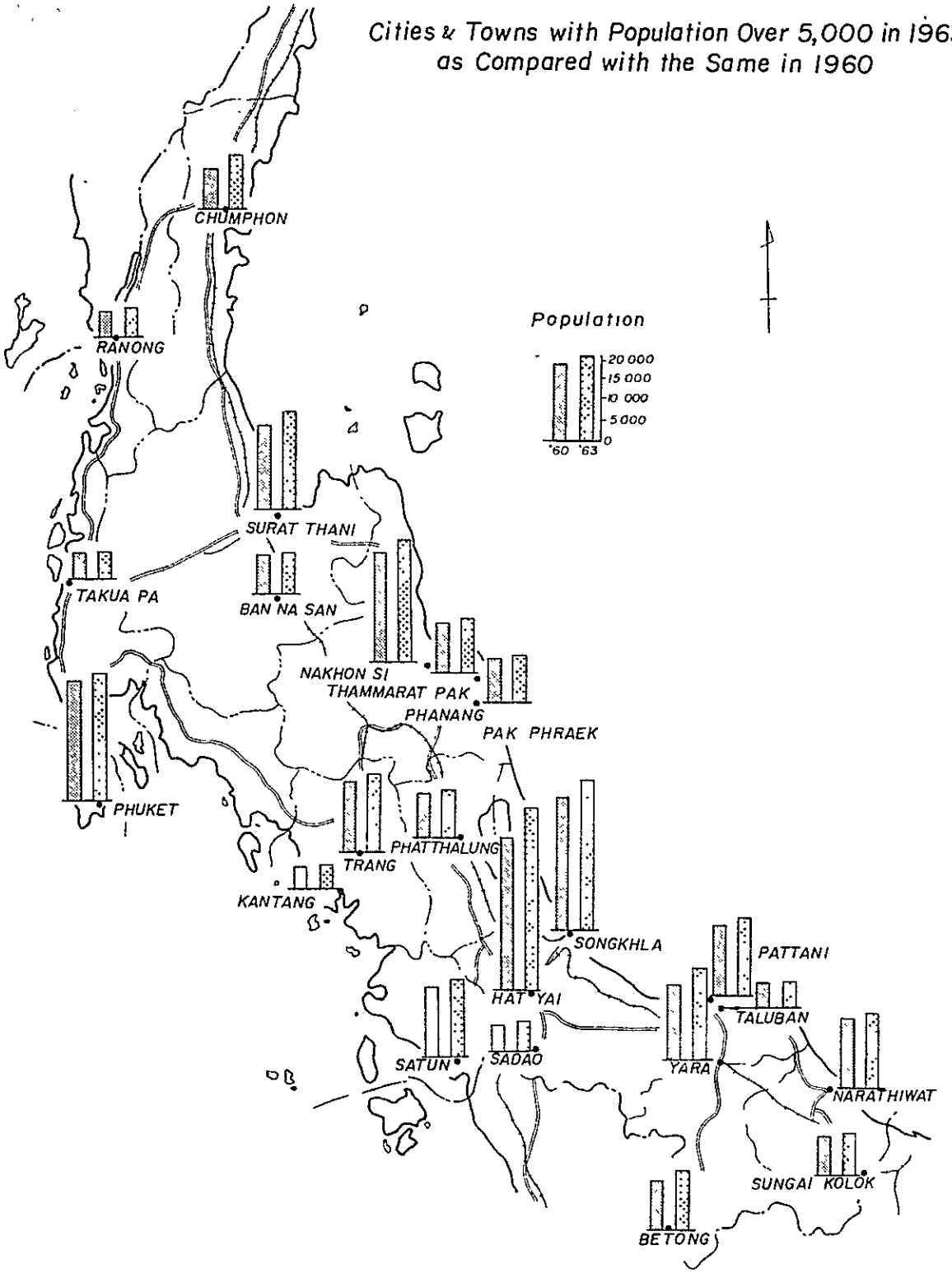


Fig. 7. Cities & Towns in Southern Thailand and their Population



Chapter 3. Social Environments and Their Future Outlined:

Section 1. Population in Cities and Towns

The population, its growth, and its density in provinces in Southern Thailand are shown in Table 3 and Fig. 6. In number, Nakhon Si Thammarat Province tops the list, and in density, Pattani Province, those along the east coast from Pattani through Songkhla to Nakhon Si Thammarat being well over the national average of Thailand. In growth rate, the provinces on the west coast from Trang to Suratant are higher than the nation-wide average, and Yala and Ranong in particular stand out.

The high density of population in the provinces on the east coast and the high rate of growth in those on the west coast is probably explained by the fact that those on the east coast have had a large concentration of population from earlier, while those on the west have seen large increases in population in recent years due to the rise in tin mining and increased communication with Malaysia. Concentration of population in cities is a barometer of modernization of the life of their inhabitants. Concentration of population in cities in Southern Thailand, as shown in Table 4 and Fig. 7, is far greater on the east coast than on the west both in number of cities and towns and in size of population. In growth rate of population in cities, the east coast also surpasses the west.

The municipal sphere of Songkhla and Haad Yai combined, has the largest populatior on the east coast, and, with the densely populated provinces of Phatthalung, Yala, Pattani, and Nahkon Si Thammarat in the background, forms an environment of high economic concentration.

Section 2. The Living Standard.

Growth in living standards is proportinate to the progress of urbanization. In Thailand, Bangkok enjoys, as may well be expected, the highest living standard. Within the scope of our investigation in Southern Thailand, Living standards seemed to be the highest in Haad Yai, as judged from the expanding area of the city, the size of its shopping center, and variety of articles. Radio and television sets are still to be diffused among the average families, but most large stores and hotels are found equipped with them.

Many of our members who have paid a visit to or stayed in Thailand were surprised to find a marked difference in things about shopping centers in Haad Yai and Songkhla from what they had seen two years before. The establishment of taxi companies and the increased number of barber shops and drug stores show the two year improvement in the standard of living in the cities.

Noteworthy, is the economic activity in Trang and Kantang on the west coast although it is impossible to make a numerical comparison in the concrete because of the lack of statistical figures to show the economic power of cities(for example, the number of stores and their sales proceeds) in our recent investigation. Stores are poorer than those in Haad Yai in appearance, but an abundance of articles in shop-windows and a variety of trade show what economic potential the city has.

There is no denying that with all their economic activity, the living standard in Southern Thailand still remain low. Mechanics and welders, who are treated as the most skilled technicians, get monthly wages of only 700 to 1,000 bahts, offices girls 500 to 600 bahts, and ordinary workmen 12 to 20 bahts daily.

The city dwellers living standard may be said to be fairly high, proportionate to the above incomes, but in villages it is much lower.

Seeing that those living only a few hundred meters away from the national highway show a fairly great difference in living standards from those living on the national highway, the number of village dwellers who will move into cities will cause a differance in the consumption of goods of the whole region and consequently in the quantity of goods handled at the port.

The standard of living in villiages is said to be remarkably different from that of two years ago. It is believed that an increasing number of those experiencing city or military life, together with the development of roads, will help to raise the living standards rapidly.

Section 3. Religious Environment.

Thailand was originally a Buddhist nation. In Southern Thailand, however, many Islamic villages are found here and there, around or surrounded by Buddhist communities. In so far as our investigation was concerned, there was no sectarian feud or strife felt or seen between them ; on the contrary they were on such good terms, rarely witnessed anywhere else in the world. People of two different religions, each with a strong tradition, are bound to form different customs and have different ways of thinking. When we think of it, it will be interesting to see how their coexistence will work on the urbanization and modernization of the communities in the future.

Speaking from somewhat of a different angle, introduction of modern thought accompanying diffusion of radio and television sets may have great influence on the development of society.

Section 4. Aspiration to Modernization.

Two things will be given here by way of exemplifying the aspiration to modernize Thailand.

One is the awakening sense of rights or general improvement in individual incomes.

The other is the development programme set forth by all provinces.

In Southern Thailand, people at large are lacking in the sense of right as is clearly seen from the fact that no fishing rights has yet been approved by anyone as described under the item on the fishery industry, or that a system for registration of land under cultivation is still to be established. In some places that were visited this time some instances of cultivated land enclosed with barbed entanglements were seen, which had never been seen two years before and which means that the sense of rights is now in bud. What surprised us was a wide diffusion of motor-cycles.

A motor-cycle costing 2,000 bahts can be bought on the hire purchase system (or, the installement system), with 1,000 bahts down payment, over a period of twelve months. To make the money for monthly payments, the buyer carries a person on his motor-cycle for one or two bahts. This practice is now widespread. On holidays young men with their motor-cycles thus bought are seen waiting at the entrance of a village for hire.

In years past, accustomed to an easy life which was assured of the minimum living by the favourable natural conditions, people took to a dull life working no more than was necessary. Now things have changed. As stated above, popularization of the installment system and the earnest desire for high wages may be said to be a manifestation of their will to follow in the wake of advanced nations, seeking modernization.

Next to be mentioned is the development which each province has made according to its own characteristic features. Generally speaking, most programmers aim at increased agricultural production, improvement of roads and highways or dredging work on rivers. Among others are a plan for construction of a hydroelectric power plant and a plan to construct a catch basin for water supply near Haad Yai which is expected to have a widespread effect.

In addition to these civil engineering works, there are plans for building a hospital, and a public hall to encourage social acitivities, and for promotion of the tourist industry. Worthy of special note in this connection is the Province of Songkhla, where most outstanding, in reflecting the present situation of development work now well under way in Southern Thailand, are the construction of roads and the establishement of a communication service to spread the economic concentration over the neighbouring towns and villages.

There are still many others, such as a plan for environment sanitation facilities, expansion of social organizations such as a police force, a plan for industrialization of local natural resources and other industrial plans of high quality.

Table 3. Population of Southern Thailand by Provinces

Provinces	Area (km^2)	Population		Population	Density	
		1947 persons	1966 persons	Growth Rate (1960/1947)	1947	1960 (persons/km^2)
Chumphon	5 746	118.460	175 284	1 48	21	31
Ranong	3 426	21.305	37 628	1.77	6	11
Surat Thani	12,821	211.679	324 784	1.54	17	25
Phang - Nga	4.100	60.355	93 119	1.55	15	23
Nak hon Si Thammarat	10.169	487 743	730 401	1.50	48	72
Phuket	801	49.104	75.652	1.54	61	95
Krabi	4.624	58.799	93.895	1.60	13	20
Phatthalung	3.269	151.964	233.844	1.54	47	72
Trang	4.944	151.739	240.463	1 58	31	49
Satun	2.669	46.326	69.639	1.50	17	26
Songkhla	6.673	350.687	500.285	1.43	52	75
Pattani	2.013	203.155	281.587	1.39	100	140
Yala	4.716	80.770	149.348	1.85	17	32
Narathiwat	4.228	168.714	266.038	1 58	40	63
Total (Southern Thailand) (Average)	70.189	2.110.800	3 271.965	1.55	30	47
Total (Thailand) (Average)	514 000	17.442.689	26.257.916	1.49	34	51

Table 4. Municipal Populations and their Increases in Southern Thailand

	Provinces	Number of Cities in 1960	Urban Population 1960	1963	1960	Total in 1960	Urban Population in 1960 (%)	Over 1,000	10,000 - 5,000	5,000 & Under
Provinces on The East Coast	Chumphon	2	13 422	16,437	1.22	175 284	7.7	Chumphon 12,471		Lang Suan 3,966
	Surat Thani	2	28,721	32,585	1.13	324,784	8 8	Surat Thani 22,983	Ban Na San 9,602	
	Nakon Si Thammarat	3	48,168	52,346	1.09	730,400	6 6	Nakon Si Thammarat 28,385		
	Pattalung	1	10,420	11,040	1.06	233,844	4.5	Pak Phanang 12,903		
	Songkhla	3	72,878	85,277	1.17	300,285	14.6	Pak Phreak 11,058		
	Pattani	2	22,749	25,080	0.88	281,587	8 1	Patthalung 11,040 Haad Yai 42,981 Songkhla 35,092	Sadao 7,204	
	Yala	2	30,153	36,899	1.23	149,348	20 2	Yala 22,412 Betong 14,487	Taluban 6,576	
	Narathiwat	2	28,360	29,530	1 04	266,038	10.6	Narathiwat 12,568 Sungai Kiok 10,962		
	Total	17	254,871	289,194	1 14	2,661,570	9.6			
Provinces on The West Coast	Ranong	1	5,993	6,878	1.15	37,628	15.9		Ranong 6,878	
	Pang-Nga	2	11,064	10,994	0.93	93,119	11.9	Phuket 29,994	Takua Pa 6,327	Phang-Nga 4,667
	Phuket	1	28,033	29,994	1 07	75,652	37 1			
	Krabi	1	2,685	3,137	1.17	93,895	2 9		Kantang 5,470	Krakı 3,137
	Trang	2	22,248	24,091	1.08	240,462	9 2	Trang 18,621		
	Satun	1	4,369	7,043	1.61	69,639	6.3		Satun 7,043	
	Total	8	74,392	82,137	1.11	610,395	12.1			
Total (Southern Thailand)		25	329,263	371,331	1.13	3,271,965	10.1			
Gross Total (Thai Kingdom)		120	3,273,865	3,863,216	1.18	26,257,916	12.5			

Chapter 4. Port Situation in Thailand.

Of ports and harbours in Thailand, the only outstanding one is Bangkok, and little is known about other posts. In the World Ports by Grayson Roll and Clover Dock, reference is made only to Bangkok.

But Thailand is not really without any other ports. Things as they stand now are outlined below.

Due to its configuration or topographical features, Thailand is divided in two in terms of the transport system, that is, the central integrated part consisting of Central, Northern and Northeastern Thailand and Southern Thailand.

Because of a short coast line and many rivers as well as the spread of lowland, the Central-Northern-Northeastern part is of the most suitable configuration for the establishment of a system of inland waterways and land transport, running radially with Bangkok as a pivot.

Even in this part, Bangkok is not the only port. In the east lie a naval port and an oil harbour making use of deep waters and surrounded by islands. In addition, on the down stream of the Mae Nam, construction of a supplementary port to Bangkok is now under consideration.

Southern Thailand, on the other hand, constitutes a part of the peninsular between the Gulf of Siam and the Indian Ocean and has a long coast line. The acreage of land per kilometer of coast line differs very widely between the two parts----- the Central-Northern-Northeastern part with 470km^2 and Southern Thailand with 42km^2 (that of Japan is 13.7km^2). In view of the distance from Bangkok, Southern Thailand is well suited for undertaking a development by establishing a port-centered transport system.

Proof is better than argument ; on the east coast of Southern Thailand are Pak Phanang, Songkhla, Pattani, and Narathiwat, and on the west coast Ranong, Pang-Nga, Phuket, Takuapa, Kantang and Satun. They are all but Phuket river ports, and except Songkhla, are all well upstream from estuaries. For instance, Port Kantang lies 22km up from the river mouth and Port Pak Phanang 6km.

Rivers in these parts run largely at slow grades through the plains. The ports on the rivers are of a small depth of water and sedimentation of drift sand makes a big problem of dredging. To give an instance, Port Kantang has spent 50 million bahts over three years to keep the depth of its mooring basin and still the problem remains unsettled.

As one of the reasons for the lagging development of ports in Southern Thailand may be cited the national character, or, rather, it may be said that due to the life environment, development could not extend beyond the cities in the inland area. Unlike Japan, where port towns coincide with major cities, it was through their subsidiary relations to Narathiwat, Haad Yai, Yala, and Trang that Pak Phanang, Songkhla, Pattani and Kantang have been able to make a gradual growth. The backwardness in the utilization of sea transport, topographically viewed, which ought to be more advantageous, has led to the separation of municipal function (the political and economic center from that of transport) to the hindrance of the development of cities. Naturally enough the hinterland of ports is limited more than anticipated. The influence which the port has on Songkhla and Haad Yai cities suddenly ceases to be felt a step outside them.

It is the case with Japan, as in other countries, that most of the goods handled at ports are destined to nearby cities and towns---even to 50km or 100km apart, though in decreasing quantities. Bulky goods like oil, coal and timber are all distributed all over the country through ports, and heavy machinery and motor cars are transported by ship as a matter of course. Dependence for foodstuff on marine products and seaside factories which process raw materials brought over by ship and which send out finished goods to markets all over the country --- so intimately related are seaborne goods with the national life. As for Songkhla, however, even oil must depend upon land transport from Malaysia for the most part, showing how alienated the life in general is from ships. Not only ships. The low level of economic activity will not stimulate new demands for goods, resulting in weak connection of the national life with transport means.

In addition, there is a very wide difference in the standard of living between cities and villages. (See appendices : photographs 1 & 2) . 90% of the total population of Southern Thailand live on self-sufficient agricultural pursuits, with little need for other kinds of goods, and as the result, actual demand for goods widely differs from that deduced from statistical data based on population.

As will be described in Section 4, Chapter 5, however, transport means are being made according to the distinctive character of each kind of goods . It goes without saying that as economic activity is promoted, defective transport facilities will give rise to a problem in the form of a bottleneck in the way of economic development.

Fig. 8. External Trade Goods in Southern Thailand by Port.

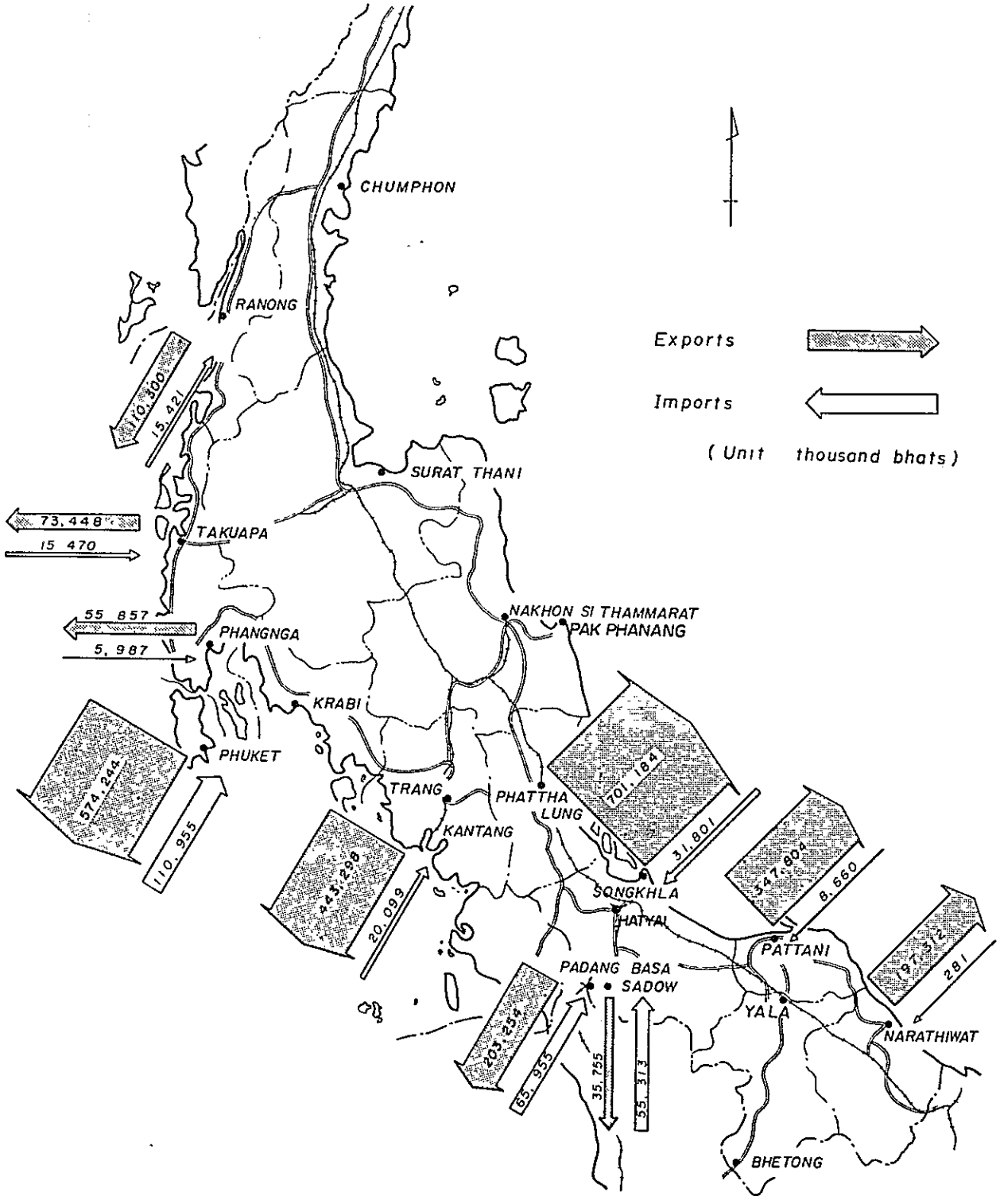


Fig. 9. Present Status of Transportation in Southern Thailand.

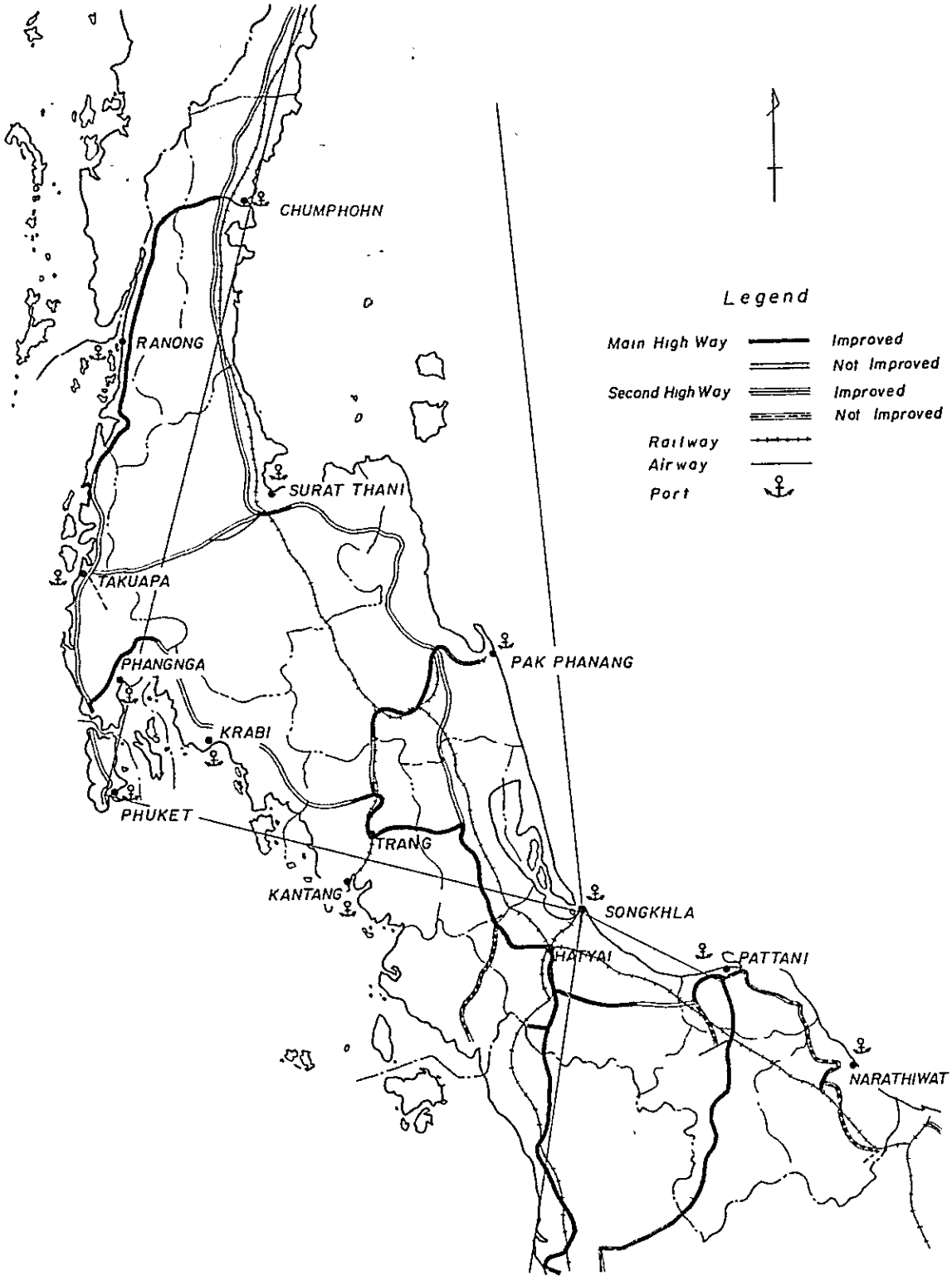
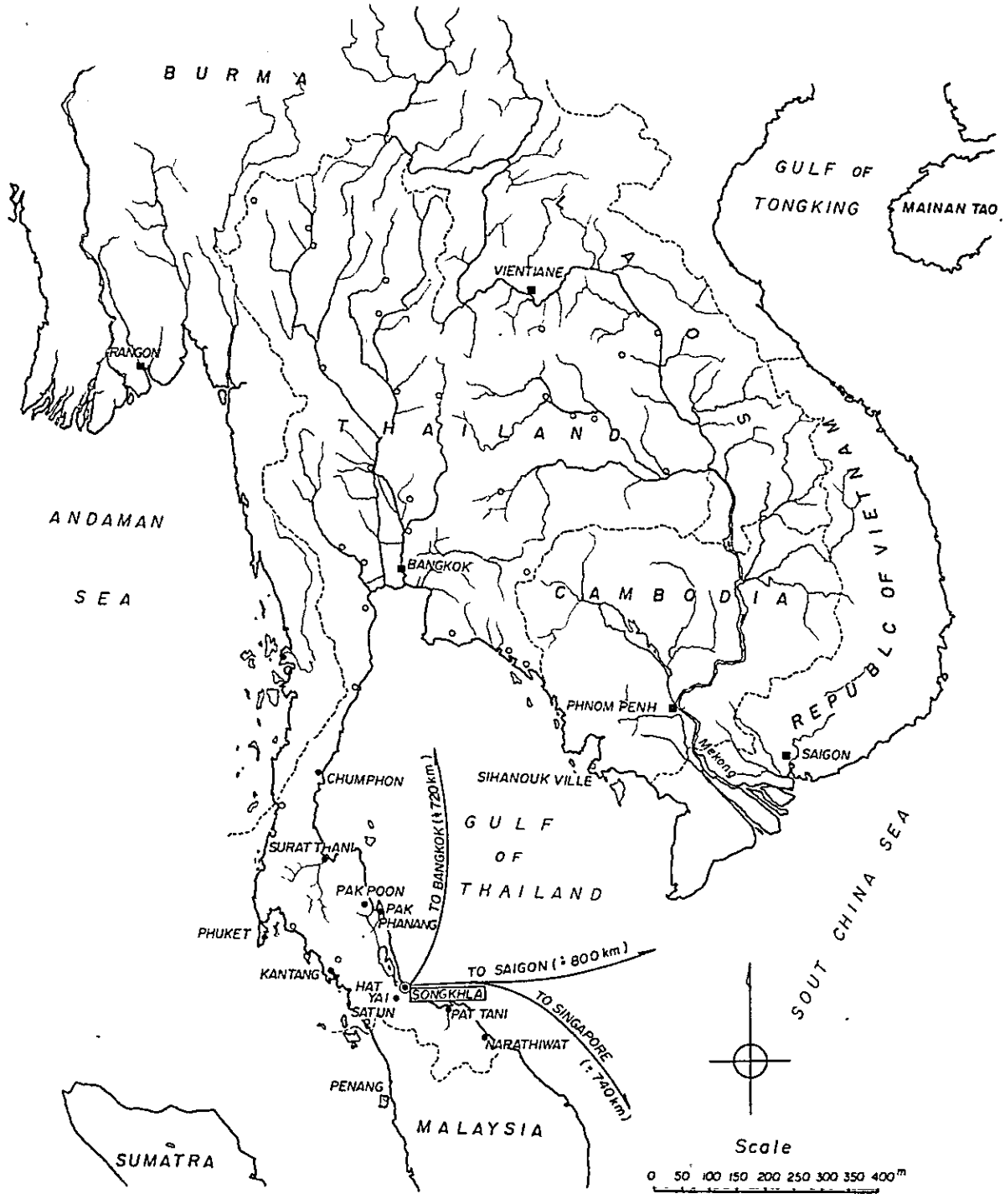


Fig. 10. Location of Songkhla Port from the International Point of Trade View



Chapter 5. Port of Songkhla

Section 1. The Situation of Songkhla Port.

The Port of Songkhla is situated on the east coast of Southern Thailand, that is, on the Gulf of Siam, near the border between Thailand and Malaysia.

From Bangkok it is about 720km by sea (or about 40 hours' sail by a 10-knot ship), about 700km by air (or about 2 hours' flight by straight service), and 974km by rail (or 22 hours' ride by express). Land transport, including roads, is liable to suspension during the rainy season.

To the Malaysian border, it is about 80km (the distance from Padan Bessar to Songkhla), about 2 hours' drive. Penang, the largest city in northern Malaysia on the Indian Ocean, can be reached by air in less than 2 hours. A straight line from Songkhla across the peninsula to the Indian Ocean is a little short of 80km. Conspicuous is a large lake lengthwise in the north of Songkhla almost in paralled with the coast line. (Fig. -10)

Nowhere on the east coast south of Songkhla down to Singapore is found a port accessible for ocean-going ships. The distance by sea from Songkhla to the estuary of the Mekong, an international river, is almost the same as from Songkhla to Singapore.

Section 2. Role as an Internal Trading Port

The Port of Songkhla is the largest and probably the only modern port that links Southern Thailand with Bangkok.

As shown in Table 5, the volume of goods handled at Songkhla Port in recent years runs at nearly 150,000 tons annually and ships coming in number about 1,000. These ships engaged in internal trade are mostly less than 500GT, most of which are less than 60GT, which is attributed partly to the poor port facilities.

Table 5. Internal Trade Goods Handled & Incoming Ships at Songkhla

Year	Incoming		Outgoing	
	Ships (number)	Goods (Tons)	Ships (number)	Goods (Tons)
1964	1,078	72,170	823	37,653
65	1,131	74,437	859	41,295
66	925	93,592	815	48,887
67	402	51,825	426	28,480

Note : Sources : Customs data

Year : Fiscal years

Figures for 1967 are for 8 months from October to May.

Due to the lack of definite statistical figures available, it is difficult to know the quantities of goods by kind.

According to the lack of definite statistical figures available, it is difficult to know the major kinds of incoming goods from Bangkok and its neighbourhood to Songkhla are sugar, construction materials (steel and cement), refreshing drinks, edible oil, condensed milk, and beans, and those going out (from Songkhla to Bangkok and its neighbourhood) are motor cars, empty bottles for refreshing drinks and silica.

According to another piece of information collected by Harinasute Co., Ltd., a powerful shipping company in Songkhla, 40% of the incoming goods are construction material, 30% are sugar, and others accounting for another 30%, while 80% of outgoing goods are silica and 20% are accounted for by empty bottles and foodstuff. As for cars, most of them are transported as part of the furniture of the owners' house-moving. On balance, internal trade goods handled at Songkhla mainly consist of incoming consumer goods and outgoing mineral products or the return of empty bottles and others.

A look at the goods kept in custody at the warehouses and open stroages of the principal shipping and transport companies, such as Harinasute Co., Ltd. and Shin Ton Co., Ltd. will be enough to endorse the reliability of the infromation referred to above.

These goods are transported by coasting regular ships plying between Bangkok and Songkhla. Things about these regular ships, which, strictly speaking, may rather be called ships for exclusive use, are shown in Table 6 as follows :

Table 6. Regular Ships

Companies	Ships Size	Routes	Number of voyage	Remarks
Harinasute Co., Ltd.	150-200GT	Bangkok-Songkhla-Pattani	14-20/mon.	
Thai Navigation Co. Ltd.	300-400	Bangkok-Songkhla-Pattani	about 8	Including Passengers.
Shin Ton Co., Ltd.	150-200	Bangkok-Songkhla-Pattani	14-20	
Oil Tanker.	200-300	Siracha-Songkhla	6-8	

Note : Passenger ships of 10-20GT. work for daily run between inlauds in Songkhla lake are not included in the above.

Consumer goods landed at Songkhla are for the most part for consumption in Haad Yai and Songkhla,and the rest, very small in quantity, are presumed to go far into the interior.

According to the information which the Union Shipping Co., Ltd. and the Harinasute Co., Ltd. obtained by enquiries, no goods are carried farther than Haad Yai.

Judged by the results of this survey, it may be concluded that the hinterland of the Port of Songkhla is confined to two cities, Songkhla and Haad Yai.

Section 3. Role as Overseas Trading Port.

As shown in Fig. 8, the Port of Songkhla is the largest overseas trading port on the east coast of the Malay Peninsula and has some relations with Japan, as will be described later on.

Its port facilities are at present so poor that ocean-going ships, unable to enter the port directly, have to cast anchor in the offing and to depend upon lighters for their cargo handling, with the result that they have to incur a larger amount of transport expenses. During the season when a northeastern monsoon prevails, large ocean-going ships find it difficult to come to anchor for lack of a suitable mooring place. The Port of Songkhla is lacking in two ways to be qualified as a good port.

Inspite of this approximately one half of the goods exported from Southern Thailand eastward to Japan and the United States are shipped via Songkhla, and as economic relations with these countries grow , the port plays a valuable part in the economic promotion of Southern Thailand and, consequently, the whole Thailand.

The recent external trade goods handled amounted to approximately 100,000 tons annually, as shown in Table 7, and incoming ships numbered 200.

Most of the ships calling the port are of 1,000 to 2,000GT class, sometimes a 10,000 GT ships calling.

Table 7. External Goods Handled at Songkhla and Ships Visiting It.

Year	Imports		Exports		
	Ships (Number)	Goods (Tons)	Ships (Number)	Goods(A) (Tons)	Of 'A', Rubber (Tons)
1964	221	6,610	216	73,885	73,873
1965	196	7,061	199	60,880	59,330
1966	201	2,095	197	100,862	57,012
1967	129	1,285	122	76,168	50,265

Note : Source: Songkhla Customs Office Data.
Years: Fiscal Year
Figures for 1967 are for 8 months from October to May.

Of these goods, imports are accounted for by consumer goods (living necessaries) brought from overseas, and exports are for the most part, rubber, which is shown in Table 7, and manganese. Once iron ore was exported, but only temporaly.

The breakdown by country of the destination of rubber exports via Songkhla Port is shown in Table 8 below. Rubber exported to Europe and Western Countries is mostly shipped through Singapore Port.

Table 8. Exports of Rubber by Country of Destination
In Percentage on Songkhla Customs Base.

Countries	Ratio of the whole of Thailand's Total exports (%)	Ratio to Southern Thailand's Total Export (%)
North American Continent	4	About 30
Japan and Other Eastern Asian Countries.	46	" 60
Countries on The Malaya Peninsula	2	" 3
India & Europe and Western Countries	48	" 30
Total	100	" 30

As for manganese, the whole lot of it is exported to Japan.

Markets for imported sundry goods (consumables for living necessaries), are confined to two cities, Songkhla and Haad Yai, as is the case with internal trade goods. Of goods for exports, rubber is collected by motor lorries from all parts of Southern Thailand. Manganese, being solely mined around Songkhla, takes the route which is thought most reasonable.

Form this statsitical data, it may be concluded that the external trade goods handled at Songkhla Port have as a sphere of influence the whole area of Southern Thailand. As is clear from rubber exports by area of destination, however, reasonable selection of transport routes is being swayed considerably due to the poor facilities of Songkhla Port and the resulting weakness in the performance of its function. For instance, while 60% of Southern Thailand's exports to Japan and other southeastern Asian countries pass Songkhla Port, only 30% of those to North America do so. This may be due in part to the smallness of the quantity of rubber exports to North America, but what should be noted here is that while both Japan and North America are to the east of Southern Thailand, the latter is farther, and in long-distance transport, increase in transport charges due to a small detour counts little, and it is with exports to such countries that a great decline is seen in the rate of goods which pass through Songkhla. It is presumable that exports to such countries are taking the route via Penang and Bangkok which have better facilities and are functioning more efficiently. About 3,000 tons of frozen lobsters and prawns annually produced

in Songkhla are exported via Penang to Japan. This shows how much of the attractive goods are lost merely because of poor port facilities and weak functioning.

Section 4. Competitive Position with Other Transport Means.

The sphere of influence of the Port of Songkhla, so far as it is concerned with external trade goods, covers the whole area of Southern Thailand, but as to internal trade goods, influence goes no further than about 30km. This limited sphere of influence was quite unreasonable to our team, and an investigation was made into its competitive relation to other transport means.

In Southern Thailand, there are as many as 15 cities which have a population of over 10,000. Although their economic activity and living standards are not so high as those of Bangkok, they should have a considerable consumption power. Since they have no manufacturing industry worthy of mention, there ought to be an inflow in some form or other of goods into those cities to reflect their consumption power. (Fig. -7)

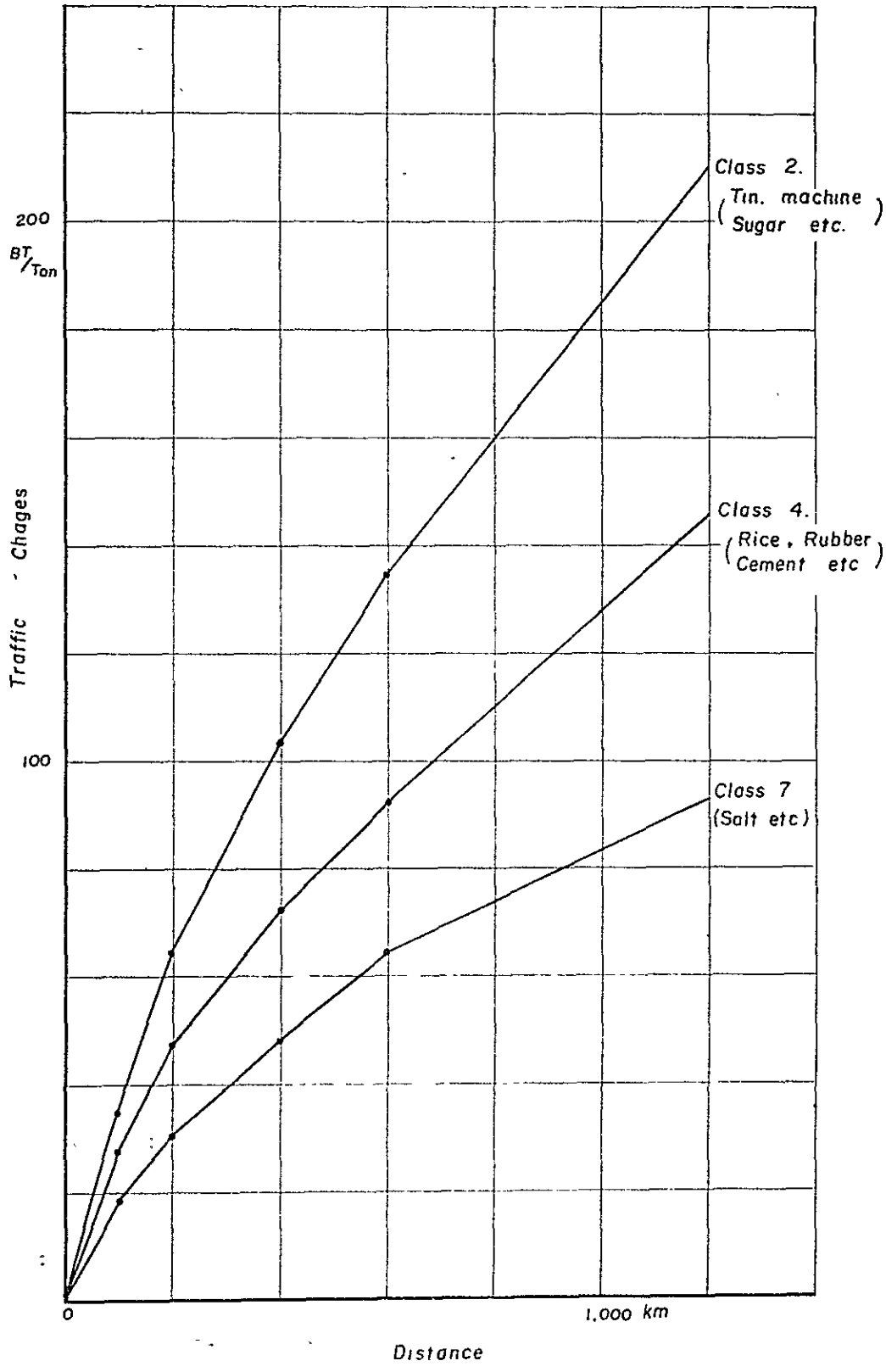
To ascertain the routes of inflow of these goods, the team paid a visit to nine out of the fifteen cities, namely, Pattani, Yala, Haad Yai, Trang, Kantang, Nakhon Si Thammarat, Pak Panang, Sadao, and Padang Bessar, and made enquiries of principal traders there. The results are outlined as follows :

Cities in the north like Nakon Si Thammarat:
From Bangkok by rail and From Bangkok by ship
Cities in the west like Kantan and Trang:
From Penang by ship
Cities on the border line like Sadao and Padang Bessar :
From Malaysia by motor lorries, and by train
Cities in the east like Songkhla, Yala and Narathiwat :
From Bangkok by ship.

It has been made clear that, viewed by kind of goods, consumables for living necessaries and construction material, which are made into a sizable quantity, were carried by ship while chemicals and the like, which need only intermittent supplies, were dependent on railway or air service for transport.

From the above results, it may be deduced that each city is reasonable enough to choose a suitable means of transport according to the distinctive nature of goods it needs. The smallness in quantity of goods which the port handles is not because other means of transport are acting as a substitute for the port. It is simply that the port has its due share of total goods which are necessarily small in quantity due to the lowness of the level of

Fig.—13 Railway charges classified by Cargo



economic activity.

It is true that the Port of Songkhla is currently leaving in the hands of other ports much of the goods which are attractive enough to it and that ships calling at Songkhla are thereby suffering a great loss.

The present state of each transport means is shown in Fig. 9.

Transport means which are competitive or cooperative with the port are railways and motor lorries, as in any other country. The amount of cargo -booking of the railway is not large. For instance, Trang Station, which is the largest cargo collector, books about 60,000 tons a year. The number of freight ton-kilometers is 1,200 ton t/km and the number of the passenger kilometer travelled is 780,000 passengers, per pilometer, which compare with Japan's 9,400t/km and 6,900,000 passengers per kilometers travelled, respectively.

The competitive power of motor lorries is far inferior even in terms of freight alone. Hence no mention here. Backwardness in the building of roads to run through the Malay Peninsula is cited as one of the causes responsible for the low competitive power of the motor lorry.

As a means for carrying passengers, motor cars are highly utilized. Use of a taxi as omnibus taxi and cheap fares are helping to promote widespread use of taxis for long travels, instance, from Haad Yai and Penang (about 200km).

Section 5. Competitive Relation to Neighbouring Ports

(1) Pak Phanang Port.

As to the situation of Pak Phanang Port, Fig. 9 of the preceding section is to be referred to.

Lying midway along the east coast of Southern Thailand, this port has the city of Nakhon Si Thammarat some 25km behind it and is about 150km north of Songkhla by sea.

The city of Pak Phanang extends on both sides of a river and is some 6km up-stream from its estuary. On the frontage of the Pak Phanang Port, the river is about 200m wide, but at a point at the estuary, it is only 0.6m. Ships of about 50 GT enter the port by availing themselves of the tidal range of about 2m.

Around the port, the river is about 200m wide and gives enough room for ships to turn a round.

Equipped with a few wooden piers, the port is far from being a normal port. In 1965, ships making port here numbered about 1,400 and goods handled were about 40,000 tons.

If in the future an expansion plan were to be made; it would cost a vast amount of money to increase the depth of the river and maintain it, which would involve many difficulties.

The port is currently utilized as a fishing port or a commercial port exclusively for coastal trade. The omission of its name in Table 6, which lists ports of call for regular service, shows that it is too poorly equipped to function as an internal trading port.

It is important for a fishing port to have facilities for collection of fish hauled and for fixing reasonable market prices of fish. Pak Phanang Port lacks the price fixing function. Along the coast of the Gulf of Siam in general, there is no established relation between fishing grounds and fishing right. A fishing boat, if it is registered at any port, is free to operate and is accustomed to landing its catches at any port near which it happens to find itself. Despite these practices, fish caught around Pak Phanang are landed and priced at Songkhla.

Pak Phanang and Nahkon Si Thammarat have a combined population of 42,000 and belong to a group of cities with a rather low rate of growth of population. In contrast with Trang, Kantang, Songkhla and Haad Yai, they have a quiet environment like the old cities which they are.

The functional weakness of the port, difficulties involved in planning for expansion, and the conditions in its hinterland as described above make it inadequate to attempt to improve the port promptly. Its communication with Bangkok is largely dependent upon railways. When the value of ports is generally realized through the consolidation of the Port of Songkhla, then demand for the expansion of Pak Phanang Port will naturally take shape.

In that event, it is desired that the rating of the position of Nahkon Si Thammarat should be established before any plan for the development of the Port of Pak Phanang is worked out, though it will involve many difficulties to construct a port with a large depth of water due to its topographical characteristics.

(2) Pattani Port.

The situation of Pattani Port is shown in Fig. 9. This port lies midway between Songkhla Port and the Malaysian border. About 40km behind it lies Yala, a newly developing city in Southern Thailand. The port is situated about 80km from Songkhla both on land and by sea.

The present port is about 6km upstream from the mouth of the river. At the mouth, the river is rather shallow, and fishing boats have some difficulty in making port. In addition, it is rather narrow at the estuary with the width of about 60m, making it difficult to provide a mooring basin, nor is there any room found near the present wooden pier for handling goods.

The volume of goods handled stood at about 110,000 tons annually, of which external trade goods (mainly of rubber) accounted for 32,000 tons and internal trade goods for 82,000 tons. Incoming ships numbered about 200 for external trade and about 600 for internal trade.

Drift sand is estimated to amount to a considerable quantity at time of floods and it is with difficulty to keep the navigable passage deep enough even for medium-sized ships.

The City of Pattani and the City of Yala, which is in the hinterland of Pattani Port, have between them a population of about 41,000. The Province of Pattani has the highest density of population in Southern Thailand and the Province of Yala the highest growth rate. A call for consolidation of the port so as to match the development of their economies is quite convincing, but river control is a prerequisite which needs cautious consideration. As is seen from the fact that the port has a regular internal coastal service, it is fairly closely connected with Bangkok. In the light of the depth of the river, however, it will not make a competitor for the Port of Songkhla after expansion.

(3) Kantang Port.

The situation of Kantang Port is shown in Fig. 9 of the preceding section. Lying on the western coast and facing the Indian Ocean, the port has developed side by side with the City of Trang in its hinterland. It is about 150km straight to Songkhla. In 1965, the port shipped about 264,000 tons of goods, received about 174,000 tons and incoming ships numbered about 1,200.

The City of Kantang has developed on the river and is about 15km from the estuary and about 22km from the port entrance, where it is 8 m deep. In front of the port facilities, the river is 3 m to 4 m deep. Drift sand forming into sand banks in and alongside the 22km passage above referred to, is making the depth of the passage uneven. The width of the river is about 150m, which is sufficient for ships currently visiting the port to turn round. The tidal range, which is said to be 3m at the river mouth, must be smaller around the port facilities.

As moorage facilities, there are a few wooden piers owned by fishing companies which they use for landing their catches, and several others for commercial use.

When the team visited the port, some ships of the 200GT class happened to be lying at anchor off the pier, proving that the river course in front was usable for anchorage.

Handling about half as much rubber for exports and nearly as much imports of external trade sundry goods as the Port of Songkhla does (see Fig. 8), and presenting activity which is next only to Songkhla as our team confirmed, Kantang is a port next only to Phuket Port in importance on the western coast.

As for its role as a fishing port, in particular, fishing companies are making positive use of the port as a landing place for their catches, it is playing the part of one of the largest fish landing ports on the Indian Ocean.

Characteristic of this port is that it has enough land along the waterside for future expansion of port facilities and that the railway sid -tracks are extended down to the waterside, giving promise of future expansion of its port function.

In most of the cities in Southern Thailand, it is common to see houses built down to the very water's edge, leaving very little room left for sites for transit sheds, warehouses, open strage, roads and railways. An exception to this is Kantang, which has a considerable space of land around and behind the piers for commercial use.

Kantang and Trang, which form one municipal area, have a combined population of about 24,000. This density of population is in no way on the high side in Southern Thailand. Nor is the growth rate.

The large number of stores in the shopping centers and the variety of articles in their windows outshine those of Pak Phanang-Nakhon Si Thammarat in activity, showing how great a part they are playing in the economy.

In our trip of investigation, we often heard a voice or of a plan for expansion of the municipal function of Kantang-Trang. Judging from such urban economic activities as described above, our team is ready to acknowledge such a plan to be sound and reasonable. From the fact that major cities in Malaysia have developed on west seacoasts, it can be deduced that Kantang City will play a large role in the economic intercommunication between Southern Thailand and Malaysia. The fact that when north eastern winds begin to blow, most fishery operations move from the east coast to the west and when we take into consideration the coastwise trade in the Indian Ocean and relations with far off western countries, their need for a port accessible for ocean going ships in quite understandable.

To look for a new place in the vicinity to construct a port and to establish a land transport system to build closer relations with Songkhla, should be an idea that cannot be overlooked.

To enlarge and reinforce the present port of Kantang to make it accessible for large ships is a conception which we cannot at once agree to, because it would involve a large amount of money to dredge the 22km-long passage and to keep it deep enough. With the Port of Penang close by, it would be less significant unless it is taken up in its relation with Songkhla.

It will not be too late to consider it after having seen how the new port of Songkhla will function.

(4) Phuket, Satun and Narathiwat Ports.

The situations of these three ports are shown in Fig. 9.

Our team unfortunately had no opportunity to pay a visit to any one of these ports All being considerably distant from Songkhla, it is deduced that they will not in stand a competitive position with Songkhla Port.

Phuket Port lies on an island close to the midway section of the west coast and is well known for tin exports. In 1965, the port handled about 25,000 tons of incoming goods and about 4,000 tons of outgoing goods, the ships coming in numbered about 500.

In the light of the lay of the land and its road system, the port has as its hinterland the provinces of Phuket, Phangnga, Krabi and Sura Thani, none of which are in a competitive position with the hinterland of Songkhla.

Satun Port is situated on the west coast and near the border between Malaysia and Thailand. It has a population of about 7,000 and its road system has little connection

with other cities. Its role seems to be to receive from Malaysia consumer goods for consumption in its neighbouring cities. It is also a river port, and except at high tides, ships are inaccessible to the port. Situated as it is in a position easy to establish connection with Songkhla on land, time may come when study will have to be made of the port as one facing the Indian Ocean in its connection with Songkhla.

Narathiwat is a port on the east coast.

From the standpoint of Songkhla Port, it lies farther south than Pattani and is less competitive with Songkhla.

In 1965, goods shipped from this port stood at 14,000 tons and goods brought in at about 8,000 tons, with 1,600 ships coming in.

The east coast of Malaysia is looked upon as very promisiong fishing grounds, but lacks a good port, and fishermen go over to the west coast to work during winter.

Chapter 6. Future of Songkhla Port

Section 1. Investigation into Future Role of the Port.

(1) Investigation from the National Viewpoint.

Progress in the means of inland transport in advanced countries has tended to shift from rivers and canals to railways to motor cars, and to aircraft historically.

In recent years, however, as a result of that roads and motor cars merit-demerit having become clear world-wide in a general way, the ship has come to regain its former role in transportation of goods and the railway in passenger transport stion, creating a new trend for transport policy to reinforce ship and railway transport facilities.

Underlying this new trend are production and movements of goods in large quantities as a result of the recent remarkable economic development, marked expansion of, and confusion in, cities, resulting from rapid growth in motor-car traffic, and the ensuing endless investment in re-development of cities.

Moreover, labout shortage as is seen in advanced countries has led to a renewed recongnition of the use of ships and railways with a large per-man transport capacity.

Apart from the normalization of motor cars and despite the advantages they have of service 'from door to door', it would be very painful indeed for a nation of low national income to have to build a well-ordered motor way, from an investment point of view.

To Thailand, which stands fairly well in economic development and which has well-exploited river trafic which can easily cooperate with sea traffic, it would prove informative to know that investment in sea transportation and port construction capable of transporting large quantities of goods at relatively low costs is the most effective kind of investment.

Moreover, ports constitute a base for the development of marine products and therefore, their role in local development should be all the greater.

Thus viewed, investment in port construction in Southern Thailand is both efficient and appropriate and should claim first priotity

Table 9. External Trade Goods Handled by Each Major Port (in Value)

(Unit thousand bahts)

Year	national Total	Bangkok			Songkhla		
		Total	Import	Export	Total	Import	Export
1960	18,246,397	14,822,337	9,252,212	5,570,125	794,658	52,703	741,955
1961	20,190,013	17,145,715	9,939,699	7,206,016	630,580	49,548	581,032
1962	21,009,835	17,845,429	11,150,724	6,694,705	643,627	42,958	600,669
1963	22,318,945	19,293,423	12,337,211	6,956,212	687,492	35,263	652,229
1964	25,602,680	23,148,793	13,867,653	9,281,140	732,985	31,801	701,184

Phuket			Kantang			Pattani		
Total	Import	Export	Total	Import	Export	Total	Import	Export
425,613	54,204	371,409	570,373	27,495	542,878	491,883	34,310	457,567
449,408	57,128	392,380	558,622	27,064	531,558	258,117	20,065	238,052
482,273	63,453	418,820	538,390	26,237	512,153	319,138	10,823	308,315
515,303	58,600	456,703	380,291	23,805	356,486	315,308	12,010	303,298
685,199	110,955	574,244	463,397	20,099	443,298	356,466	8,660	347,806

Port Songkhla is the largest internal trading port that connects Southern Thailand with Bangkok and at the same time, the second largest external trading port next to Bangkok, as shown in Table 9. Rubber shipped from Songkhla is the largest of Thailand's exports next to rice in value and manganese shipped from Songkhla is the fourth next to maize.

Exports from Songkhla Port consist of important goods which support Thailand's balance of payments. Rubber is particularly world wide goods, as shown in Table 8.

Imports, although they amount to only about 5,000 tons, consist of very important goods which support modern life and play an essential part in keeping up and improving the living standards of the inhabitants in the hinterland.

As development construction and industrialization make progress, imports of industrial manufactures from advanced countries will become inevitable.

This strength of the port is reflected in the number of foreign trading ships visiting this port annually, which now stands at about 200, as stated before.

These ships currently have to lie at anchor under the shelter of Island Koh Nu, from where to get connected with land. This means an annual loss of at least 3 million bahts paid as lighterage. If to this loss are added other visible and invisible losses ---- loss from damage to goods, loss due to frozen goods bypassing Songkhla to other ports only because these goods are not fit to be carried by a lighter, or loss of profits derivable from supply of water and fuel --- they would addup to an enormous amount, which would otherwise be turned to profits for Songkhla.

In the light of a trend to ever-growing international economic exchange and the necessity for establishing efficient routes for incoming and outgoing goods which are capable of earning foreign exchange, the importance of the Port of Songkhla should be all the greater.

Considering, especially, a closer connection, in terms of sea transport, which Thailand enjoys with such nations east of Thailand as the United States and Japan, the Port of Songkhla, which is on the east coast, rather than any ports on the west coast, should be consolidated. This will be a surer and faster way of developing Thailand.

Table 9 lists only the five high-ranking ports.

Table-10 Amount of Trade with Each Major Nation (1964)

(unit : million bahts)

	Nations	Exports	Imports	Total
East of Thailand	Japan	2.673	4.704	7.377
	The United States	547	2.301	2.848
	Hongkong	979	402	1.381
	Other Nations	1.418	1.147	2.565
	Total	5.617	8.554	14.171
In Between	Federation of Malaya	1.654	203	1.857
	Indonesia	995	472	1.467
	Singapore	891	263	1.154
	Total	3.540	938	4.478
West of Thailand	Britain	577	1.326	1.903
	West Germany	571	1.093	1.664
	Netherlands	573	505	1.078
	Other Nations	1.006	1.448	2.454
	Total	2.727	4.372	7.099
	Gross Total	11.884	13.864	25.748

(2) Examination from the International Viewpoint.

The Port of Songkhla is situated on the way from the United States and Far Eastern countries to Europe or its reverse course, as is clearly seen on the map of the world. It also occupies the most important position in the network of mutual communication between south-east Asian nations.

Fig. 11 is a straightforward representation of this rating of Songkhla's position.

It goes without saying that Bangkok, the capital, holds the most important position in Thailand, as shown in Table 9, both economically and politically and in the amount of trade, both internal and external.

The importance Bangkok holds in international marine transportation routes is, therefore indisputable. But Songkhla Port is also so situated that it is qualified to become one of the most important ports of call.

This position of Songkhla is endorsed in concrete by the fact that Bangkok is situated at the deepest end of the Gulf of Siam, so that ships navigating round the southern end of Vietnam call at Bangkok and sail on to Singapore and other ports, covering a distance of 1,100km within the Gulf of Siam alone.

Should any ship happen to have a small qunatity of cargo to discharge or take in at Bangkok, the 1,100km voyage in the Gulf of Siam would prove very uneconomical to the ship. In such a case, it is fully conceivable that the ship could more economically get through the carrying of such cargo by calling at Songkhla and discharging it there, leaving the rest of the transport service to a coastal trading ship.

Already there is a regular internal trade service established between Bangkok and Songkhla. If this route is improved to a greater stability by the present plan, the Port of Songkhla will come to have a larger role as a port supplementary to Bangkok.

To make sure whether the above conception is reasonable or not, the team made an investigation of the goods discharged at Bangkok, ship by ship, over a period of one month, January, 1967. It is regrettable that the result was not enough to tell the quantity of such goods ship by ship.

It is necessary collectively to investigate over a long period the quantities of goods discharged and taken in ship by ship in order to have sure grounds to prove whether the conception is reasonable or not. For the present we must content ourselves with the reasonableness as deduced from the goods landed at Bangkok alone.

First of all, an outlined situation of external trading ships which called at Bangkok during the month of January, 1967, will be given in the following table:

Table 11. Goods Discharged at Bangkok by Incoming Ships.

Incoming or outgoing	Item / Description	Number of Ships	Registered Tonnage	Goods Discharged
Incoming	Goods discharged at public wharves	87	284,844	187,009 Tons
	Goods discharged at exclusive wharves	26	129,565	248,580
	Ships taking in ballast and partial goods	70	163,735	
	Total	183	578,194	435,589
Outgoing	Ships taking in goods	136	367,319	398,373
	Ships taking in ballast only and departing	32	194,538	
	Total	168	561,538	398,373

Source : Monthly Report On Bangkok Port.

The types of the 87 ships and the quantities of the goods handled by them at the public wharves are given in Fig. 11.

To go straight after calling at Songkhla without breaking the voyage at Bangkok and to call at Bangkok after calling at Songkhla make a difference of 1,100km, which is about 60 hours' (2.5 days') voyage for a 10-knots ship.

The per-day cost of a ship of 6,000GT is estimated at about 50,000 bahts including depreciation and operation expenses, which amounts to making a loss allowance of 125,000 bahts is made for a voyage calling at Bangkok.

Internal freight rates from Songkhla to Bangkok are 100 bahts per ton of cargo, including charges for transhipment. This means that a 6,000GT ship can carry up to 500 tons of cargo more economically by omitting Bangkok.

Comparison between these results and Fig. 11 shows that about 10 ships could take such a route in January alone in 1967.

The ships which used exclusive wharves had a large quantity of goods to discharge, and for that reason, there is little possibilities for such ships on such a route being materialized.

As for the 70 ships which took in ballast and partial cargo as shown in Table 11. there is every possibility for them to choose a route without calling at Bangkok.

More detailed consideration must be given to the quantity of cargo to be taken in at Bangkok, but from the above result, it is judged that a considerable number of ships can content themselves with a call at Songkhla alone.

Seeing the present situation of Ships' waiting berths at Bangkok, the construction of Songkhla Port will relieve the Port of Bangkok of its heavy burden. In this sense, it is concluded that the construction of Songkhla Port is a pressing need.

(3) Examination from the Viewpoint of Port Function.

(a) Distrubutive Function.

As international interchange goes on growing, the importance of ports to Thailand, when viewed in the light of the lie of its land, should be very highly rated.

Even in its domestic interchange, as is seen between Southern Thailand and Bangkok, marine transport, with low rates of freight and a small amount of investment in facilities, should claim a very high rating, when compared with other transport means.

Where goods gather, there develops commercial function to meet it. A banking business, repair dockyards, and recreation centers for mariners come into being, as illustrated in Singapore and Penag. The consolidation of a port has brough collection and distribution of goods and development of commercial function, which has in turn given birth to processing industries and drawn many tourists. These examples are enough to show how great the economic strength of distributive function is.

The city of Haad Yai, once a smaller city than Songkhla, made itself a local point of traffic from Malaysia, the east coast and the west coast when a railway was built there and has grown into the largest city in Southern Thailand, having a population of more than 50,000. This may be a good example of the effect of traffic effect on urbarn development.

(b) Productive Function.

A step deeper into the distributive function of the port brings to our attention the productive function which the port has.

The best example is found in the way Japan has been making the best use of her ports.

Unfortunately Japan is not blessed with natural industrial resources worthy of mention, such as iron ore and crude oil. For all of these raw materials, Japan has to depend on imports, seaborne goods brought from overseas.

When she was successful in getting manufactures with ports, economy in the charge for transporting raw material inland was so great that at last she was able to produce steel which was cheaper than, and oil which was in no way inferior to, any produced in any country in the world, thus making herself a world industrial nation.

Up to 35% of the present national gross product of Japan is accounted for by these manufacturers in her ports and 50% of her economic growth in the 1960's has been supported by this striking development of her industrial strength.

Once the ship was the supreme transport means for passengers. The railway then emerged to make itself felt as a powerful competitor and now the railway is threatened by aircraft and motor cars.

The recent rapid growth in port technology has made it possible to construct a port where once it was impossible to construct one. A port incorporating productive function will, it is anticipated, continue to eulogize the blessing of development in the future.

If the Port of Songkhla is seen in this light. One will seahow intriguing it is. Behind the port lies Lake Songkhla with an acreage of about 1,000 km^2, extending over about 70km from north to south. Being only 1-1.5 meters deep, the lake is for the present being used by the fishing industry. Although the lake is shallow, a waterway could be cut through it so that ships of a reasonable size could sail in. Land would be recovered along the shore, where agriculture and forestry could be developed and livestock and fish farming would be introduced. The products would be brough to Songkhla. The Port of Songkhala incorporating a powerful industrial zone would not then be a dream.

Construction of manufactories to process these primary products would become a motive power to draw other kinds of manufactories products of which would be exported to neighbouring developing countries and bring gains to Songkhla.

Viewed broadly from its geographical position, Songkhla poses another problem which, together with the plan for construction of a port, needs to be taken into consideration beforehand, a problem of building a fishing base and introducing factories.

That Songkhla can be connected with the Indian Ocean across the narrow strip of land will be a further encouragement to the implementation of this programme.

Fig. 12. Transport Charge Belt . (Iron Bar, Cement, Etc)

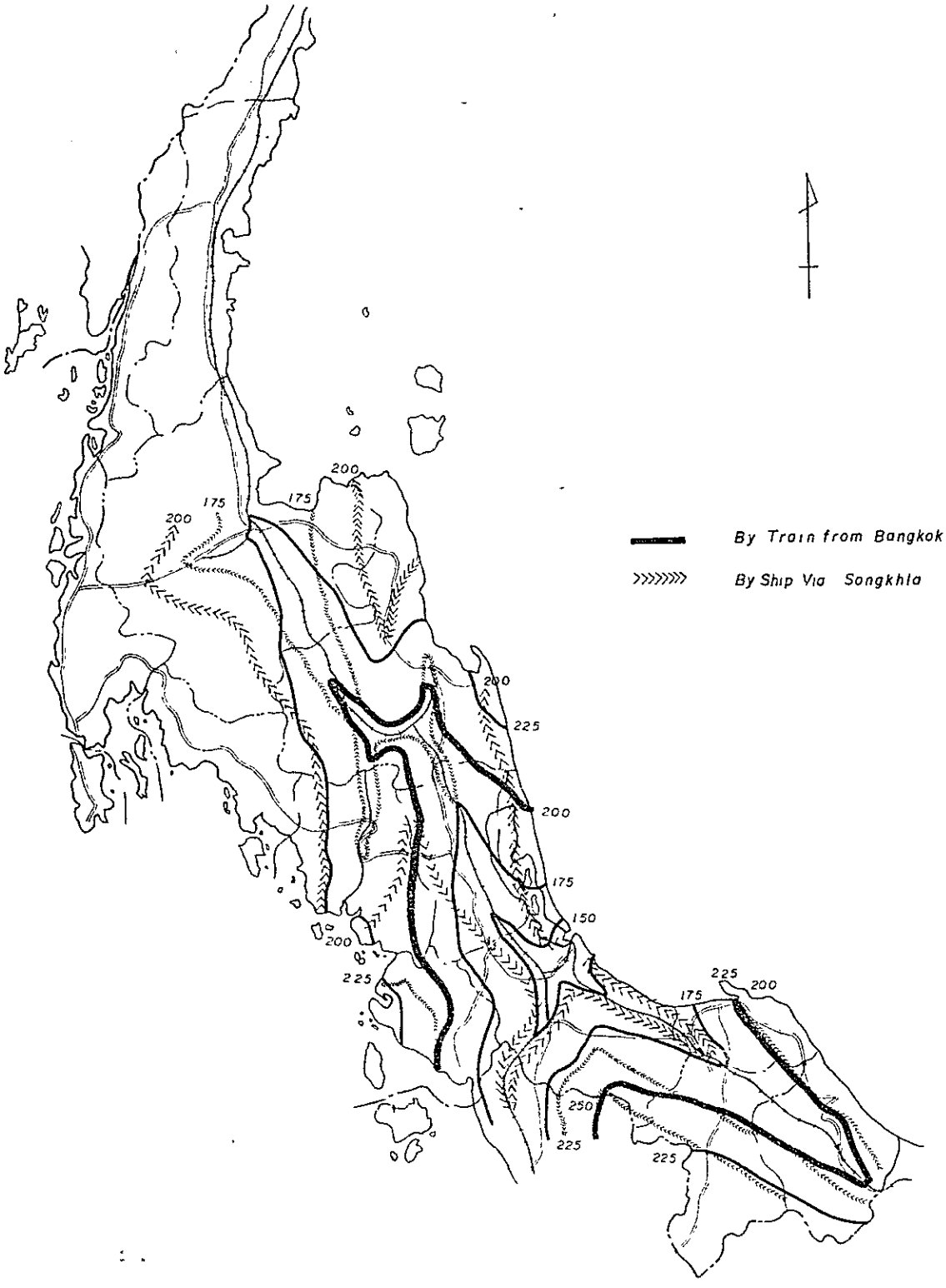
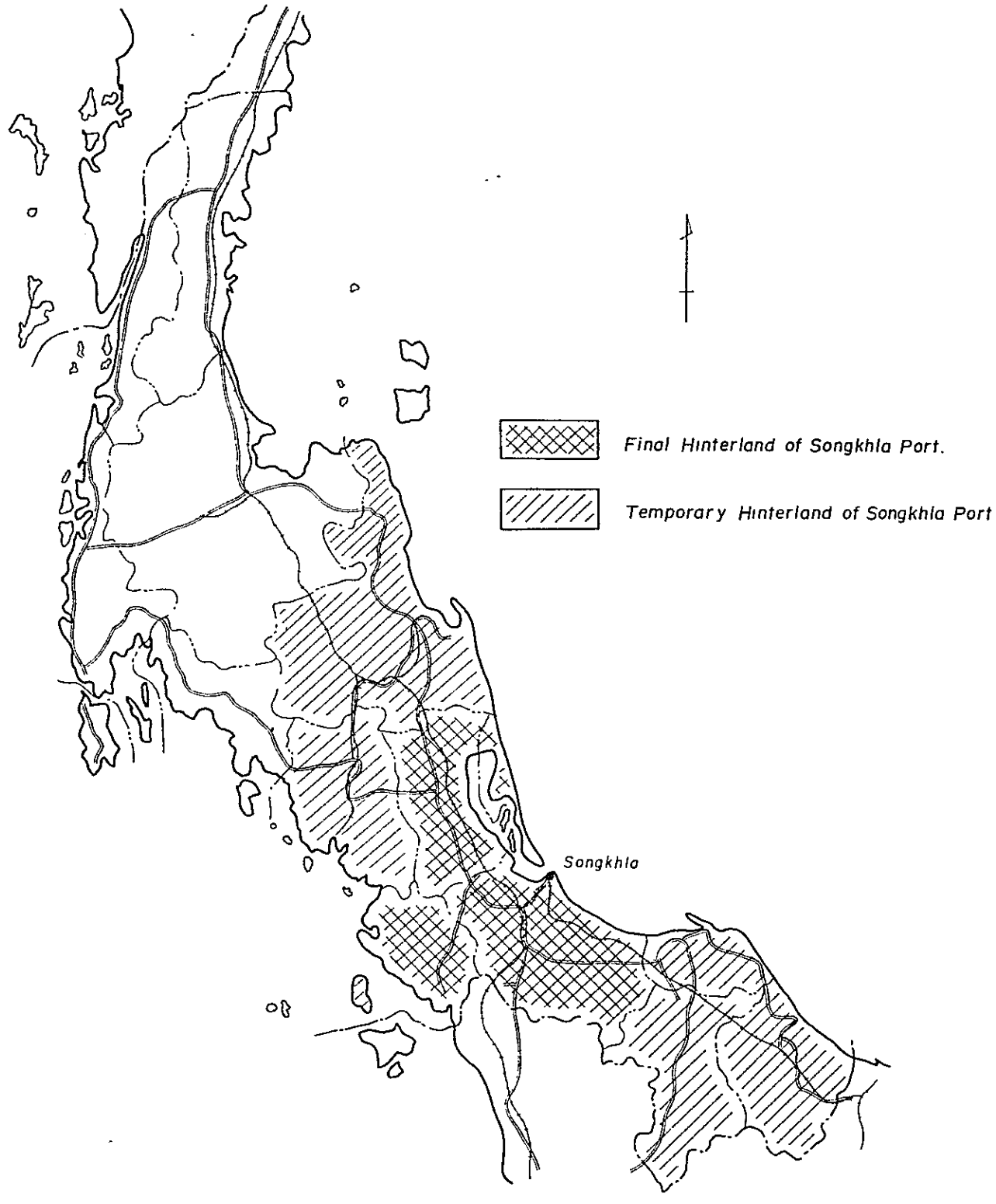


Fig.14. Sphere of Influence of Songkhla Port.



Section 2. Examination into the Sphere of Influence of Songkhla.

(1) In Relation to Internal Trade.

In so far as internal trade is concerned, the hinterland of Songkhla Port is for the present confined to the cities of Songkhla and Haad Yai. Comparison between the freight rates zone for railway transport from Bangkok and the freight rates zone for transshipment via Songkhla from Bangkok tells, as shown in Fig. 12, that the optimum sphere of influence of Songkhla Port should cover a wide area from Nakhon Si Thammarat in the north to the border line between Thailand and Malaysia in the south.

It is possible, however, that due to past practices, this area will persist in remaining under the influence of railway transport. Anyway it is likely that in the future when ports of Pak Phanang, Pattani, and Narathiwat are constructed in the wake of Songkhla Port, the hinterland of Songkhla Port is bound shrink.

On this assumption; Fig. 14 has been calculated. It represents the hinterland for the present based on a single hatch and a future established sphere of influence based on double hatches.

(2) In Relation to External Trade.

So far as external trade goes, Songkhla Port has as its hinterland the whole area of Southern Thailand at present. It holds a superior position in relation to such nations as of Thailand as the North American Continent and Japan.

This trend is clearly understandable from the freight rate zone shown in Fig. 12.

For these reasons, it is concluded that the hinterland is larger for external trade than for internal trade, that for the former extending as far as the province of Surat Thani.

Note : The method of calculating freight rate zones ;

Railway freights have been computed on the basis of the distances from Bangkok to the main stations in Southern Thailand (Table 12) and the list of freight rates classified by kind of goods (Fig. 13) which were obtained from the data of the Thailand National Railway. Motor-lorry charges have been calculated based on the actual rate of 1,400 bahts per ton for Songkhla-Penang (220 km) and calculated at 10 bahts per ton for 8km. On this calculation, for a 5-ton motor-lorry hired for Songkhla-Haad Yai (25km), 150 bahts will be charged. As it is capable of making two return trips a day, it will earn 300 bahts a day, which should be reasonable.

As to shipping freight rates, enquiry was made of Harinasute Co. in Songkhla and a rate of 60 bahts per ton was obtained for Bangkok-Songkhla. Cargo handling charges are put at 1/2 of the present charges, with mechanization of cargo handling taken into account.

Freight rates from one place to another have been determined as follows:

Charge of on-rail = Railway charges + motor lorry charges. Charge by sea = shipping charges + railway charges or motor lorry charges.

Table 12. Distances from Bangkok to the Main Stations In Southern Thailand.

Suras	651 Km
Tungsong	773
Nakorn Sritomaraj	832
Trung	845
Patalung	862
Kan Tang	866
Haad Yai	945
Songkhla	974
Padong Bessar	990
Kok po	1,025
Yala	1,055
Tanyongmas	1,116
Sungaikalog	1,159

Fig. 12 has been prepared in a fairly abstract way, and is subject to some changes, depending upon future development of the road network. To grasp the general situation, such changes can be ignored.

Fig. 12 shows that Nahkon Si Thammarat lies just at a point where railway and marine transport are competitive.

Section 3. Examination into the Estimation of the Volume of Goods.

As already shown elsewhere, volume of goods are ; incoming external trade goods, about 5,000 tons ; outgoing external trade goods, 100,000 tons ; incoming internal trade goods, about 100,000 tons and outgoing internal trade goods, about 50,000 tons.

The above goods classified by their character are given in Table 13, in which figures represent an average for the past three years in order to make even ups and downs from year to year.

Fig. 19. An Example of Tides in Songkhla Port.

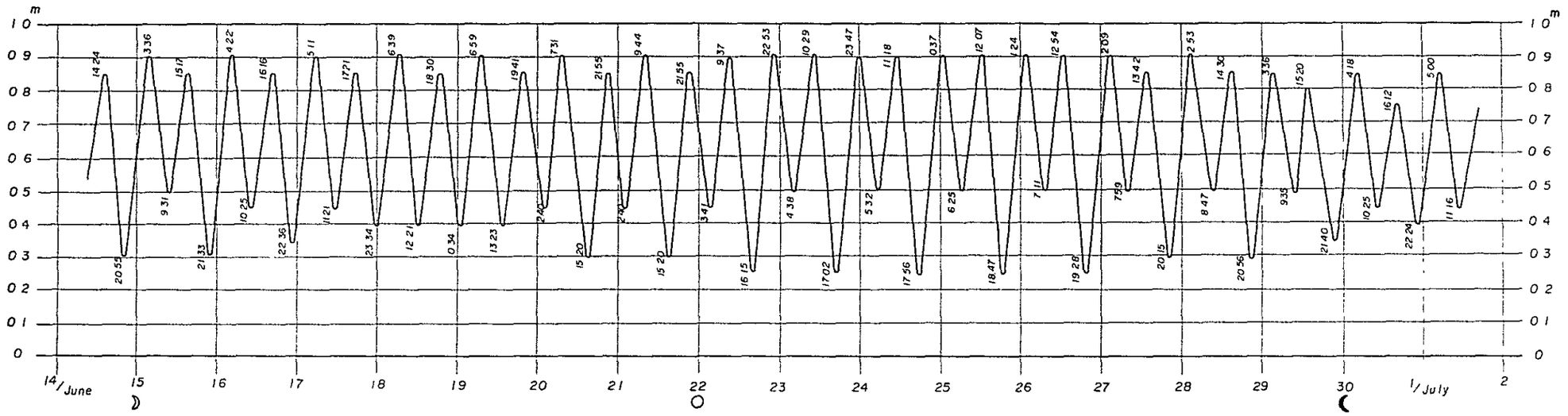


Table 13. Goods Handled at Songkhla Classified by Character.

(Averaged for the past 3 years)

Class.	Total	External Trade Goods		Internal Trade Goods	
		Incoming	Outgoing	Incoming	Outgoing
General Consumer Goods	105,000	5,000		80,000	20,000
Construction Material	(25,000)			25,000	
Living Necessaries	(80,000)	(5,000)		(55,000)	20,000
Rubber	60,000		60,000		
Manganese & Silica	45,000		20,000		25,000
Total	210,000	5,000	80,000	80,000	45,000

Note : Sources: For total, Songkhla Customs Office.
Classified figures were obtained by making enquiries.

In estimating future volumes of goods, goods currently handled and those expected to be handled have been separately treated as follows, with the target set about ten years hence, or 1980.

There are some methods of making estimation.

One is to put into correlation collective economic indices (generally G.N.P. is used) and growth rates of the volume of goods handled at a port, another to put into correlation such economic indices as are closely related with goods handled at ports (in Japan indices of industrial products are taken, in view of the close relation between ports and manufacturing industries) and growth rates of the volume of goods handled at a port, a third, calculation on the basis of plans for factories' and agricultural production in the hinterland, and lastly, by integrating the volume of each item of goods.

The method of integrating the volumes of goods on the basis of the production plans of each kind of industry has a merit in that it makes it possible to follow up investigation into rationalization of a transport system part by part, but a drawback, as well, in that results are not always highly accurate. There is danger of accumulation of errors made in the estimation of each of a larger number of industries.

If the method which employs collective economic indices as the base is used, there is little fear of making miscalculation of the general situation. But unless a sequence of cause and effect between the economic indices and goods handled at a port has been clarified,

the result will be meaningless.

For our present purpose, in view of the fact that general consumer goods which constitute a greater part of the incoming external and internal trade goods are closely related with the standards of living and, especially, with the high level of living standards of city dwellers, estimation of the volume of goods is to be made on the basis of the urban population and their living standards.

As for rubber and silica, their production plans are easy to make, and therefore, their volumes have been estimated individually, to be added to that of general consumer goods afterwards.

Thus two methods have been jointly adopted here, namely, estimation based on collective economic indices and estimation based on the production plan for each item of goods.

(1) Growth in the Volume of Goods Currently Handled.

(i) General consumer goods.

(a) The growth rate of population of Thailand is on the high side in the world, with an annual growth rate of about 3% for the past ten odd years, and the new 5-year plan of the Thai Government gives an estimated annual growth rate of 3.3%.

At this rate of growth, total population in 1980 will be 46 million (to increase at 3.3% yearly till 1970 and at 3% from 1970 to 1980, based on the population in 1960) or 48 million (to increase at 3% through to 1980 based on the population in 1960).

For the present purpose, in expectation of a possible decline in the growth rate in the future, the population in 1980 has been put at 5 million. (This figure has been worked out on the basis of the population in 1960 and at the growth rate of 3.3% up untill 1970 and at 2.5% from 1970 to 1980.)

(b) The proportion of the population in Southern Thailand to that of Thailand as a whole was 12.1% in 1947 and 12.4% in 1960, showing a gradual increase. With its relatively stable and blessed economy, Southern Thailand is expected to see this trend continue in the future.

On this assumption, it is estimated that in 1980 total population in Southern Thailand will reach 13% of that of the whole Thailand.

(c) In Southern Thailand, the population in the sphere of influence of Songkhla port is considered as follows.

Provided that two provinces, Nakhon Si Thammarat and Trang, which are considered under the influence of Songkhla Port, are where railway transport and transport by ship are in full competition.

In addition, for general consumer goods, these two provinces are dominantly dependent upon railway transport from Bangkok or supply from Malaysia, and this practice of transportation of goods is considered to persist. Hence omission of the two provinces from the sphere of influence of Songkhla Port.

Fig. 12 and 14 are to be referred to.

There is no doubt that three provinces, Songkhla, Phatthalung and Satun, come under the influence of Songkhla Port.

As for three provinces, Pattani, Yala, and Narathiwat, although goods are transported there via Pattani Port, a sizable portion of them, when Songkhla Port is completed as a modern port, are expected to go via Songkhla Port, Pattani Port losing much of its influence as a port. Taking into account the influence of Pattani Port, therefore, it is assumed that one half of their population come under the influence of Songkhla Port.

(d) The proportion of the combined population of three provinces, Songkhla, Phatthalung and Satun, to the total population of Southern Thailand dropped from 26% in 1947 to 24.6% in 1960.

Due to elevation expected to take place in their role as the key position in traffic as the result of completion of the port and resulting development of industry, their population in 1980 will regain the level of 1947. On this assumption, their combined population is estimated to reach 1,500,000 in 1980.

The ratio of the combined population of the three provinces, Pattani, Yala and Narathiwat to the total of Southern Thailand was 21.4% in 1947 and 21.3% in 1960, remaining almost unchanged. This trend is assumed to persist and in 1980 they will have a population of about 1,300,000 of which about 600,000 are assumed to under the influence of Songkhla Port.

(e) So far as general consumer goods are concerned, urban population should in the main have positive connection with goods handled at ports. The proportion of the

urban population to the total in Thailand as a whole stood in 1960 at 12.5%, in Southern Thailand at 10.1%, in three provinces of Phatthalung, Songkhla and Satun combined at 10.9%, and in the three provinces of Pattani, Yala, and Narathiwat combined at 11.7%. From this it is assumed that the ratio of urban population of Southern Thailand in 1980 is to equal the mean value of the ratio of urban population of present Central Thailand and that of present Southern Thailand, and that in the case of other provinces, the ratio of the value of each province to the mean value of Southern Thailand is to be taken for their urban population ratios On this assumption, the urban population ratio of the three provinces around Songkhla will be 22.5% and that of the three provinces south of and including Pattani, 22 0%.

The urban population thus calculated in the sphere of influence of Songkhla Port will be 310,000 in the three provinces around Songkhla, and 130,000 in the three provinces south of and including Pattani, totalling 440,000, or about 5 times as large as that of present Haad Yai and Songkhla combined.

(f) Improvemnt in the living standard is considered to be proportionate to growth in gross national product. The rate of growth estimated by the Thai Government in its new 5-year plan is 5% a year. This rate taken intact, the consumption level in 1980 will be approximately double that of 1965.

(g) On the above estimation, general consumer goods passing through Songkhla Port in 1980 will be calculated by multiplying the current volume of general consumer goods by 5 (that is, the growth ratio of urban population in the sphere of influence) and again by 2 (that is, the growth rate of goods consumed due to improvement in the living standard), thus working out about 1 million tons.

(h) So long as regional distribution of industry remains as it is now, or so long as the concentrating development of manufacturing industries in Central Thailand continues, some one million tons of goods will have to be brought in. This fact should not be overlooked.

Putting average charges for transport between Songkhla and Bangkok at 100 bahts (including charges for handling of goods), transport charges alone will run up to 100 million.

If efforts are made for the promotion of industry and self-sufficiency of this region is raised in degree, it will help develop the local economy. Not only that, it will amount to economizing transport charges and, with some kinds of goods, even foreign currency. These economies will then be applied to other effective demand, doubling and tripling the effect.

(i) For that purpose and with the view of increasing the supply of goods within the region, the contents of goods now handled at Songkhla Port have been re-examined. The result

is as follows:

About 100,000 tons of general consumer goods are classified into about 30,000 tons of construction material (steel materials and cement) and some 70,000 tons of consumables for living necessaries.

Construction material: it is considered difficult to raise supply power within the region.

Steel material: it is conceivable to try to make it easy to transport by importing it in a less processed form and thus to make it less bulky.

About 70,000 tons of consumables for living necessaries are broken down into sugar, refreshing drinks, edible oil, condensed milk and beans. Of these, sugar and condensed m milk are impossible in realizing self-sufficiency within the region, but as to refreshing drinks, edible oil and beans, it should be passible to attain a higher degree of self-sufficiency. It is possible for edible oil even to be sent out to other regions.

(j) In short, leaving construction material which constitutes some 30% of the general consumer goods untouched, and assuming one half of the remaining 70% is to be switched to local supply, the volume of general consumer goods to pass through Songkhla Port in 1980 is estimated at 650,000 tons.

(ii) Rubber.

Rubber, a staple article of export: no great increased production can be estimated in the following ten years. This is because it will be ten years hence before the replanting currently taking place will produce any fruit. It is therefore estimated that rubber will remain at the present 60,000- ton level.

(iii) Manganese and Silica.

There are possibilities of manganese and silica increasing in production as goods in meeting increasing demand.

Manganese, however, is not always produced in good quality and in addition, its deposits are relatively small, estimated at about 1 million tons. It is, therefore, estimated to remain at the present level of a maximum capacity of 40,000 tons.

As far silica with its good quality and large amounts of deposits, it is desired that active mining will be pushed forward. Considering what the Thai Government in its new 5-year plan proposes an estimated growth of 50% for the glass industry, production of silica in ten years hence (1980) is estimated to double the present production to 50,000 tons.

(2) New Kinds of Goods.

Thus far goods which passed through Songkhla Port in the past have been considered. There ought to be some new kinds of goods developed.

(i) Rice

Rice is one of it such goods. As we have seen already, even in Southern Thailand, some provinces are selfsufficient in rice while others are not. Two provinces, Nakhon Si Thammarat and Phatthalung, are more than self-sufficient, sending out some 100,000 tons.

(ii) Pulp.

Production of chips out of aged rubber plants or of forest resources may be thought of as a new industry. A move, if any, towards its industrialization is still to take shape, so that no estimation is possible at present. Suffice it to point out that there are possibilities.

(iii) Oil and Fiber Plants.

The planting of oil and fiber plants may be thought of as a new kind of industry. Their products are to be turned out in a form of final-products, and their production will be too small to need any estimation here.

(iv) Others.

It is not impossible to take up more minor goods of a small quantity, but if we think of the degree of accuracy of the estimation of general consumer goods, it may be said of them that their quantities are included in the estimation of general consumer goods.

Therefore, total volume of goods for 1980 is estimated at 900,000 tons.

Goods as broken down into internal and external trade and incoming and outgoing goods are considered as follows ·

Construction material: steel materials alone are to be imported, and the ratio of steel material to total construction materials is put at about 15%. About 10% of living necessaries are to be imported from overseas.

There is to be no more of return of empty bottles. Hence no outgoing goods in internal trade will take place

Rubber will all be exported. Manganese is to be exported and silica is destined to Bangkok.

Rice: 50% each for internal and external trade.

These results are shown in Table 14.

Table 14. Estimates of the Volumes of Goods (as in 1980)

Unit : ton.

Class.	Total	External Trade Goods		Internal Trade Goods	
		Incoming	Outgoing	Incoming	Outgoing
General Consumer Goods	650,000	100,000		550,000	
Construction Material	(300,000)	50,000		(250,000)	
Living Necessaries	(350,000)	(50,000)		(300,000)	
Rubber	60,000		60,000		
Manganese & Silica	90,000		40,000		50,000
Rice	100,000		50,000		50,000
Total	900,000	100,000	150,000		100,000

Section 4 Examination of Incoming Ships

Ships making entry into the ports of Songkhla and Bangkok during the year 1964 are classified by register tonnage in Table 15.

Table - 15 Ships Making Entry into the Ports of Songkhla & Bangkok Classified by Register Tonnage

Class of Ship (Register Tonnage)	Port of Songkhla		Port of Bangkok
	Internal Trade	External Trade	External Trade
500 tons & under	100 %	54.0 %	12.7 %
500 - 1,000		7.3	20.9
1,000 - 1,500		8.6	
1,500 - 2,000		4.4	8.9
2,000 - 3,000		22.3	16.8
3,000 - 4,000		2.9	13.0
4,000 - 5,000		0	12.6
5,000 - 6,000		0.5	6.6
6,000 - 7,000		-	6.0
7,000 - 8,000		-	2.5
Total		100.0	100.0

Remarks Source : For Songkhla Port, from data of Songkhla Customs Office.
For Bangkok, from Bangkok Port-Gateway to Thailand.

(The carrying capacity of a ship is variously measured. The principal units of measurement are register tonnage, gross tonnage and deadweight tonnage. As to relations between them, Section 2, Chapter 3. Part III, is to be referred to.)

Ships currently visiting Songkhla Port as classified by tonnage are all, in the case of internal trade, 500R.T. or under. In the case of external trade, however, those of 500R.T. or under account for about 55%, those of 1,000R.T. or under, for about 60%, and those of between 1,000R.T. and 4,000R.T., for 40%.

Larger ships often visit the port, but their number is negligible in percentage.

Of the goods estimated to be handled in the future, internal trade goods are predominant as shown in Table 14.

These goods are in the main, of a relatively small lot as is the case with construction material and living necessaries, and are conveniently transported by small ships.

Ships of Thai nationality are mostly of 1,000G.T. (600-900R.T.), according to Lloyd's statistics.

From the standpoint of rationalization of the transport system, it is more effective

to switch small ships currently engaged in external trade to internal trade.

External trade goods expected to be handled in the future are estimated to amount to about 250,000 tons.

These goods mostly consist of manganese and silica which are more advantageously exportable in a large volume.

While ships tend to grow larger through out the world, they seek goods in a large quantities in their effort to cut transport costs.

In this respect, manganese and silica stand at a disadvantage. Due to limited capacity of their producers, it will not necessarily be advisable to see ships grow large in size in so far as their transportation is concerned.

It may well be concluded that, when we think of ships which bring living necessaries over from foreign countries or of those ocean-going ships calling at Songkhla Port, ships of 3,000 to 4,000R.T. (= 4,000 6,000G.T.) may come to play the main role.

Of course, it is not unlikely that far larger ships may sometimes call at Songkhla Port.

Even in the present state of things of Bangkok, ships of over 4,000R.T. visiting there account for about 25%.

But all of them do not come with a full load.

It can be said with Songkhla Port, as well, that of such large ships, only those of shallow draught can be taken into consideration.

It is not advisable in terms of investment efficiency to construct a port which is accessible to ships of any size whatever.

PART III. NATURE AND PRESENT STATE OF FACILITIES IN SONGKHLA

Chapter 1. Natural Features

Section 1. Topography

Section 2. Weather Conditions

Section 3. Hydrography Datum

Section 4. Soil

Section 5. Recommendations

Chapter 2. Present State of Port Facilities

Section 1. Navigable Passage and External Facilities

Section 3. Cargo Handling Facilities

Section 4. Storage and Warehouse Facilities

Fig. 15 Topographical Lake Map Including Songkhla Port .

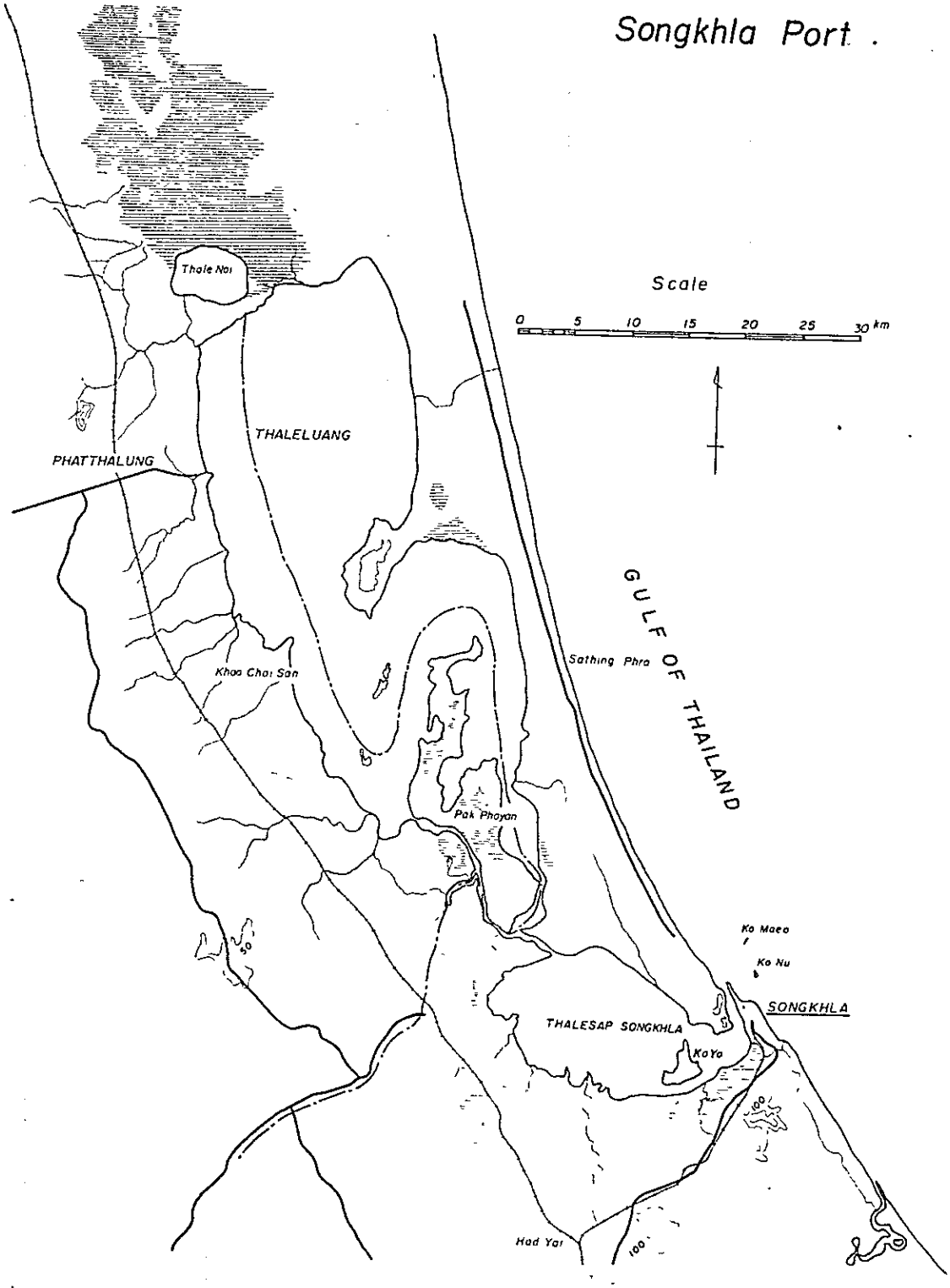


Photo-1 Prespective View of Songkhla Port and Surrounding Area

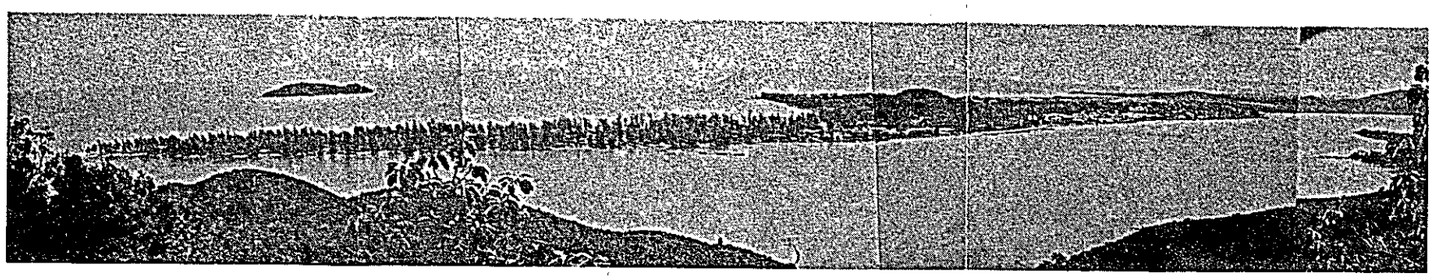
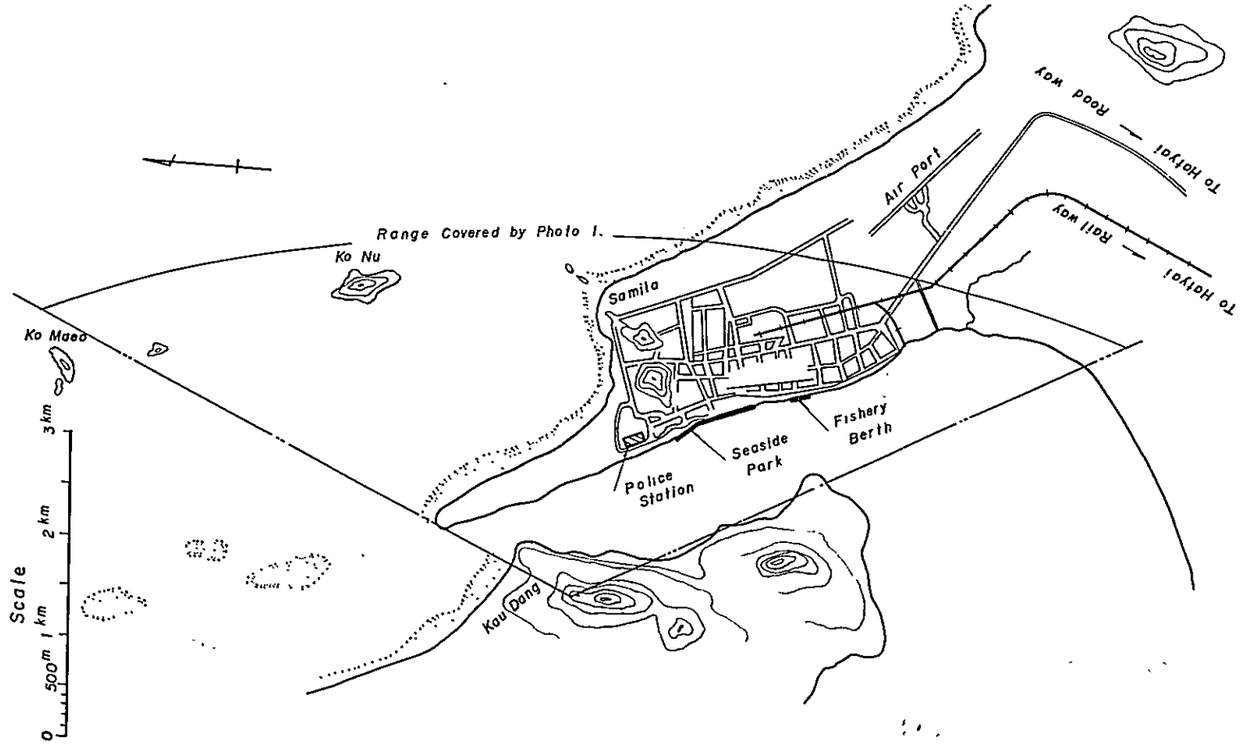


Fig. 16 Topographical Map of the area Araund Songkhla Port.



PART III. NATURE AND PRESENT STATE OF FACILITIES IN SONGKHLA

Chapter 1. Natural Features

Section 1. Topography

For the topography of a wide area including Lake Songkhla, Fig.-15 is to be referred to and for the topography surrounding the port of Songkhla, Fig. -16 and Photo-1 is to be referred to. As is clear from Fig. -15, the topography around Songkhla was formed, it is thought, as the result of long years of continuous upheaval of the sea bed which left Lake Songkhla in the form of a large-scale lagoon and of the accumulation of drift sand along the sea coast and of sand and earth carried along by flood flows from the lake which formed the present city area.

Seeing that the vast surface of Lake Songkhla functions as a sedimentation basis, as it were, quantities of sand and earth carried along by flood flows are considered not very large except on special occasions. It is conceivable that until the present topography was formed, there had been repeated closings and reopenings of the mouth of the lake by the force of drift sand of the open sea and flood flows from the lake. The fact that mountains of 200 meters above sea level are found rising here and there in the plain area in an abrupt way, that several islands and reefs lie scattered in the open sea not more than 2km from the coast line, that the coast line suddenly turns at a point where sunken rocks lie and skirt along the foot of a table land stretching from east to west, forcing the narrow strip of land between the waterway and the sea coast to narrow into a headland of sorts --- all these combine to verify the above process of topographical transformation.

Lake Songkhla, which is divided into Lake Sapp and Lake Luang by a narrow waterway, is approximately 80km lengthwise and approximately 1,000km^2 in surface area, extending over the provinces of Songkhla and Phatthalung. Lake Sapp is approximately 0 to 0.5 meters deep. On both sides of Koyo Island near the mouth of Lake Sapp run natural channels with a width of around 20 to 50 meters and a depth of around 2 to 4 meters. These channels join near the base of Songkhla Headland (see Fig. -16).

Photo 1 shows a view of the present Songkhla city and its surrounding area seen from the hill top on the opposite bank of the projected portion of the headland which is shown in Fig. -16. Shown in the center of the picture is the waterway which connects the abovementioned lake with the open sea and currently serves as a berth for incoming ships. A natural channel which may be considered as forming the center line of this waterway runs alongside the city area of Songkhla and joins the abovementioned natural channel. The depth of the channel ranges from -4 to -6 meters in many places in front of the city area but where it is narrow it is in some places as deep as -10 meters.

The island shown in the front left side of the picture is known as Rat Island (Kob Nu). Further left, not shown in the picture, there lies another island called Cot Island (Koh Maws). Though not clearly seen in the picture, there are sunken rocks scattered in several places near the island.

The projected portion of the headland is about 2,000 meters in length, about 250 meters in width and consists of plain land about +2.5 meters above the sea level. A long white building seen at the foot of a hill at the base of the projected portion is the police station recently constructed and a small building, a newly-built dwelling. From the tip of the projected portion covered with needle-leaved trees, as if to extend it, run a series of shallows several kilometers into the sea, some of them showing themselves in sand banks in the sea. This long range of shallows is now hampering a short-cut between the open sea and the berthing waterways. (Fig.-22)

Section 2. Weather Conditions

(1) General

The climate of Songkhla varies considerably between two monsoon seasons, the southwest and the northeast. Early in the northeast monsoon season from November through December, it rains heavily and strong wind blows. In the southwest monsoon season from May through September, wind blows hard and it rains little. This phenomemon is contrary to that in Bangkok.

The annual average of the daily average temperatures is 27.8°C, that of the daily maximum temperatures is 31.6°C and that of the daily minimum temperatures is 24.1°C, according to the data from the Songkhla Weather Station for 1937 through 1960. Classification by the month indicates that the temperature was the highest in May with the daily average temperature of 28.9°C and the daily maximum temperature of 33.2°C, and the lowest was in December with the average daily temperature of 26.5°C and the daily masimum temperature of 29.2°C.

Relative humidity, according to the same data, was 81.4% for the yearly average. By the month, humidity was high in November of the rainy season with 83.5% and low in August with 76.1%.

A study of the data on fog from the Songkhla Weather Station for a period of 10 years from 1951 through 1960, indicates that the average number of foggy days for the year was 23 days. A breakdown of this figure indicates that the fog was seen most during the period from February through June with 3 to 4 days a month and less in other months with no more than 1 day a month. It is presumed that this data is a mere statistical indication of the number of days on which the

Fig-11 Cargo Tonnage Discharged at Bangkok Port by size of ship (Jan. 1967)

Ships enclosed by dotted line may find it economical & coll at Songkhla port in South East Asian trade.

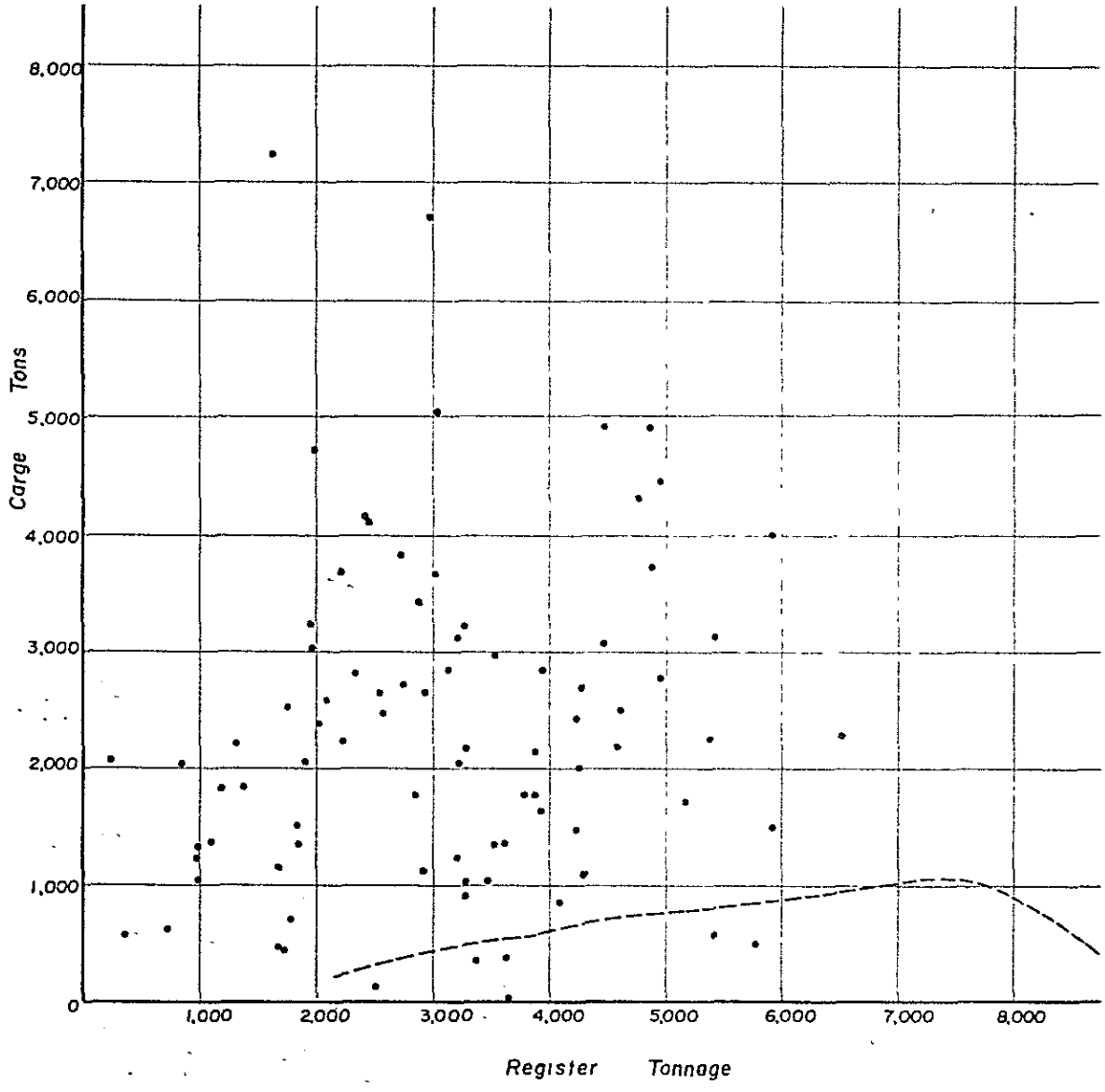
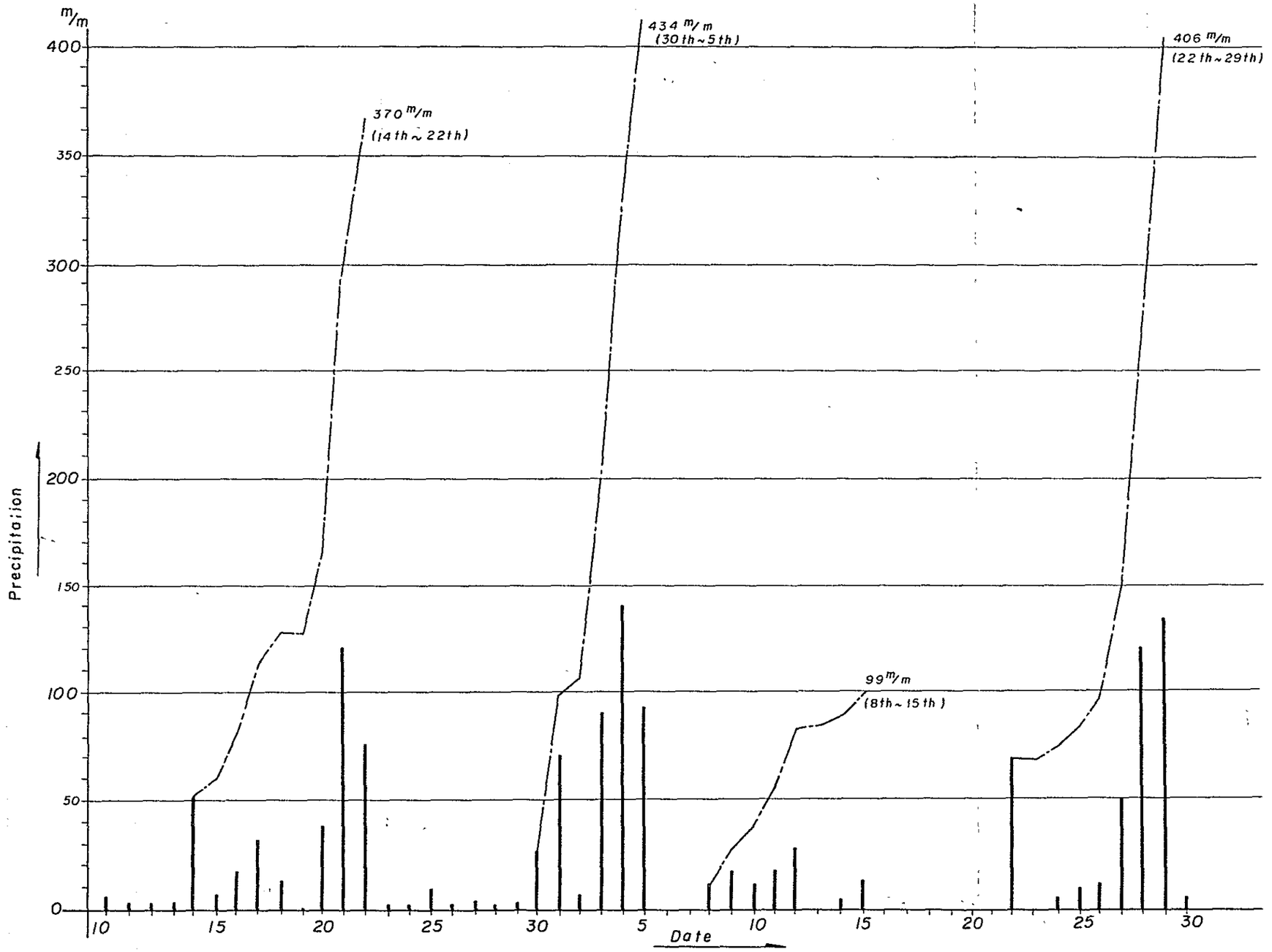


Fig. 18. Graph Showing Cumulative Precipitation for the Period, Nov. to Dec., 1966



presence of fog was observed regardless of the density of fog and that there were many days which were foggy for a short time or the density of fog was low. There was not a single instance during the stay of the survey team that it encountered fog so dense as to obstruct the navigation of ships. It should be noted, however, that during the rainy season, when it rains hard, visibility at sea is extremely low.

As to earthquakes, it is considered that there is no need for particular consideration, as is proved by the fact that a pagoda of brick construction at an old temple which is considered to have been built several hundred years ago still remains intact without any damage.

(2) Rainfall

According to the data from the Songkhla Weather Station for a 10-year period from January 1957 through April 1967, the annual average rainfall was approximately 2,000mm, the annual maximum rainfall during the 10-year period, 3,340mm (1966) and the minimum annual rainfall, 1,400mm (1958). The monthly average rainfall is as shown in Fig.-17. A summary of frequency of monthly rainfall is shown in Table-16. As known from Fig.-17, breakdown by the month indicates that it rains most in the 3 months from October through December, accouting for 50% of the total annual rainfall. Taking the total rainfall of the 3 months' period from October through December for the rainfall during rainy season, the maximum rainfall recorded during a 10-year period from 1957 through 1966 was 1,973mm (1966), the minimum rainfall, 750mm (1964) and the average rainfall, 1,238mm.

In addition to this, the survey team was able to obtain daily rainfall for a period from November through December, 1966, and grasp the actual conditions of a concentrated heavy rain fall.

These conditions are illustrated in Fig.-18. The monthly rainfall of 917.9mm in December 1966 was, according to "Monthly & Annual Rainfall (1911 - 1966) : Thailand" published by the Meteorological Agency, the second highest monthly rainfall next to 1,185.4mm in November 1915 and is considered on which comes once every 30 years. Moreover, in a two month' period from November through December, a rainfall of 100 - 430 mm continuing for 6 to 8 days occurred 4 times and 2 of them were massive rainfalls, exceeding 400mm. They resulted in an inundation of the whole area of Haad Yai and Songkhla from the end of November to December. The damage on those occasions was so great that road traffic was completely disrupted between Songkhla and Haad Yai and many houses were under water. The city of Songkhla did not suffer any special damage in human life and

property, but it is said that many houses were under water. The fishery pier was saved from inundation but the surrounding houses were inundated because they stood 50cm lower than the pier. As is characteristic of the tropics, rainfall in this region tends to be strongly localized, and it is inconceivable that the rain as mentioned above should fall in the entire basin of Lake Songkhla. However, the heaviness of rainfall is such that the danger of a flood resulting in inundation of the city area such as previously mentioned can well be expected. The fact that the floors of houses in the city are approximately 1 meter above the ground may have been the result of past experiences of the flooding of the lake, inun - dation or inadequate drainage at the time of heavy rainfall.

Table-16. Monthly Precipitation and Frequency of Rainfalls

(January 1957 - April 1967)

Grade of Precipitation(mm)	Number of Months
0 - 100	64
101 - 200	28
201 - 300	7
301 - 400	11
401 - 500	5
501 - 600	4
601 - 700	1
701 - 800	3
801 - 900	0
901 - 1,000	1

(3) Wind

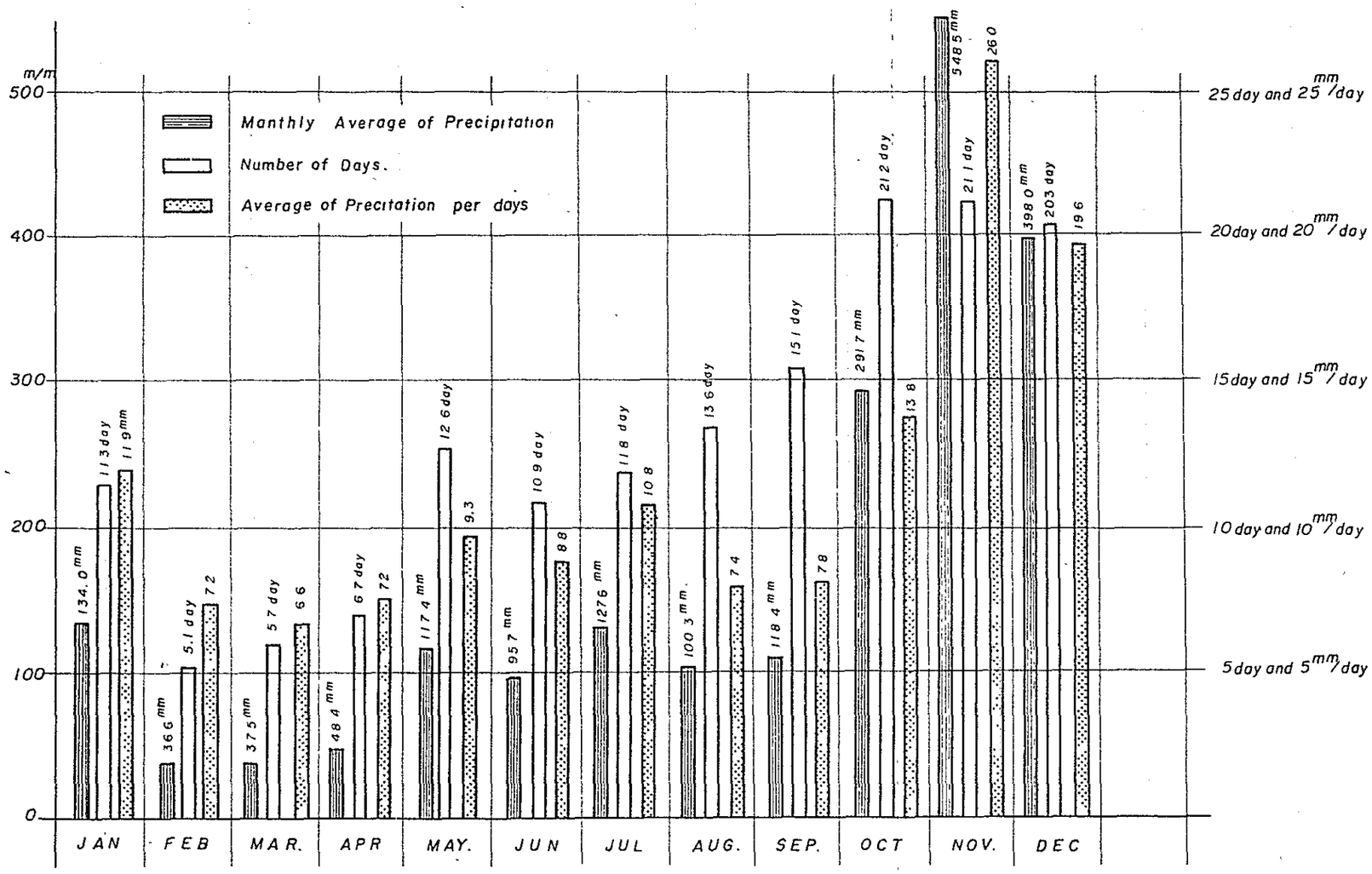
As mentioned in the Summary, the wind in Songkhla is of two types---that blows in the northeast monsoon season and that in the southwest monsoon season. It is in the northeast monsoon season of November through December (as shown in Table-17.) that strong winds prevail.

Table 17. Wind in Songkhla (1951 - 1960)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Main Wind Direction	E	E	E	E	N	SW	SW	WSW	SWS	SWW	NEE	E
Average Wind Velocity(knot)	13.4	9.2	6.2	5.0	3.0	3.0	3.2	3.8	3.2	3.0	5.0	9 6
Maximum Wind Velocity(knot)	44.0	44.0	37.0	52.0	44.0	52.0	52.0	52.7	37.0	44.0	68.0	44.0

Note: Data from Climatological Summaries. The Thailand Meteorological Agency.

Fig. 17 Monthly Average of Precipitation (Jan. 1957– Apr. 1967)



Though the maximum wind velocity is, according to Table-17, recorded as 68 knots, it is gathered from various data that the figure represents the instantaneous velocity of wind recorded in a short period of time during a squall.

Also, according to the above mentioned data, a large low pressure, experienced only once every few years, hits the area, bringing disaster caused by a strong wind and a heavy rainfall and often sinking fishing craft.

It is necessary to anticipate more than one squall daily, and that they are generally in the afternoon, during the northeast monsoon season. However, during the southwest monsoon season the number of squals decreases. A sudden gust of wind following a squall was experienced during the survey by this team. It was so strong that trees in the projected portion of the headland were blown down on the road.

Section 3. Hydrography Datum

(1) Tides and their standard level

The Port of Songkhla is characterized by perfect diurnal tides with little diurnal inequality. An example of this phenomenon is illustrated in Fig. -19.

The Port and Harbor Bureau of the Thai Government has obtained and is utilizing the following datum level and the tidal heights based on the results of the observations conducted over a long period of time in the vicinity of Rat Island (Koh Nu) off the Port of Songkhla.

Spring Hight Tide	+1.370m
Neap Hight Tide	+1.050m
M.S.W.L.	+0.972m
D.L.	±0

The tide table published every year by the Hydrographic Bureau, Thailand Naval Department, is based on these data. According to the data, the mean water level in the vicinity of Rat Island (Koh Nu) is high from November through January and low from July through August, the difference being close to 40cm. The mean water level recently obtained by the survey team from the Tide Table of 1965 was approximately +70cm above the datum level, but the official mean water level was +0.972m. Spring range and neap range calculated from the 1965 tide table are 65cm and 35cm, respectively. In waters such as Lake Songkhla which are connected with the open sea by a comparatively short and narrow waterway, the sea water flows in and out according to changes in the tide level of the

open sea, and the water level of the lake also responds sensitively to the tides. These phenomena of flow of sea water are observed in this region during the dry season begining at the end of January and ending in October in which the water level of the lake is low. During the rainy season the water level of the lake is always higher than that of the open sea and a one-way flow to the open sea is observed. As to the differences in the water level between the waterway and the lake during the dry season, it was observed during the survey that the tide range near the middle of the waterway was approximately one-half of that of the open sea. Judging from this figure, the spring range is from 30 to 35cm and the neap range is approximately from 15 to 20cm.

According to the survey conducted at the tip of the waterway, change in the tide level takes place a little later than in the open sea but it rises almost to the same level of the high tide of Rat Island (Koh Nu) which is given in the Tide Table.

Though survey was not conducted of the tide range of the lake, a trial calculation conducted on the assumption that the water level of Lake Sapp rises uniformly indicates that the water level of Lake Sapp is to rise 17cm at spring tide and 12cm at neap tide. These figures are considered appropriate judging from the aforesaid tide range at the middle of the waterway.

As to the datum level on land, benches are located at several places in the city of Songkhla, taken from the datum level of Rat Island (Koh Nu).

The main bench, called Mg, is located in the vicinity of rocks near the Samila Hotel and its height above sea-level stands at +3,468m above the datum level(the value used in 1967).

This Mg. bench and a temporary Nu bench, which stands at the base of the Naval pier, were employed in our survey and boring operations. This Nu bench had been transferred from Mg. bench, and according to a check made recently by this survey team, a difference of 9mm was found against the distance of approximately 2km between Mg. and Nu as compared with the figure of the former location.

(2) Tidal Current

The marine chart shows the existence of a tidal current of 2 - 3 knots off the Port of Songkhla.

According to an observation conducted during this survey, it seems a tidal current of only about 1.5 knots flows in a northwestern direction at flood tide and in a southerly direction at ebb tide. In the waterway there is a current as a result of this tide range. The result of a survey of the tidal current conducted during

Photo-2 Mg Bench Mark

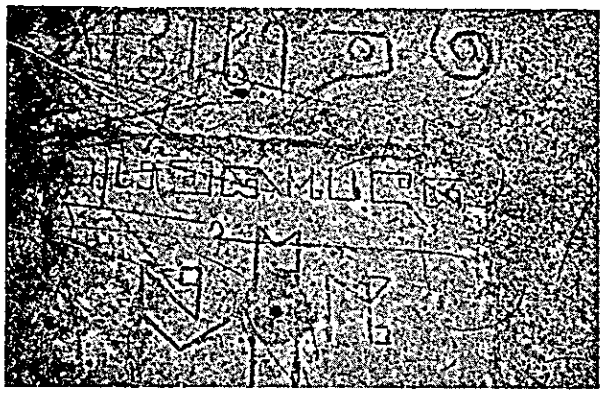


Photo-3 Mg Bench Mark

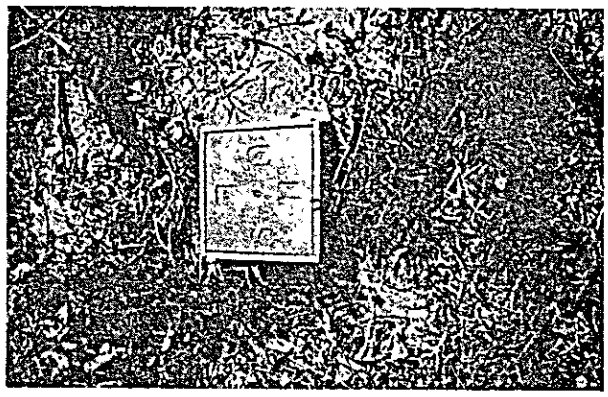
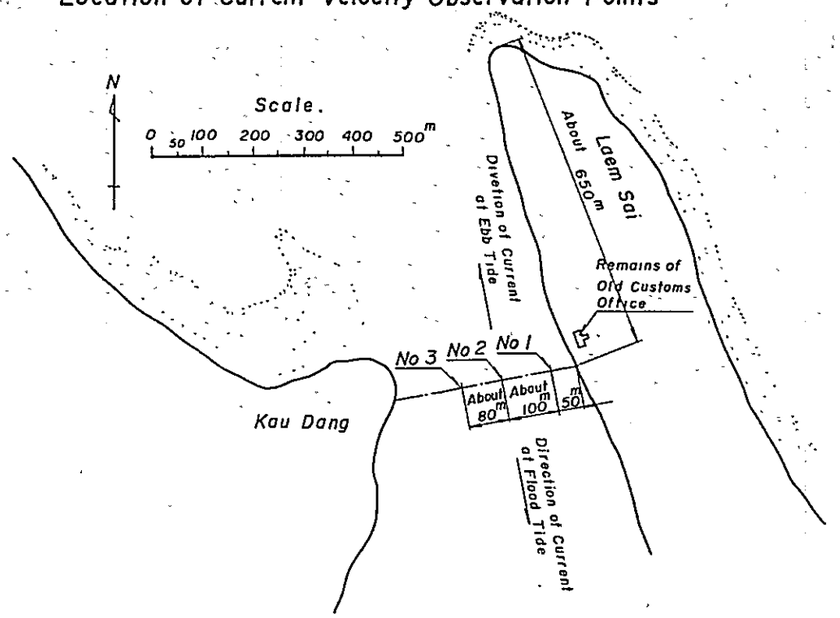
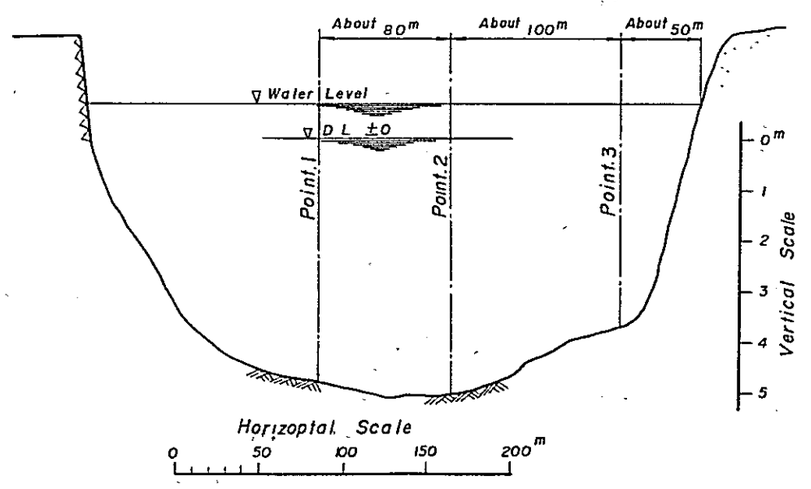


Fig. 20. Current Velocities Ovserved (During June 23-24, 1967)

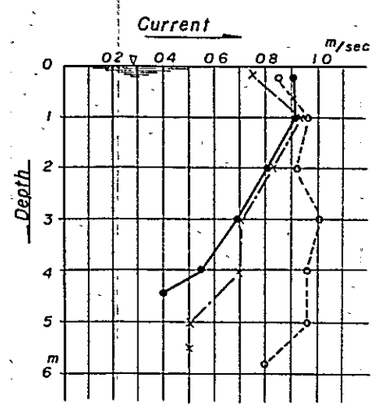
Location of Current Velocity Observation Points



Sectional View of Current Velocity Obseruation Points



Maximum Curret Velocity at Ebb Tide.



NOTES

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Maximum Current Velocity at Flood Tide

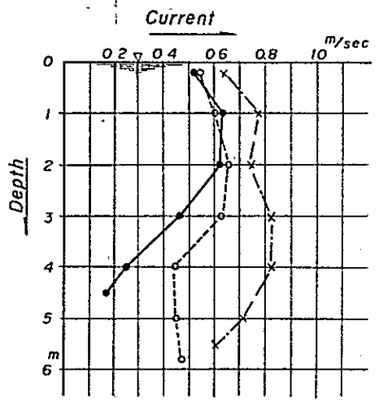


Photo-4 Scouring on the Projection of Songkhla Headland (1)

Photo-5 Scouring on the Projection of Songkhla Headland (2)

the period from 22 to 23 June, 1967, shows that at high tide, the maximum velocity of the current in the waterway is 0.8m/sec. in the direction of the upper reaches and the maximum flux is approximately 1,300m^3/sec. and at ebb tide, the maximum velocity of the current was 1.0m/sec in the downstream direction and the maximum flux was approximately 1,500m^3/sec. This high velocity of the current and large flux are recorded only at a specific time, corresponding to changes in the tide level.

Further, June 22 to 23, when our observation was made, happened to fall on days when the flood tide was on the larger side in that month and the tide range according to the tide table was 65cm. Since the tide range in late June shows larger values throughout the year, the aforesaid current velocity and the flux may safely be regarded as almost the maximum figures in the dry season.

Details of the results of the survey are as shown in Fig. 20.

(3) The flux and the velocity of the current in the waterway and the rise of water level in the lake at the time of floods.

When the vast water area of Lake Songkhla, or the vastness of the catchment area of the lake and the aforesaid massive heavy rainfall are considered, it is expected that the volume of water flowing out of Lake Songkhla is great and the velocity of the current in the waterway is high, as may also be gathered from the fact that there exist places of 10 meters or more in depth. However, because of the volume of water stored in Lake Songkhla, the peak of the out-flow is reached shortly after the rainy season sets in and continues from early November until early January. During this period the flow of yellowish brown water continues and the sea water is forced out of the waterway.

Of the relationship between the precipitation and the volume of flow, there is only one example of measured value, which was obtained on December 4, 1965. The precipitation in Songkhla in November of that year was 711mm and the average flux at that time was 2,100m^3/sec.

Calculation of the average monthly flux, on the assumption that the entire area of Lake Songkhla had the aforesaid maximum monthly precipitation of 1,185mm, gives the figure of 3,700m^3/sec. In this calculation, the volume of evaporation, the volume of infiltration into the ground and the volume of run-off to some other regions were taken into consideration.

As to the maximum volume of flow due to an abnormal rainfall, it would be appropriate to estimate it at 4,000m^3/sec. by making some allowance for the aforesaid value. Calculation of the velocity of the current in the waterway by considering the effect of the tide range on this volume of flow, 4,000m^3/sec, the maximum velocity of the current at the average cross-section is approximately 20m/sec. Therefore, the maximum velocity of the current near the surface would be between 2.5m/sec and near the bottom the velocity of the current would be approximately 1.5m/sec.

Again, a rough calculation of the extent of rise in the water level of the lake indicates a rise of approximately 1.2 meters above the average water level of the open sea.

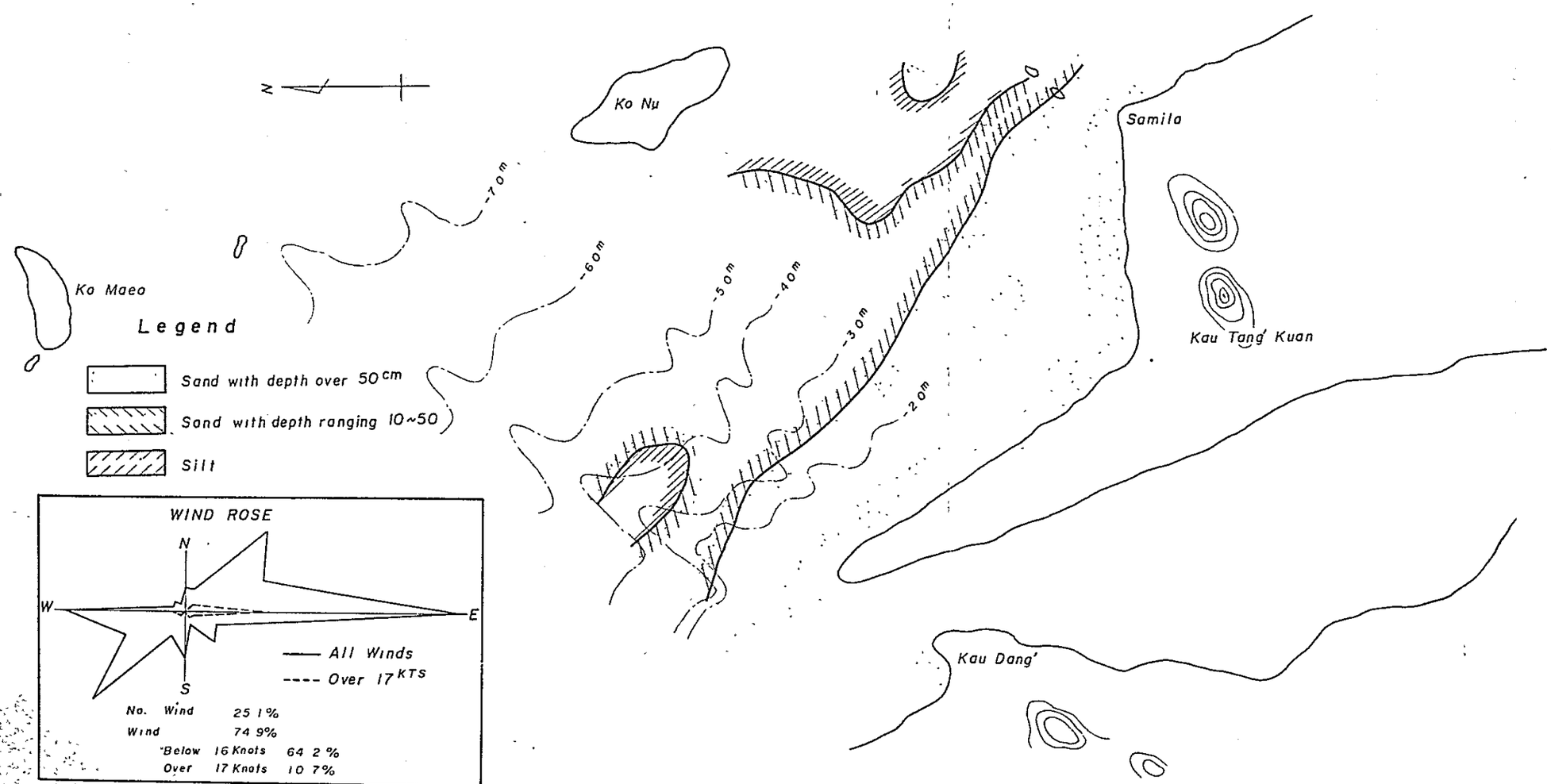
If the same method of calculation is to be applied to the heavy rainfall in December 1966, the maximum volume of flow would have been approximately 3,000m^3/sec. the maximum velocity of the current at the cross section of the waterway would have worked out at approximately 1.5m/sec. and the water level of the lake would have risen to approximately 1.8m, which is higher by about 0.8m than the average water level of the sea +0.972m. The water level at the center of the waterway at high tide of the open sea would have been about +1.6 meters. As it was, the fishery pier was not inundated, but judging from the fact that the surrounding area was under water, it is considered that this estimation is almost correct. Further, as for the damage on that occasion, some sections of the shoulders of the roads were washed away in several places on the side of the waterway at the projected portion of the headland. The condition on that occasion is illustrated in Photo 4 and 5. It is desired that a survey covering a long period of time should be immediately taken and a study should be made by all means in order to obtain surveyed values relative to the important points of the lake and waterway, as it is required from time to time.

(4) Waves

Waves at Songkhla become a main point of consideration as they surge right against the coast, driven by the continuous wind in the northeast monsoon season from January through February. At other times, waves caused by the passage of low atmospheric pressure become a problem.

Observation conducted from November through December 1965 indicates that continuous waves of 0.5 to 1.0 meter high were seen and that when a strong wind continued for some time, the height of waves reached approximately 1.5. There were many occasions when these waves developed in a short period of time, fanned by a strong wind.

Fig. 21. Soil Conditions at sea bottom (Surveyed on June 6, 1967)



Therefore, the sea formed white caps presenting an extremely rough aspect. Observations conducted from April through June of 1967 indicated that surges of a 10-seconds period or more were seen till mid-May and that a calm sea continued in June. During this period, however, a squall hit almost every day during the afternoon, a strong wind producing waves, which in many cases continued until even ing.

Even at these times, the waves showed white-caps frequently. Information obtained at the site revealed that the sea is calmest in May through June. It is worthy of note that a calm sea in the morning may suddenly turn rough in the afternoon. Such a phenomenon was also observed on the surface of Lake Sapp during our stay.

According to the record of typhoons, it is estimated that the waves from 1.5 to 2.0 meters high generated by a storm come in dozens of times a year and those from 2.0 to 2.5 meters high several times a year. The waves are caused by a large scale low pressure which comes once every few years, it should be appropriate to estimate the height of waves at around 3.0 meters. Also, it should be added that the shores of the waterway near the projected portion of the headland are eroded by waves generated by ships frequently passing through the waterway.

(5) Drift Sand

A walk along the sea coast and the shore of the waterway of the lake makes one feel that it is not too much to say that a forethought about the phenomenon of drift sand will definitely determine a port project. It draws our attention that where the shore line makes a curve, rocks are found scattered here and there in the sea. A view of the reefs along the shore in front of the Samila Hotel, of sunken rocks off shore, the alignment of a series of islands, and a view of a pecular topography marked by the shoreline along the foot of the hill and suddenly turning to end in a tapering tip against the rising hills on the sandy plain land behind---if with these views in the background, one thinks of the fact that an easterly wind is dominant in the area, and that the northeast wind is the author of storm which in turn generates high waves and causes damage to the beach,. one would feel as if he were watching a piece of formative arts which the phenomenon of drift sand is working on at a certain moment as it drifts along in the northwestern direction.

On the opposite shore of the waterway of the lake, which almost parellels the sea coast, along the foot of a hill near the outlet to the sea, a line of exposed rocks is found and where it breaks, the outlet of the waterway is formed. On the extension of the waterway, there lies a long sand bank. It is considered to have

been formed of the aforesaid drift sand carried by the current as it flowed to the sea scouring the shores when the water level of the lake rose and of fine floating matter contained in yellowish water carried directly by the current and scattered around the mouth of the sea. All along the coast from the Samila reefs to the tip of the headland, the area along the coast line which runs past the opening of the water way, and along the foot of the hill and further to the west, marked with oceanic complicaties and the current in the waterway, the nature of soil of the sea bottom shoulc, therefore, also be complicated, and especially after a storm, the shallow sea bottom near the sea coast should naturally be disrupted. For this reason, what is desired is to obtain complete data relative to various phenomena that have worked over a long period on the coast line and the contour line of the sea surface surrounded by a series of islands and the coastal line. The sand along the straight shore line to the southeast of the Samila reefs is composed of relatively coarse grains of 1mm or more in diameter. It was observed that the sand on the shore line northwest from the point of indentation is good and similar to the sand found on the beach of the waterway of the lake.

The sea bottom is shown in Fig. -21. In the area from Samila to the tip of the projected portion of the headland, the sea bottom is covered by a layer of sand 50cm or more thick over the distance of 500 - 1,000 meters from the beach and further out to sea, the layer of sand is only from 10 to 30cm thick.

Judging from the fact that this boundary line almost corresponds to the contour line of -3.0m in depth, the limit of the violent movement of sand on the sea bottom is presumed to be along the contour line of -3.0m in depth.

Judged from the volumes of drift sand along the coast, it is gathered from changes seen in the beach and sand banks off the tip of the projected portion that drift sand moves along not only in the northwest but in the southeast direction alike. However, the movement in the northwest direction is prominent and it is estimated that one hundred thousand cubic meters of drift sand is moving in that direction every year even when the movement in one direction is set off against the other. The volume of earth and sand discharged through the waterway of the lake is still to be determined, but of the earth and sand and rubbish flowing into the lake from surrounding areas during the rainy season, only light matters are presumed to be carried toward the mouth to the sea in a relatively short period of time.

Since the area through which the lake water flows into the waterway is narrow, it is pointed out that consolidation of this area at an early opportunity and a measure in the direction of simplifying the relationship between the lake water and the waterway will result in easy maintenance of the depth of the waterway which is to serve as a berthing basin and consequently in reduced expenses for maintenance and dredging operations.

Section 4. Soil

This survey team conducted soil surveys at a total of 45 points, with three divided characteristics in mind, the waterway of the lake, the projected area of the headland and the open sea. At the represntative points out of the 45 points, sample soils in natural state were collected and put to required physical and dynamical tests as well as the standard penetration tests and determination of soil nature on the site were conducted.

The soil in the waterway, in general, is covered by fine sand to the depth of about -11.0m from the sea bottom, but beneath it a layer of brownish clay of the laterite type continues. This layer of clay is hard and strong. The soil at the projecting portion of the headland is composed alternately of sand and clay, and at the depth of -11m, a layer of hard clay similar to that in the waterway, is found, and between them lies a blue gray soft layer of alluvium.

The uppermost layer at the bottom of the open sea lies a thin layer of coarse sand and near the coast is soft blue gray layer of a alluvium clay lying underneath. The strength of this layer of clay is about 1/2 of that of the clay in the waterway and no increase in strength is seen in the lower layer. Also, both in the waterway and the open sea, no rock foundation or hard oild is found down to a depth of -10m.

A typical soil columnar chart for the waterway and the open sea area is given in Fig. -23. Judging from the results of soil tests, there is little difficulty in constructing port facilities in the waterway in terms of the strength of soil, however, in the open sea area, the soft ground foundation will require serious consideration. A hasty adoption of the constructions on the open sea side may invite an increase in construction costs or extension of a construction period and the soil condition shows that building heavy structures there could cause a breakdown or give rise to problems such as sinking in the future.

Songkhla No. C-2

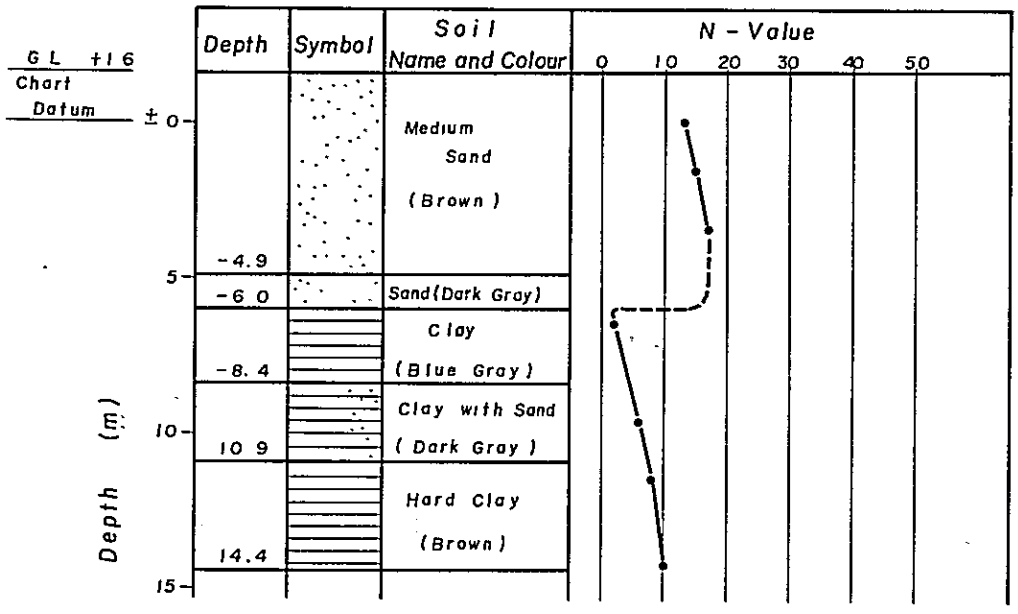
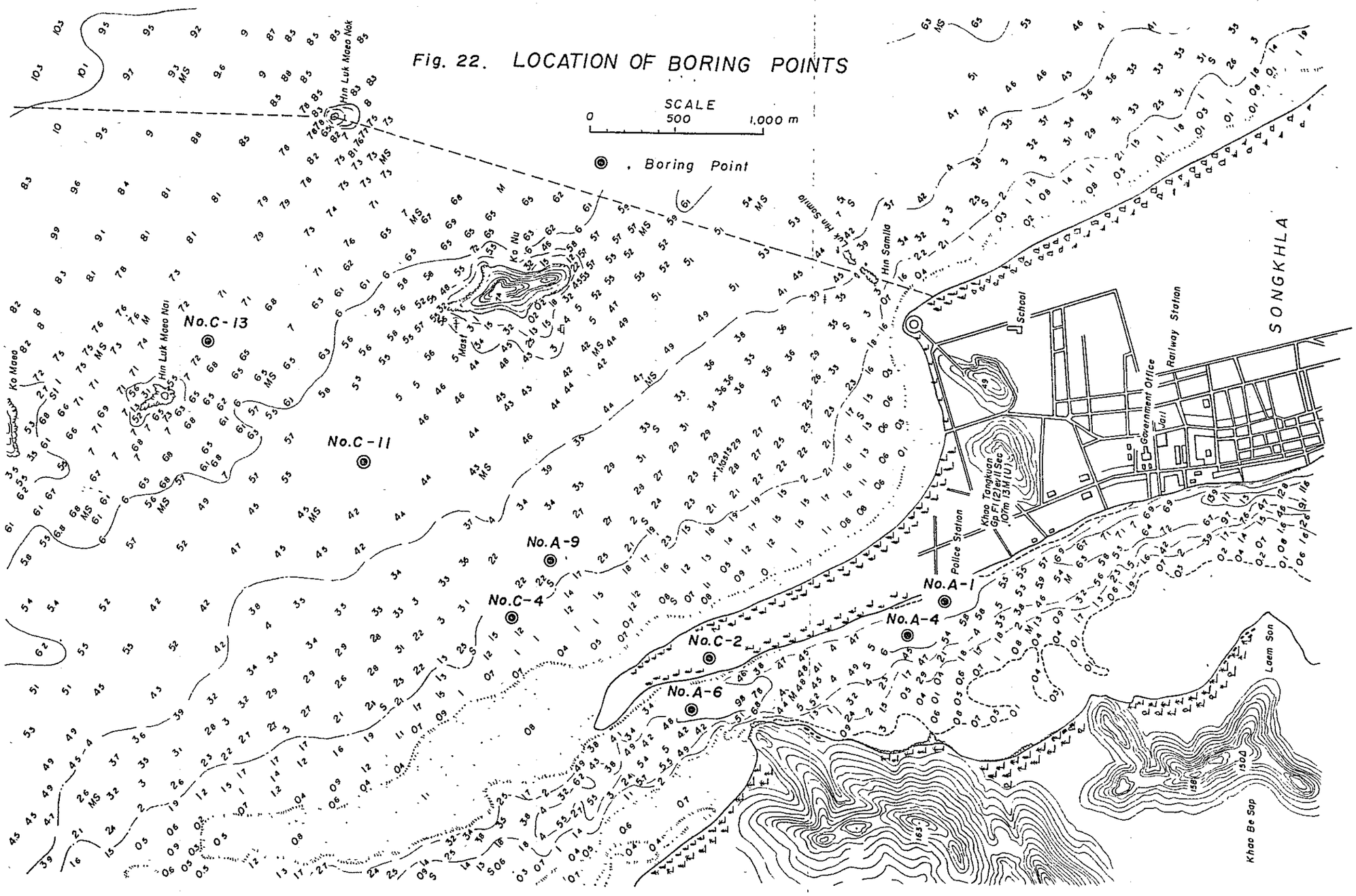


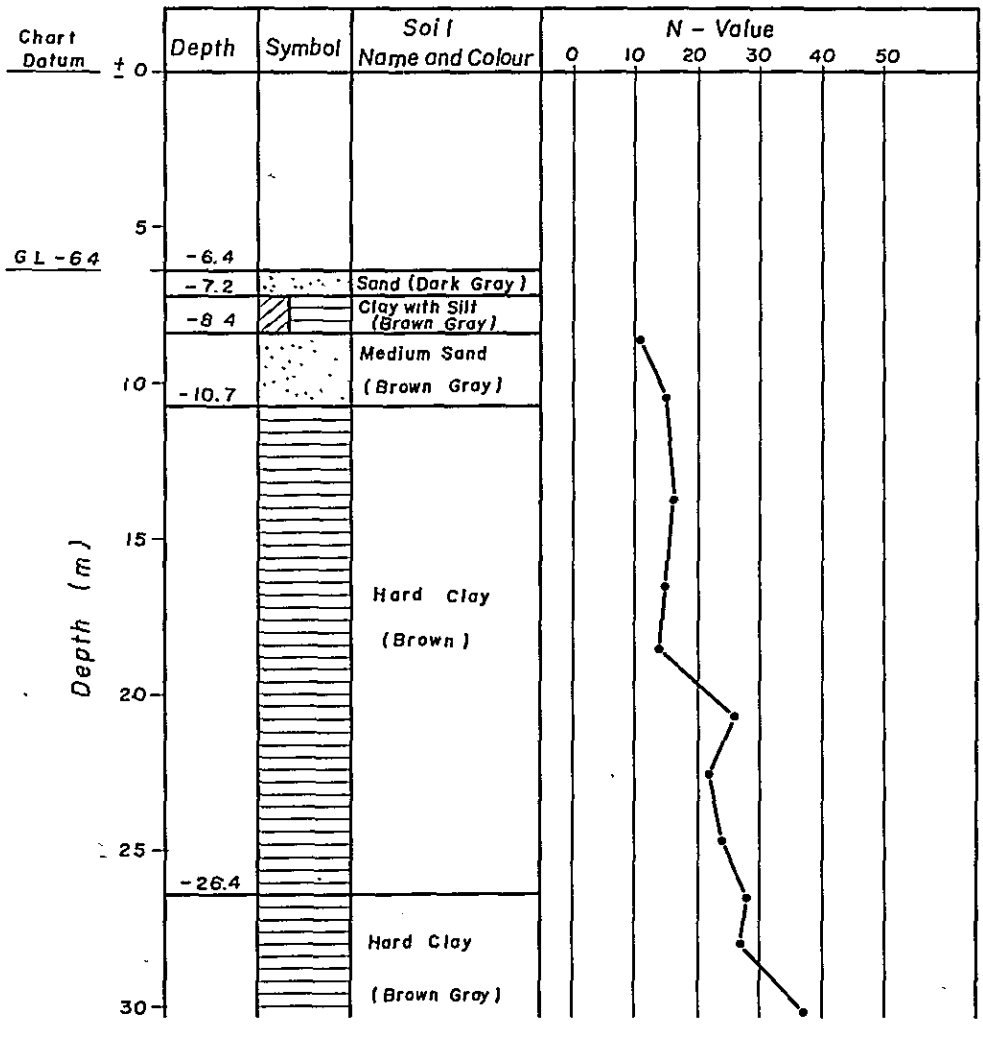
Fig. 22. LOCATION OF BORING POINTS



Section 5. Recommendations

What was most keenly felt was the shortage of required basic survey data for consideration in connection with the port construction, such as construction of structures, provision of the required land and ship maneuvering areas, with the result that specialized knowledge and experience had to be relied upon to work out inferences and assumptions to turn to in many cases. This may have been inevitable. However, it is recommended that in the future an attempt be made to collect basic data and to conduct various surveys over a long continuous period in preparation for the extension project at the earliest possible time. Investigation required for the surveying of drift sand along the sea coast, various surveys on hydrographical phenomena with emphasis on a new port entrance and comprehensive surveying of soil and sea level may be cited. It should be added that the sinking of structures, phenomenon of drift sand against artificial constructions, total sinking of a pier area (very often caused by the pumping out of underground water) have been observed as possible problems in this area which may cause disaster after the completion of the port.

Songkhla No A-1 Fig. 23. Soil Profile



Chapter 2. Present State of Port Facilities

Section 1. Navigable Passage and External Facilities

There is no man-made navigable passage to the port of Songkhla which lies on the lake's waterway. Fishing vessels, large and small, passing through the port choose the deep route close to the coast of Songkhla city for navigation and must trace the natural channels when putting out to sea. Because of reliance on the natural waterway, even small fishing craft are unable to sail out to the open sea directly from the tip of the projected portion of Songkhla headland due to banks and shallows which exist around the port entrance. Because of the changeability of these long shallows and banks, there is no fixed route leading to the outside of the port. There are no facilities such as breakwaters in the port of Songkhla at present.

Section 2. Mooring Facilities

Table 18 shows a list of existing mooring facilities. Facilities shown in Table 18 were constructed in the course of natural development, extending over approximately 2km in front of the city area of Songkhla.

Except for the newly constructed marine pier, simple wooden piers and about an equal number of those of concrete pile sub-structure boarded over are used as mooring facilities. The newly constructed marine pier is the only public mooring facility and other facilities are privately owned by shipping or petroleum companies.

In front of the park, there are many wooden mooring posts, simply driven into the ground and connected to land by boards.

Section 3. Cargo Handling Facilities

As to the existing cargo handling facilities at the port of Songkhla, there is a 1-ton derick crane, owned by THAI NAVIGATION CO. LTD., a shipping company and a loading chute owned by HARINASUTE CO. LTD. This chute is used to load a ship with silica and manganese carried by trucks to the port.

Cargo handling is done mostly by hand and even in the case of THAI NAVIGATION CO., LTD., the cargo unloaded at the pier by a derick crane is being transported to the company's ware-houses about 50 meters away by monocycle. In the case of cargo handling in the off-shore ships' dericks are being utilized.

Table 18. List of Existing Mooring Facilities

Name	Front Depth in meter	Width in meter	Construction	Remarks
Navy pier	-4.0		Concrete pier	
Marine Police pier	-3.5		Concrete pier	
Thai Navigation Co., pier	-3.5		Concrete pile covered with	Equipped with 1 tone crane, capacity· 150t/d
Sammit oil floating tank	-3.0		wooden boards	water supply facility monthly sales of 140t, only water supply facility which can be transported by ship.
Shipyard			3 rows x 2 ships	Only wooden vessels of 30 GT
Shipyard (Shinsakon Co.) pier				For 200 GT
Shin Tong Co. pier	-3.0		Concrete pile covered with wooden boards	Repaire of netting boat possible. Open storage area 1000m^2;shed 50m^2, for shipping of silica sand.
Esso oil pier	-30.0		- do -	Capacity: 33,000l, 95,000/month.
Marine pier	-40	90	Concrete	
Fish market pier	-2.5	5	Concrete pier covered with wooden boards	Unloading of fish and ferry service between islands in the lake.
Esso oil tank				Capacity: 18,000l, 14,000l/month
Shell oil tank				Capacity: 32,000l, 10,000l/A
Caltex oil tank				Capacity: 80,000l, 15,000l/month
Custom pier	-3.5	30	Concrete pier	
Harin aste co. pier	-4.5	10	Concrete pier	Equipped with facility for water supply
Ruble pier	-2.0		Concrete pier covered with wooden boards	
Summit oil pier	-2.0			With loading deck, capacity· 40,000
Oil floating tank	-45			200,000l/month

Section 4. Wharf Facilities

(1) Storage and Warehouse Facilities

Warehouses owned by the shipping companies are located in several places. Warehouses are generally flat wooden bouidings and some are old and generally in poor condition. Privately owned warehouses are found built together with owners' dwellings on the seaside. Floor area of the warehouse is spacious compared with the volume of cargo being handled and warehouses full of cargo are seldom seen. Also, because of competition among the shipping companies for cargo handling, storage free of charge is often the case.

There is no transit shed. On the aforesaid marine pier is a cargo sorting section, which is being utilized effectively.

Oil storage facilities are gasoline stands and the capacity of each stand is shown in table 18.

As for lumber yards, coal yards or storage facilities for dangerous goods, there are none worthy of mention. As for open storage, there is one for manganese along the port railway and another, which is part of a shipping company's compound, is being utilized for handling cargo and for silica.

(2) Port Transportation Facilities

Main roads in the city of Songkhla are of 5 to 10m in width and have an excellent road surface and alignment and are paved.

The center part of the roads are paved with asphalt. Compared with the main roads in the city, the roads in the port area, such as the road to the marine pier and the one passing in front of the police station and extending to the projected portion of the headland, are extremely narrow with a width of around 4m.

A port railway extends from Songkhla Station to the southern end of the city but is not connected with the present port area.

However, at Songkhla Station there are side tracks capable of handling heavy cargo.

(3) Other Related Facilities

Light house: One light house is located on the top of Mt. Chgo Tong Kuan. (100m high)

Radio Beacon: Located on the top of the aforesaid mountain.

Water Supply: Facilities are found only at HARINASUTE CO., LTD., and others use well water carried by carts.

Filling Station: Located in 5 to 8 places.

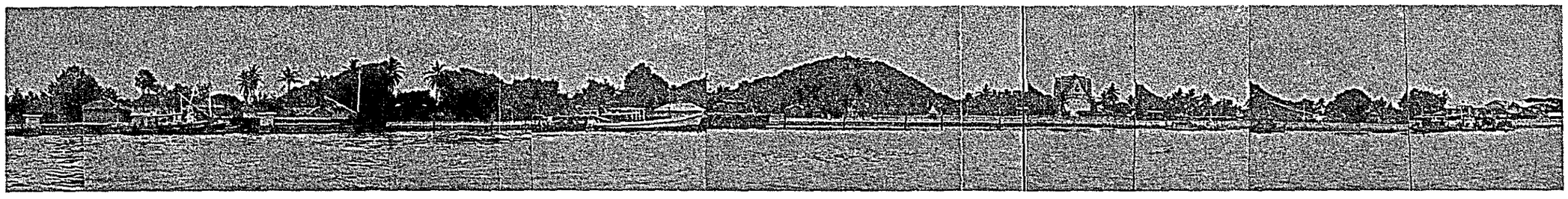
Facilities for Ship Repair: Two docks of a slipway system exist and have a capacity of repairing ships of about 100 tons.

(4) Management Organizations

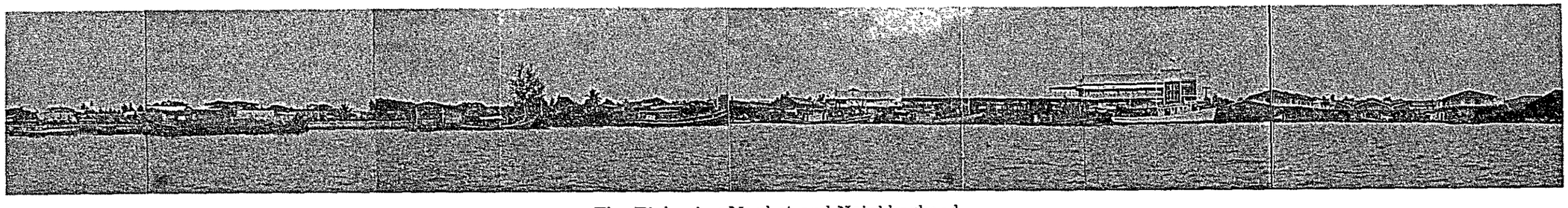
A greater part of the port facilities are owned by private enterprises and there is no management organization equivalent to the port authorities at the port of Bangkok.

Detachments of the Government agencies related to the port which are found in the city of Songkhla, though they are not the maganement organizations, are as follows. Port Bureau, Customs Office, Water Police Station, Marine Products Bureau, Weather Station, Emigration Office, and Public Hospitals.

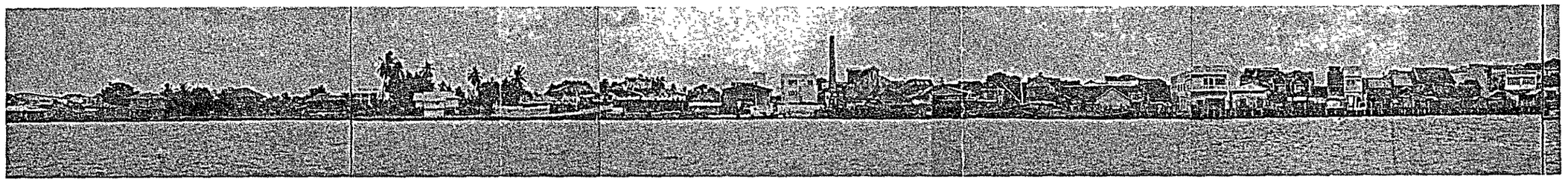
Present State of Songkhla Port



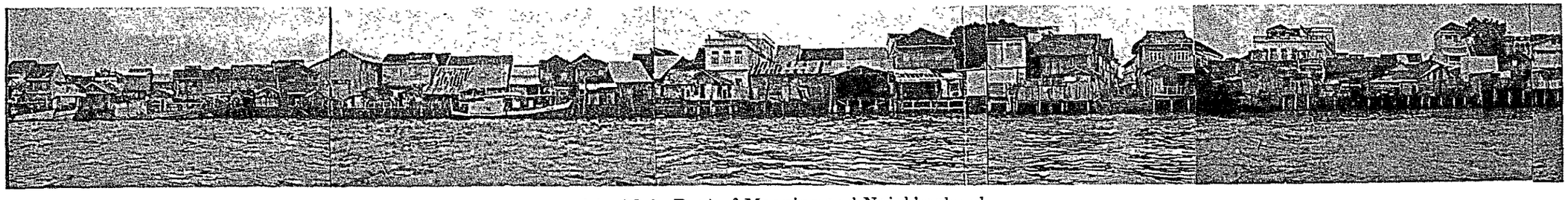
The Riverside Park and Neighborhood



The Fisheries Market and Neighborhood

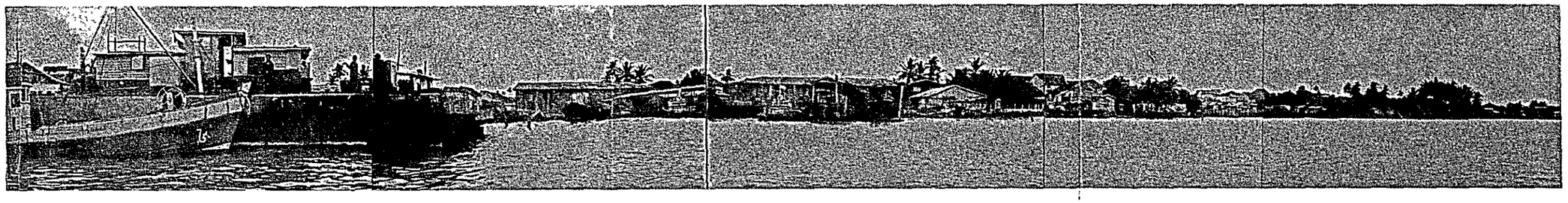


The Central Market, Mooring and Neighborhood



The Main Part of Mooring and Neighborhood

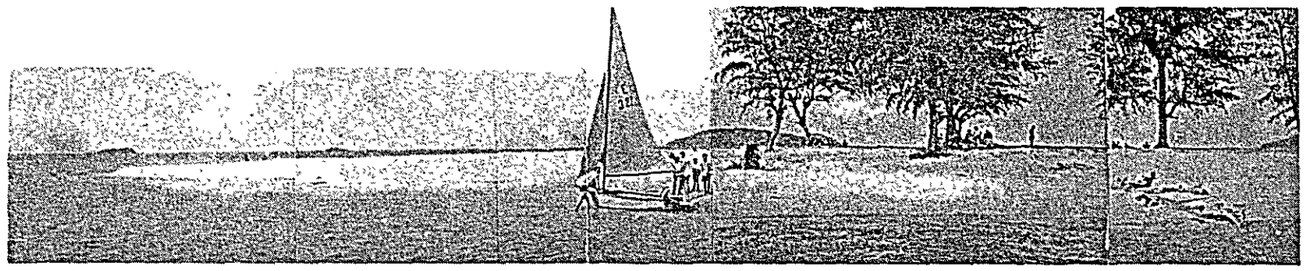
A Quay Wall look on to the Mouth of Lake



The End of Mooring (proposed a railway siding) look on to the Mouth of Lake

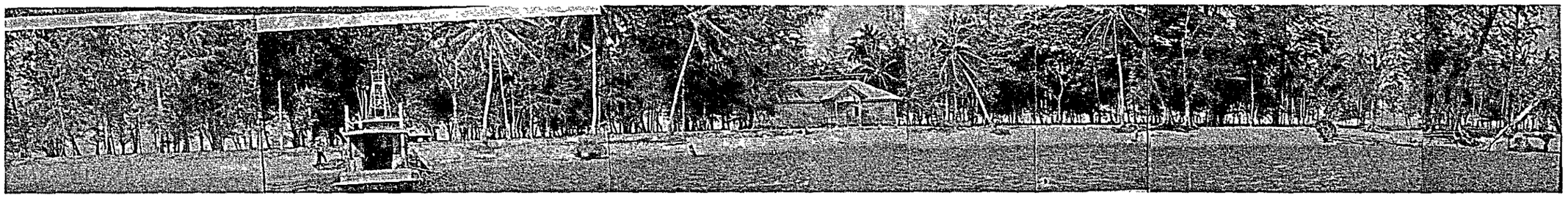
PART IV. PORT AND HARBOUR PROJECT

Photo-6 Present State of Songkhla Port



The projected Portion of Songkhla Headland

Excavating Point at Harbour Entrance

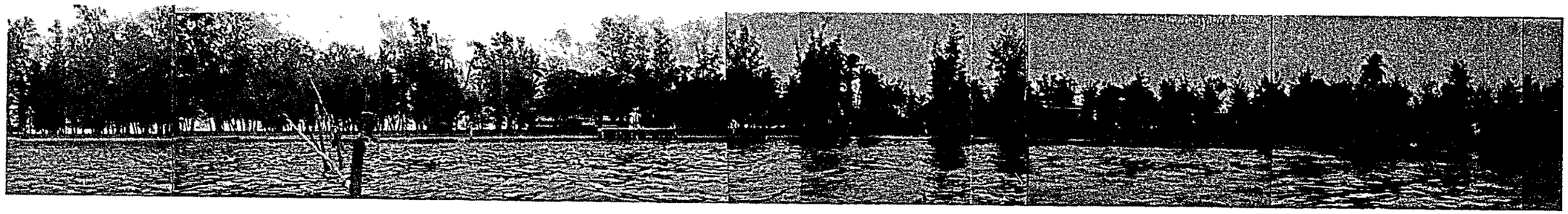


Breakwater Groin links Revetment

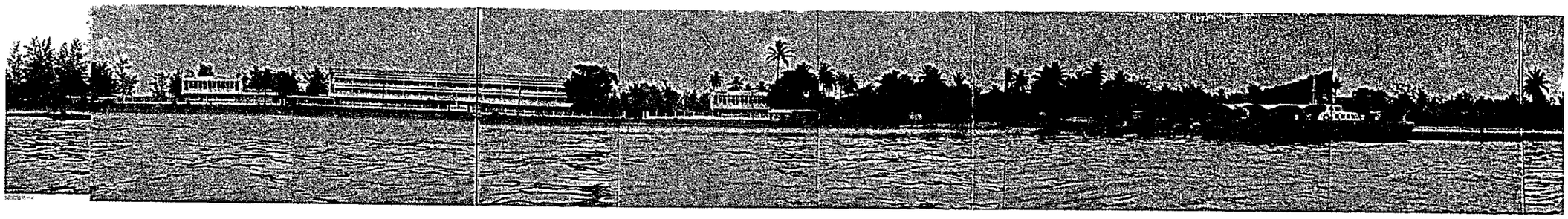
Revetment

Lighter's Wharf

-5.5m Quay Wall Point



-5.5m Quay Wall links -8.0m Quay Wall



-8.0m Quay Wall Point

The Riverside Park

As a site for a new port to serve this purpose, two alternatives may be supplemented -- the one: on the waterways leading to the lake, the other on the shore facing the open sea at the tip of the headland.

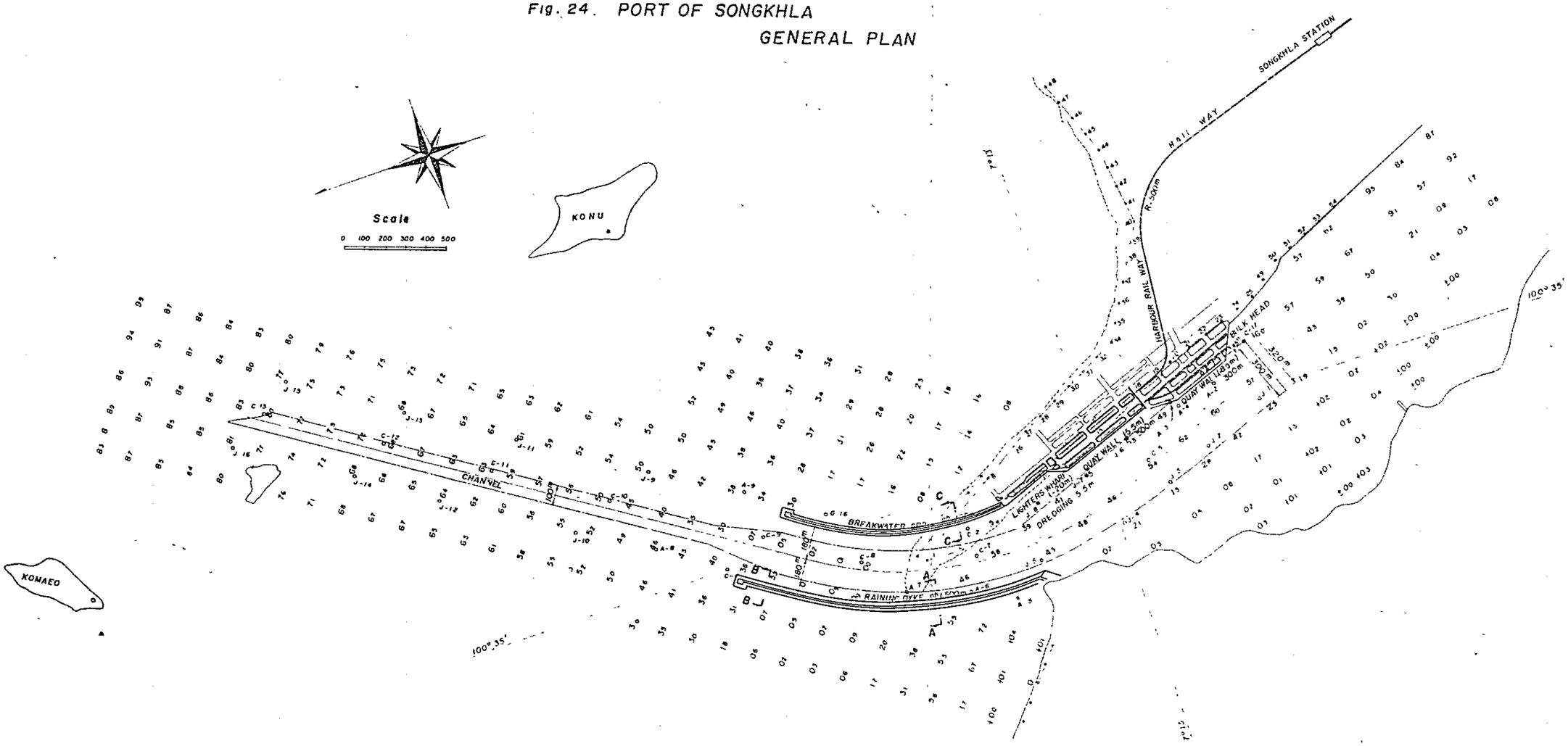
Taking into consideration the weather and geological conditions, the volume and kind of goods handled, the connection between the city area and the new port area, construction cost and the ultimate shape of the port of Songkhla, the team preferred the former for the initial stage of the plan.

Adoption of the latter for a site involves many unknown difficulties. It would be necessary to have an accurate knowledge of the phenomenon of drift sand and based on this knowledge, to construct a large dike or breakwater. However no data is available for this breakwater, if constructed, it would provide a calm basin but not necessarily provide a safe shelter from strong winds and the sea-beds of soft soil might unexpectedly involve large construction costs. It can't be said to be economical to spend a big investment, in the structure like breakwater which is no use other than during rough seas and is not directly profitable to either ships or cargos at all times.

Against this, the preferred plan to provide anchorage on the waterways in side consists of the construction of two short training dikes, which are to serve not only as a breakwater and a sand protecting dike, but as a new current conduct cutting away from existed big bars in the estuary by excavating the tip of the headland to make a port entrance. The constructive work will be executed with relative ease and with such accuracy that we can tell the exact time when the port will become available according to the establishment of a skilled plan of the construction program. Taking into consideration all natural conditions, hydraulics, soil mechanics and attaching importance to the maneuvering of ships, the team would like to adopt the type of dykes as shown in Fig. -28. If the port is to be utilized by all visiting ships and to be able to serve as a supplementary port to Bangkok Port, as well, the port should be furnished with a navigable passage and anchorage which have a depth of -8m to -9m. To this end, the passage outside the port and the anchorage inside the port need dredging. The earth from the dredging is to be used to raise the wharf area to such a level as will be secure against floods caused by extraodinaly heavy rainfalls and to create land of the minimum area required for railways, motor cars, transit sheds and warehouses to function to their full capacity. Any surplus earth is to be thrown in behind the training dikes to reinforce them and at the same time to build a foothold for a fishing port to be constructed in the future.

A ground plan is given in Fig. -24. The number of berths has been decided so as to match the number by size of ships coming into port as well as to cope with maneuvering of ships and future expansion.

Fig. 24. PORT OF SONGKHLA
GENERAL PLAN



Stage 1
- 赤 線 Sub stage 1
- 黒 線 Sub stage 2

Section 3. Subdivision of the First Stage.

(1) Subdivision of the First Stage

In consideration of insufficiency of funds on one hand and the lack of experiences on the part of the natives in taking the modern port into stride, on the other, it is possible to think of constructing, first, a wharf for exclusive use by home trade ships, and when land facilities and transport routes of hinterland are fully consolidated and their operation is under way, then a wharf for foreign trade ships. Viewed as a whole, however, this means not only doing much of the work once done, which is uneconomical but will cause retardation of the development of the new port. Surrounding circumstances have forced us to think, as a last resort, of dividing the first stage into two sub-stages, given for reference in Fig -25. This is to provide a navigable passage and anchorage of -5.5m deep and a matching wharf for use by ships of 1,500GT. By this method most of the dredging cost and the whole of construction cost for the wharf for external trade ships can be dispensed with, reducing the initial cost of construction.

(2) The Second Sub-Stage

Supposing the 2nd sub-stage is to be started upon completion of the 1st sub-stage, the navigable passage will then have been in operation, dredging work under such conditions will naturally be costly because of the lower efficiency of a dredger. Much of the work once finished will have to be done over again, such as re-placing navigation aids, establishment of preparation for works, construction of an extending quaywall cutting away a part of temporary wall, and inconvenience will lead to a higher total cost in completing the first stage project.

It is usual for the 2nd sub-stage work to start at least several years after the completion of the 1st. This is unwise from the standpoint of a repayment plan, to say nothing of disadvantages to ocean-going ships during this period and the resulting delay in the development of the district. The 2nd sub-stage consists of increasing the depth of the navigable passage and the anchorage up to -8m, upon completion of which it is expected that not only ships desirous of making use of this port but also large ocean-going ships now calling at Bangkok (ship of 6,000GT) will have access to this port

This will bring into being a well-balanced wharf for both coastal and ocean-going ships which is considered to be the minimum requirement at present in Thailand. It is advisable as far as circumstances permit to adopt a plan for the First stage to be carried out at one line regardless of their devision into two sub-stages or not because the recent trend of larger ships and their facilities are unavoidable.

Section 4. The Second Stage Plan

Upon the completion of the first stage work, ocean-going ships will begin more frequent visit than coastal to make port, engaging in handling cargo. Activity in the handling and transportation of goods is bound to bring about rapid transaction in perishable foodstuff, fuel, water, and ships' fittings, not to speak of the spendings of ships' crews, which will stimulate the economy. Increase in trade will bring prosperity, first, to the communication and transportation industries and banking; the construction industry will then be attracted and the city area will begin to expand. The success of the new port entrance will accelerate the building of a large base for coastal fishing boats. To summarize, a city with development potential, which Songkhla is, will become animated as illustrated by a familiar example, Penang, which now embraces a population of 700,000 only because e it is an ocean going ship stop over port.

The speedy rise of new industries is bound to give rise to a land problem. Increase in kind and volume of goods handled will necessitate the building of new sheds and godowns, of a shipbuilding yard and a repair dock, of a thermal power station which will have to depend upon imports for fuel supplies, provision of timber pools and a shipping pool for small ships, the building of an open storage for construction materials such as sand, gravel, iron and steel and of the expansion of a port construction office. All these require suitable waterside ground for their sites, which should be secured beforehand lest they should prove a bottleneck in the way of carrying out the plan. A certain area of suitable land will have to be reserved in good order for a residential area to meet the expected inflow of people and for a residential quarters for workmen as well. With these in mind, an all-round comprehensive plan should be made for the 2nd stage and those following.

In coping with the increases expected in the near future in the number of berths for ocean-going ships, the water surface extending along the shore up to the frontage of the waterside park of Songkhla City is considered the best site for expansion of the wharf. Sites for a expanded port construction office, a maintenance yard of navigation aids, a storage of dangerous goods such as oil, a power station, a wharf for safekeeping of oil and bulk freight brought over by ship, and a new shipbuilding and a repair dock for ocean ships, it would be common idea to keep free for future reclaiming the shallow part of the water way on the opposite bank of the new port wharf along the foot of a hill. For mutual approach between the expanded port area and the surrounding village area, it is now planned to build a bridge, tunnel, ropeway and ferry facilities near the port entrance and at a narrow place where the lake pours into the waterways.

The plan of extension presupposes a reasonable solution of these problems: the

size of the anchorage area in the port, the effect of tidal currents on the flooding of the reclained land due to a rise of the lake during the rainy seasons, preventive measures against sand drifting from the lake into the anchorage area, and how to reduce maintenance dredging of sediments.

By the time when Songkhla shows itself as a full-fledged port town, there will possibly be arising problems and accidents due to joint use of the port entrance between fishing and merchant ships, there will be a desire for the separation of the fishing sector. By then becoming ship berthes will be too few to handle increasing transit cargo, and impeding quick despatch of ships. On the other hand, the economy of the city will have expanded and will have been strong enough for the expansion of facilities to be carried out, necessary data accummlated over a long period of time on natural conditions will have been made available, and the port construction engineering and its technical skill will have greatly improved. In these circumstances, there will be advise to move the fishing base to the outer side of the training dike, north-west of the foot hill on the opposite bank, and the construction, by comprising the island in the offing of the open-sea shore, of a new port with an anchorage area which will contain a wharf for exclusive use by ships carrying transit cargo or an isolated wharf for dangerous cargo such as oil brought over by large ships. Concurrently or shortly after a plan for the development of the lake and rationalization of transport routes both on land and by water will be put forth. This will encourage integration of Hajai City with Songkhla, which will produce a new broad situation favourable to utilization of water-side land by converting part of the lake into a light industry zone as part of the city. Fig. -26 is the outcome of a stretch of imagination with all this in mind.

Viewed simply in the light of the present state of things in Songkhla, the plan may be no more than a pipedream. It is to be noted, however, that it is a product of the survey of social economy of Part I and of natural conditions of Part II and is based on the experience we have had in our own country. All this is to develop out of, and in close relation with, the first stage plan. Hence its inclusion in this report.

Fig. 26. General schedule for development of the port of Songkhla (Final stage)

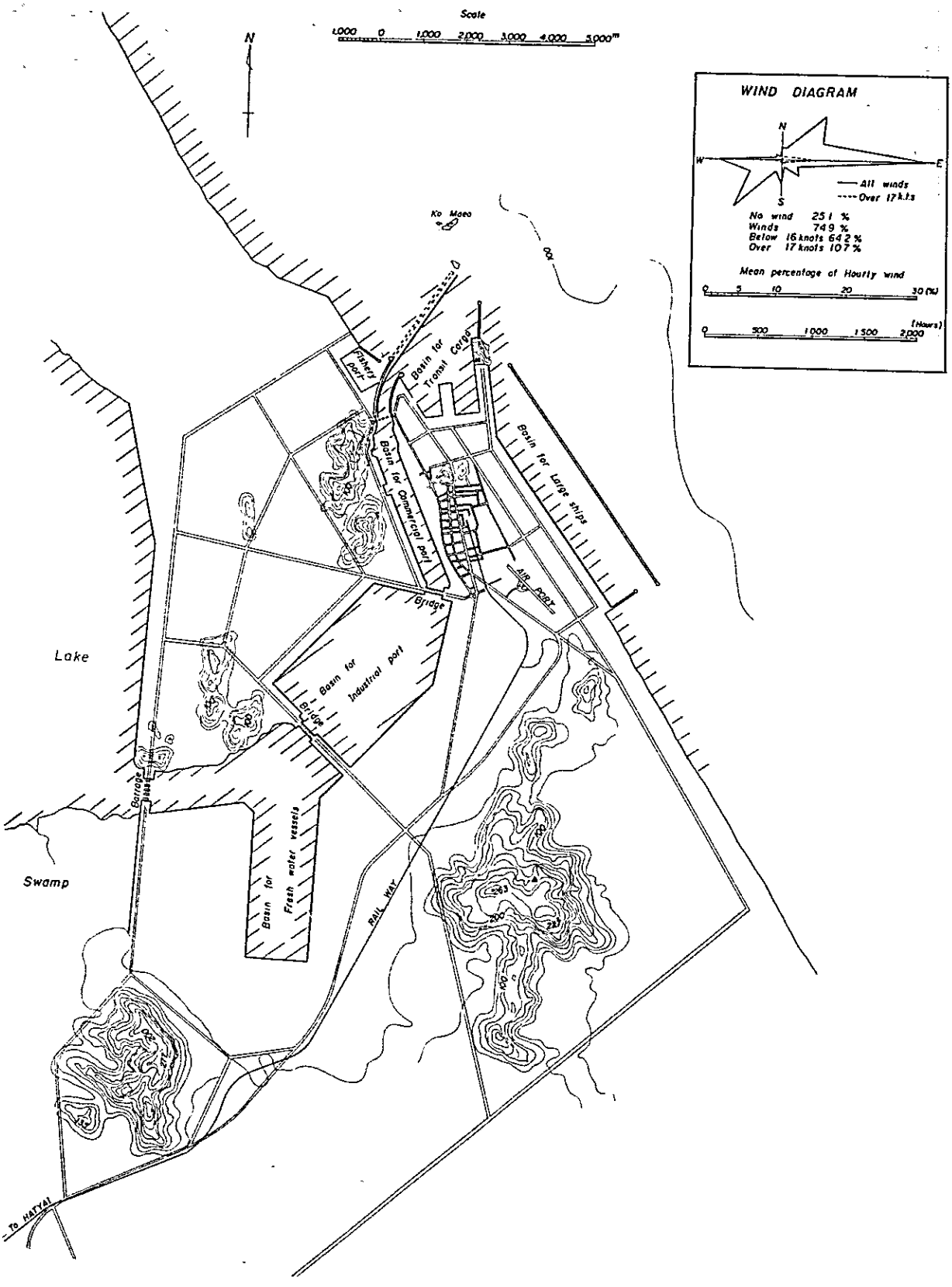
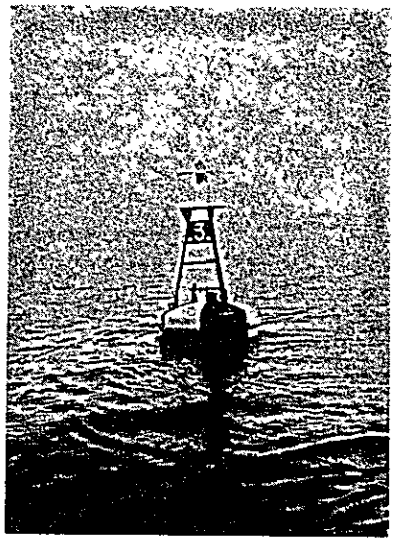
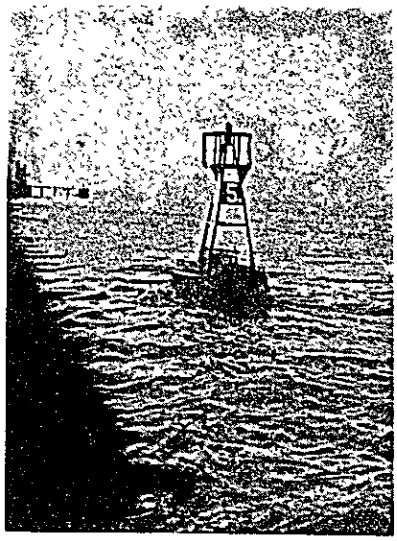


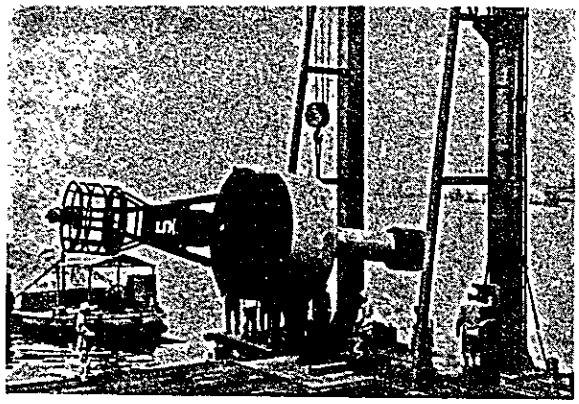
Photo-7 Example of Navigational Aids



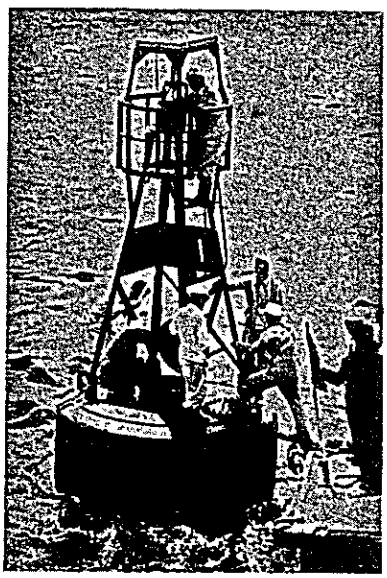
Special Signal Buoy



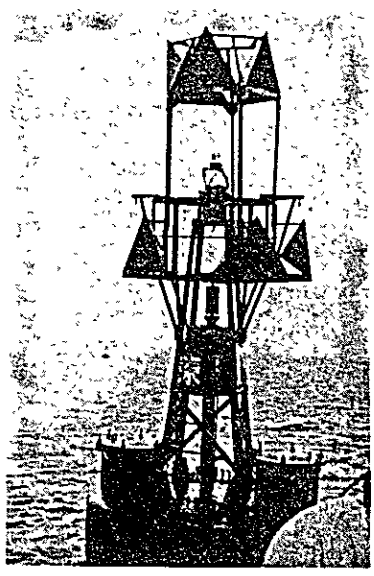
Ordinary Light Buoy



Buoy Handling at Aids to Navigation Base



Solar Cell Type Light Buoy



Wave Rower Light Type Buoy with Radar Reflection and Phone Signal

Chapter 2. Plan for Port Facilities

The following description concerns the contents of the first stage plan as proposed by this team.

Section 1. Water-Surface Facilities

(1) Navigable Passage

In this plan the width of the navigable passage is set at 200m between the training dikes and at 100m in the open sea as far as the -8m contour line. The largest ship the plan has in mind is 6,000GT (or 8,000GT, if required). Ships of this size will be able to make shift with a 100m-wide passage for the present, provided navigation weak control is in force on the open-sea passage. While the passage makes a large curve as it enters the waterways between the training dikes, whips cut their speed in their effort to moor, resulting in limited freedom in their maneuvering. On this account it is not unlikely that some large ships may have to depend on tugboats depending upon the circumstances, diminishing the efficiency of the port. For this reason the passage is to have a width of 200m between the training dikes.

(2) Anchorage

The primary concern in the anchorage basin was to make enough room and depth for large ships to turn with ease and to secure frequent passage of small ships, and secondly, it was intended to secure from the forefront of the quaywall the required volume of earth for the creation of land for a new wharf site.

Since provision for a required number of berths is planned along the quaywall, it is thought there will be very few ships waiting berths. Although it is not unlikely that a ship larger (there was an instance of a 10,000GT ship making port) than those the plan has in view may come taking the tide or with a shallow drift and that small ships may crowd at a time in a larger number than the berths can afford, they ought to be able to make shift by lying at anchor in the anchorage.

(3) Navigation Aids

Navigation aids are indispensable in securing safe entry into port. This plan intends to errect a pair of large floating lights buoy with rader reflection at the entrance of the roadstead, a pair of small lighthouses at the entrance of the passage between the training dike and breakwater, a pair of guide posts on the mountainous side and ten simple floating lights along the curving part of the passages and basin to show the limit of the safe depth. As it is rarely foggy in Songkhla, that many floating lights and other marks will be enough to secure safe entry into port at all

times except during heavy rain when they will be out of sight. In the event of the open-sea passage being extended in the future, danger lights will be needed to show the existence of sunken rocks. As sources of light for floating light buoys, solar batteries or one to make use of movements of waves to generate electricity can be used. These are very easy to maintain and manage. Some examples of floating lights which have been working in Japan Port are given in Photo 7.

Section 2. Training Dike & Breakwater Groin

In planning for training dikes and breakwater groins, these points are to be noted: to secure safe entry into port, to protect the port from waves in the open sea and drift sand, to construct them in such a way as will require the least possible amount of dredging work on the passage and the basin with due consideration given to the curve, and that structures be designed at reasonable costs and have a cross section which promises security and appropriateness. In the case where the direction of the natural waterway has to be once choked and then changed as in our plan, due consideration has to be given to hydrographic problems, in addition to the above demands. Any error in the right solution of these problems would bring to nil all the merits of this plan which has been worked out so as a limited amount is need for investment.

The point from which the training dike and breakwater groin start on the inside of the port was decided in favor of the latter after consideration had been made, concerning the minimum distance required by a ship entering the port to run before it is moored and in case of steering out the distance before it gets its engine operating and to the former a radius of the curve enough to steer a ship by herself and to guide the flow of current smoothly, and keep the direction of outward passage in such a state that will allow ships at all times a safe access to the port avoiding the danger of grounding on a sunken shoal in the offing near the island or without being affected by strong winds.

According to our soil survey, any further extension northward of the training dike and the breakwater groin will be confronted by a sudden deterioration in soil nature of the sea-bed. Even though they should be extended any further, it would be questionable whether they would be effective and construction costs would rise sharply.

The interval of the training dike and breakwater groin was decided from two angles· to secure the width necessary for the navigable passage and to secure the cross section of the flowing water that is required during time of flood in the lake. The strong inclination of the center line of the current nearing the training dike on the northern side has been taken note of. As stated in the part on natural conditions, the section of neck passage should be so prepared as to counter the maximum discharge of 4,000m^3/sec. Should

this section be too small, there would be danger of the foundation of the structures being scoured or of overflowing. Should the width of the section be too large, the tractive force would naturally weaken, which would mean wasting money on the preservation of depth. The first sub-stage plan of the first stage put the depth of the navigable passage at -5.5m, and in this case the section is not large enough. But a heavy flood accompanying danger seldom occurs and an abnormal velocity of flow which will accompany such a flood will work to increase the depth, and there fore, it is judged nothing vital will happen.

The breakwater is so extended that its tip reaches a point -3m deep where it is considered the strong movement of beach drift sand in these parts dies away. Most of the drift sand is intercepted by the breakwater and begins to settle at its root on the east side. The coastline will gradually recede on the side of the west training dike under the influence of the frequent strong north-western winds. In the event that drift sand moving round the tip of the breakwater should go on accumulating and begin to fill up the navigable passage in any remarkable degree, then a simple submerged breakwater may be extended or a new sand protecting dam may be built near Samila sunken rock or some other measure will be taken based on the findings of the survey on natural conditions which will be conducted by that time.

In regard to the structural section of the breakwater, the adopted wave-height in the open sea is taken to be 3.0m. For the training dike section which forms the curved part of the navigable passage, should be a structure capable of matching the scouring force and care should be taken that it is capable of resisting overflow. In constructing a training dike and a breakwater groin, it is important to take care that the structures will be protected from the effect of waves caused by sailing ships, waves coming in from the open sea, and that small ships will not be disturbed in their navigation by those ripples coming deep into the port.

Section 3. Mooring Facilities

(1) Fundamental Elements

Investigation was made of the ships making entry into this port in past years with regard to their size liner or tramper, their use, circumstances in which they came into and out of the port, their moored days, the quantity and kind of goods they carried, etc. Careful estimation was then made of the quantity and kind of goods likely to be brought over in the future. As a result, the required number of berths by size of ships was worked out in this way: 3 berths for large ships, with 6,000GT taken as the standard; 5 or 6 for smaller ships, with 1,500GT: and several berths for miscellaneous ships of no more than 300GT. In considering things especially ocean-going ships, the present state of coordination of the neighbouring ports, which were thought to come into closer relationship with Songkhla, and the

trend of the world shipping industry as well, were taken into consideration. It was concluded that this extension of mooring facilities by size of ships should be the most appropriate both in terms of economy and function in the light of the present state of the Port of Songkhla.

How and where the facilities are to be constructed along the waterways is shown in Fig.-24, which is the outcome of various studies of the natural conditions, geographical conditions deemed advantageous to receiving, distributing and handling goods, how to economize construction costs, relations between the new wharf and the existing cities, consideration to future possible extension, etc.

(2) -8m Deep Quaywall

At present, three berths will be enough to accommodate ships of more than 3,000GT which come to the port of Songkhla. The standard type of ocean-going cargo ships of advanced countries shows a marked trend of growth in size, but most of them are of a 6,000GT class, their total averaging around 3,000GT according to the statistics on world shipping. Bangkok Port also adopts for a wharf for larger ships a structure to match -8.5m depth alongside. When there is a desire for expansion of Songkhla Port, it will probably be for this type of quaywall, and it follows therefore that a quaywall is to be constructed at a place where it can easily be extended.

Ships coming to Songkhla have to pass through the curved part into the waterways inside the port and then be moored. When leaving the port, they must, even with the help of a tugboat, make a gentle turn soon after starting the engine and leaving the berth. Hence they need some distance of a straight route between berth and the curved point of channel.

Large ships have a large quantity of cargo to handle. Their berth must naturally have a large area of land behind as sites for an apron, a shed, a warehouse, port railway, roads etc. The unit cost of construction per 1m will be higher in order to meet these conditions, a conservative project estimate has been made of a 300m extension of the -8m quaywall at a fixed place for two berths, at present, which are expected to handle 350,000 tons of cargo.

(3) -5.5m Deep Quaywall

Today's situation in the Port of Songkhla is such that the part playing the most important role has to handle 75 per cent of the incoming ships. Anchoring days taken into account, this produces a need for a quaywall of five berths. If handling capacity is taken into account, 500m is short of meeting the need. Most of the cargo handled consists of internal trade goods of various kinds, and calls for construction of a shed which can also serve as a role of warehouse. Ships of this type are by far easier to

maneuver than those referred to above, therefore, a quaywall for their use may be constructed nearer to the port entrance than the -8m-deep quaywall, facilitating their entrance and exit without being affected by the curve in the passage. In order maneuver than those referred to above, therefore, a quaywall for their use may be constructed nearer to the port entrance than the -8m-deep quaywall, facilitating their entrance and exit without being affected by the curve in the passage. In order that the mooring and departure from the berths of large ocean-going ships and the moving at the quay of smaller ships of around or less than 1,500GT would likely be together in an efficient operation, it is desirable for the two different depth quaywalls be placed to some degree apart from each other. This can be said also of the attached land which belongs to each quay. Having seen in the neighbouring countries how active 3,000GT ships are, Songkhla should have the quay for this class of ships. However, construction costs makes us hesitate to prepare a quaywall for many different class of large ships. Because ships do not always make port with a full draft, a quaywall of a certain depth alongside should naturally allow a certain degree of tolerance in size to ships utilizing it.

To link quaywalls of different depth, there is a need to differ succesively in the depth. In addition, in a port like Songkhla, which is marked with a current, some measure will have to be taken to prevent quaywalls from being scoured or filled with sedimentation and quaywalls should have an aligment which does not stem the current.

In order that medium-sized ships of 2,000GT to 4,000GT may be made efficient use of along the link-wall, it has been so designed that between the two quaywalls, a 150m-long quaywall will be constructed slantwise to facilitate easy mooring and unmooring, thus satisfying all requirments. With the -5.5m-deep quaywall extended to 650m, including the slantwise quaywall, it is planned to handle 550,000 tons of cargo annually, with some degree of difficulty being taken for granted. The optimum capacity is deemed to be 450,000 tons. With the existing private-owned 50,000-ton-capacity mooring facilities on the upper course of the waterways and with a lighter wharf for smaller ships to be referred to later on, is expected to handle 50,000 tons, the said length of extensions of the quaywall will, at the time planned in the first stage plan, just equal the required basic numerical value calculated for the ships making port and the cargo they will handle.

(4) Landing Quay for Lighter

It has been decided that a lighter wharf of -2m-deep wall is to be built, which is to have a length of 350m which links line of 150m on to the -5.5m quaywall at the end of that part which, while serving as a revetment to protect the land

from the base of the breakwater on the eastern side of the port entrance, constitutes the inside of the curved route in the port.

This is intended for cargo-handling by lighters in such cases as when a ship moored off or to the quaywall handle cargo on both sides of the ship at the same time or when bulk cargo or construction material which is hard to keep for a long time on the quaywall apron needs a yard on the waterside. The place is expected for facilities for communication facilities with the opposite bank, for connection by water between the existing old port area or the lake district on the upper course and the new modern port area, where port railway stations will be built in the future. This 500m-long and -2m-deep wharf is also usable for a base for tugboats, for subsidiary mooring facilities for use by small miscellaneous motor-ships less than 300GT which are incapable of making use of the -5.5m-deep quaywall. If some simple cargo-handling equipment is installed and used exclusively for cargo, some 50,000 tons of goods can be handled annualy in the length of 500m including a link wall of 150m.

(5) Temporary Revetment

Between the existing revetments for the waterside park, temporary revetments will have to be constructed on the upper side of the -8.0m-long quaywall. They are to be used habitually not only for pilot boats but for the moorage of tugboats which are employed to help large ships moor.

Section 4. Facilities on Wharves

(1) Storage Facilities

These include specialized storage facilities, such as a shed, a godown, a warehouse, a yard for bulk goods, a cement silo and an oil tank, etc. Public sheds of external-trade are usually constructed together with quaywall at the same time because of the necessity for quick despatch of ships. Out of consideration of Customs formallties, it is usually the case with an external-trade shed that it is used in isolation from an internal-trade shed, and therefore, warehouses of private use on the -8.0m-deep quaywall ought to be behind a shed with full consideration given to their location and structure.

The floor area of a shed is subject to various restrictions depending on the handling capacity of the quaywall, turnover and the kind of goods stored, and the hinter-land transport capacity. A survey was made of the present state of Songkhla in this respect and it has been found that about 16,000m^2 of floor space is needed. So is with the open freight storage, which will also have an area of about 2,000m^2 Whether it is to be placed under public or private management is for the port

administrator to decide by taking into consideration conditions of the port and government policy. For the present, in order to enable the port to begin to function promptly to begin to function, two buildings are to be built, one each for internal and external trade, along the quaywall, with an adequate area for each.

As for warehouses it is usual for them to be constructed by shipping, warehouse and land on water transport companies. What are and what structure a ware-house should have might dirrer among groupings of companies, but in view of the limited area of the available land, a many-storied building is now envisioned. Floor area: since it should be at least several times as large as that of the shed, a minimum area has been reserved in the rear of the open freight storage showing in the proposed.

(2) Lay out Plan

Various kinds of cargo-handling equipment, fixed or movable on land or water, either private or publicly owned, should be provided step by step.

For fender, bollards and mooring posts, the width of the apron, the height and width of the entrance of the sheds, the wall and ceiling of the sheds construction, which require careful design, only illustrations are given.

(3) Other Facilities

Tugboats, port highways and a railway are necessary for the promotion of efficiency and easy use of the port.

Tugboats: a 300H.P. motorboat will be enough for the -5.5m-deep quay-wall and a 500H.P. one for the -8.0m-deep quaywall. Judged by the incoming ships as reckoned from the volume of cargo, one tugboat for each will suffice for the time being, and with the view of securing floating unit including dredgers, pile drive machines etc. safe passage through the curved portion of the roadstead and in view of the current, it is desired to keep standby one of a little higher performance than those referred to above for miscellaneous use.

Port roads on land: three kinds are needed: one to aim at promoting efficient fuctioning of all equipment of the wharf and to connect one with another so to operate solidly, another to connect the wharf area with the old wharf area and the city, and the third to run through the old wharf area and the city to join the national highway. Taking into consideration the future scale of Songkhla and future possible expansion of the port area, it is desired that a system of roads with the width as illustrated should be built at least in the port area.

Railway: the present railway is to be extended from Songkhla Station to a new station to be built in the port area, and from this station side tracks are to run to the open storage and the warehouse compound, to facilitate transportation of goods over a wide area. For the present, motor-lorries may be enough to fill the purpose.

The question of water and oil supply always goes with ships as they come in. Water supply capacity should be such that a large ship can be supplied with 100 tons of water in a few hours. The supply capacity, which is even now not enough to fill the demand of the whole Songkhla, as well as the quality of water, should be examined carefully. Some measure is to be taken as a makeshift as soon as possible. For example, rain falling on the roofs of the sheds is to be led by a conduct to be stored underground or wells are to be drilled in the wharf area if it gives soft water.

A sharp increase is also expected in electricity consumption: electricity for night illumination of the wharves, power for storage and other management facilities, power for the manufacturing of ice and cold storage,etc. A full investigation of improving the present state of power supply is equally necessary. Because of the heavy rainfalls peculiar to this district, a special health device is to be thought out in the interest of dwellings and drainage in the port area.

(4) Management and Operation Institutions

For smooth operation of a modern port, the Port and Harbor Bureau should try to regulate ships, cargo and passengers systematically. A minimum of wireless apparatus, wireless telegraph, signal towers and pilots for the ships should be provided. Government offices in charge of Customs administration, quarantine, immigration service, maritime police, postal services, etc. will perform their respective duties in the port area, and there will be demand for land sites for shipping agents, banks, insurance companies, suppliers of ships' fittings, foodstuff, recreation services for crews, tec. To promote the efficiency of skilled workers engaged in cargo handling and to secure the necessary number of them, necessitate provision for their dwellings in some measure.

An imaginary drawing is given by way of illustration to show an arrangement of those institutions on the construction site of Songkhla Port which will enable them to work in concert in helping the modern wharf discharge its full capacity.

Fig 29. LAY OUT OF FACILITIES

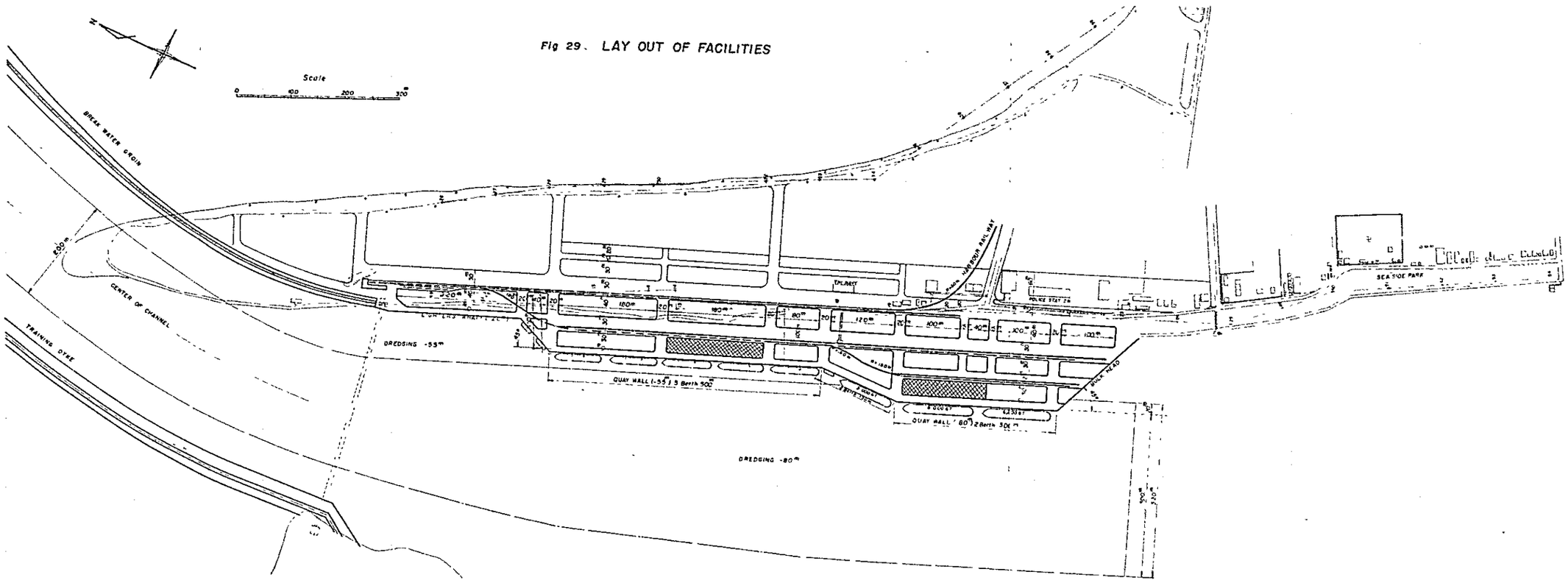
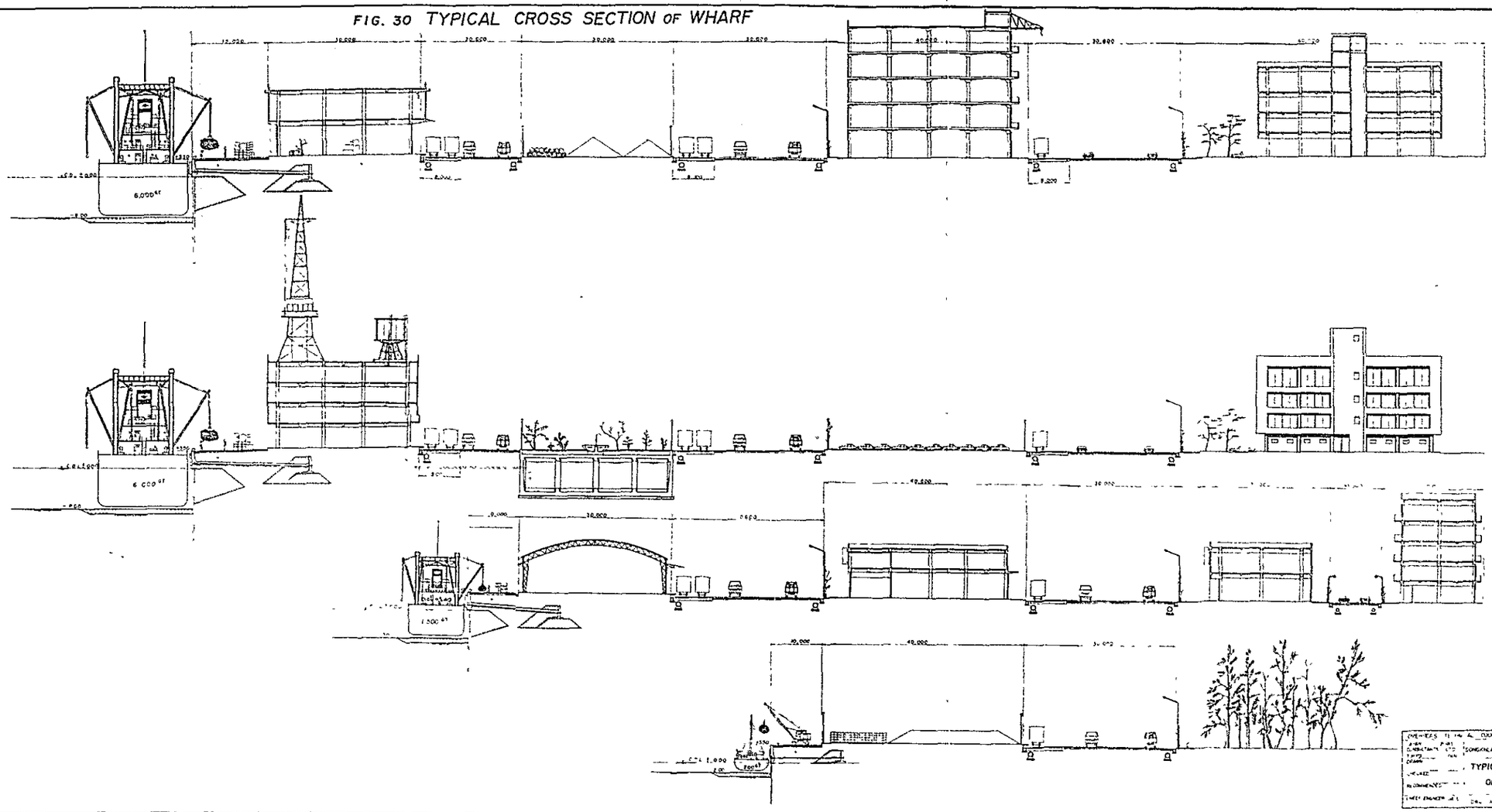


FIG. 30 TYPICAL CROSS SECTION OF WHARF



Chapter 3. Construction

To realize the above-stated plan for construction of facilities, an accurate and minute survey should first be conducted and then practical designs should be worked out for each structure according to the values of survey result. Description will be made here based on the standard design, which has taken special necessities of the locality into consideration as possible to get the cost estimation.

Such matters deemed to be of special importance---machines and materials necessary for construction work, the design met to the spot, progressive way of work and estimate costs of construction---will be taken up in the following.

Section 1. General Description

The construction work may broadly be classified as follows: Submerged structures such as training dike and breakwater groin: waterside structures such as revetments and quaywalls; establishments on the water such as navigation aids; dredging, reclamation and raising of the ground: and various kinds of construction on land. It is taken for granted that purchases of land if required, compensations of the rights on the land and water, and various necessary official formalities will have been finished before the work com mences.

What is feared to derange construction progress owing to trouble includes the number of days needed for arrival at the spot, collection of the construction materials and machines which convey from outside, the executional schedule which is to include the weather conditions peculiar to this district, peculiar customs of people if there are any, line-up of skilled and unskilled workmen, accuracy grade of data for spot survey on geological and hydrographical features, and securing a right work-base in due time etc.

A considerable measure of difference will be inevitable in the estimation cost, finished conditions and period for construction of work according to which system will be adopted, namely, the authorities direct executional system, the owner-contractor system, and the international tender system.

Section 2. Design

The basic of all the structures which will have influence on the execution of work, acutely period for, and costs of, construction are entrance structure and wall structure. Some of the things which require special care in designing will be dealt with here.

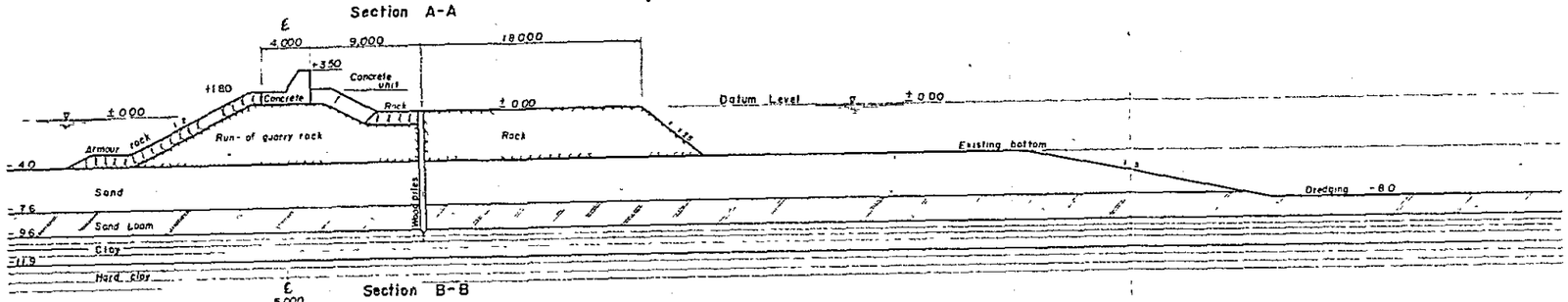
(1) Training Dike and Breakwater Groin

In the execution of work, the time at which to change the direction of current

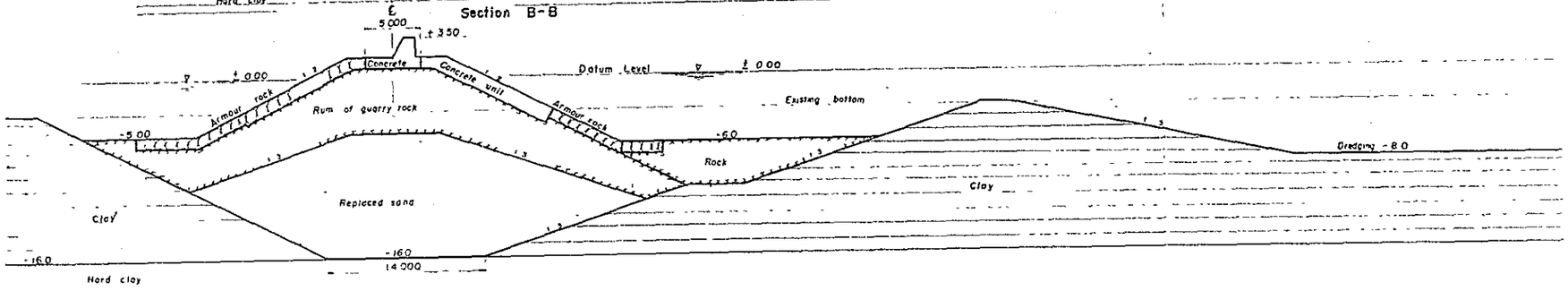
Fig 27 CROSS SECTION OF TRAINING DYKE & BREAKWATER GROIN

TRAINING DYKE

Section A-A

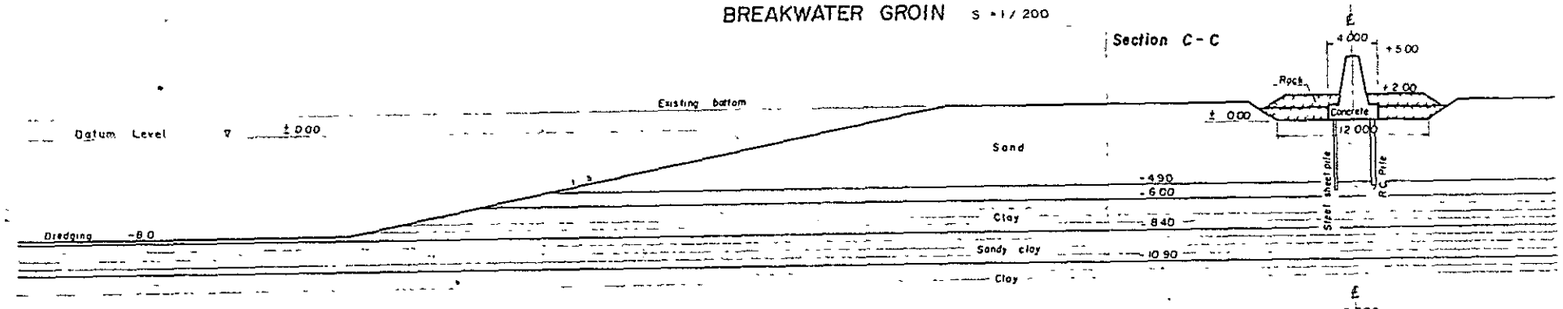


Section B-B

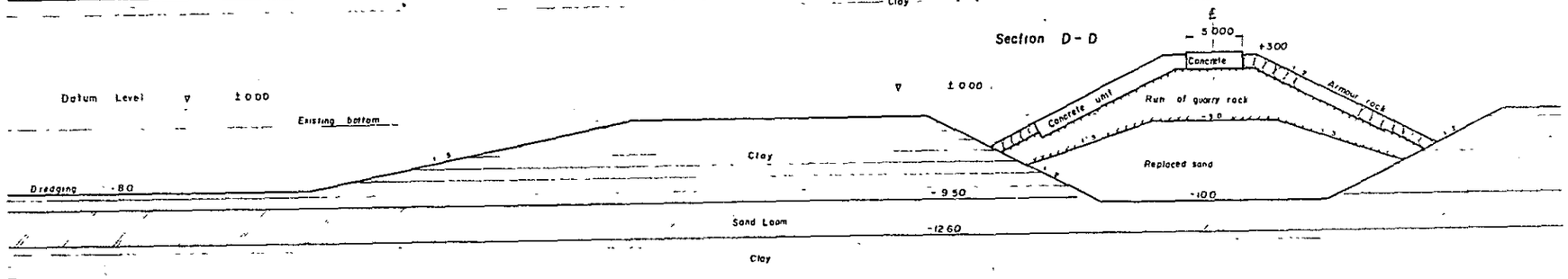


BREAKWATER GROIN S = 1/200

Section C-C



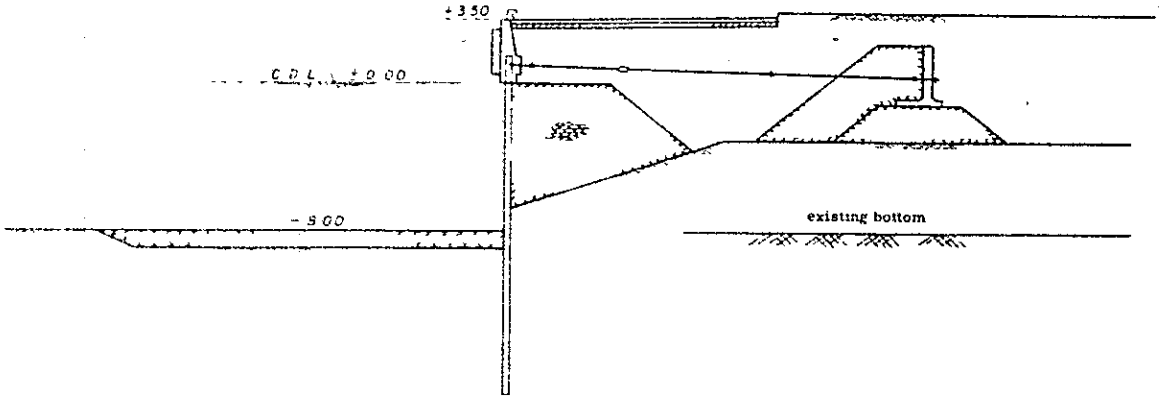
Section D-D



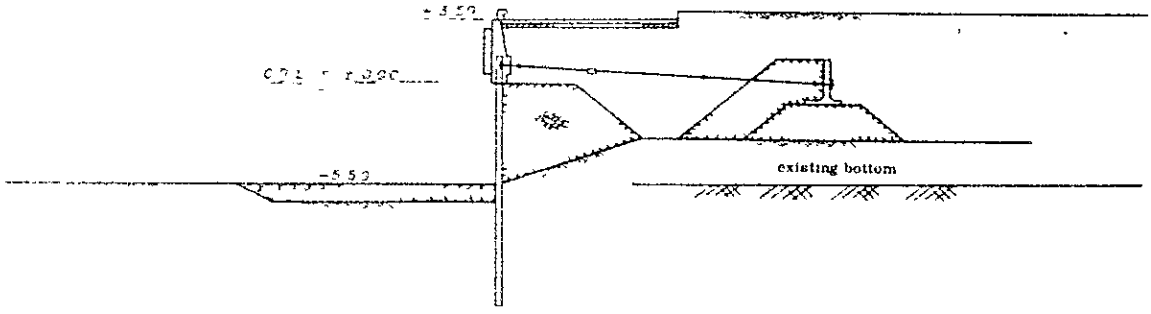
OVERSEAS TECHNICAL COOPERATION AGENCY, JAPAN	
JAPAN PORT CONSULTANTS LTD. TOKYO, JAPAN	SONGKHLA PORT CONSTRUCTION PROJECT
DRAWN	CROSS SECTION OF TRAINIG
CHECKED	DYKE & BREAKWATER GROIN
RECOMMENDED	
CHIEF ENGINEER DATE	DWG NO / SHEET NO

Fig 28 Cross Section of Quay Wall & Lighter's Wharf.

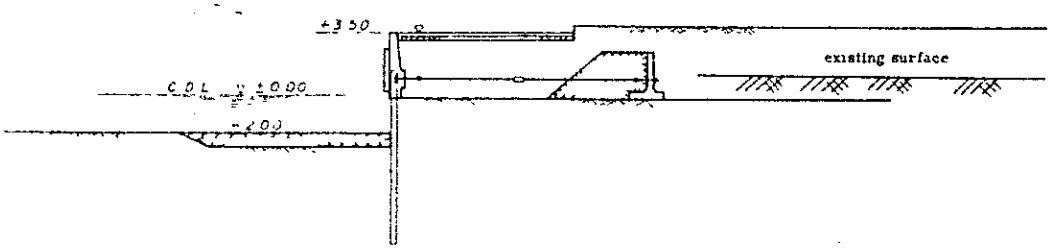
-8.0m Quay Wall (Sub-Stage 2)



-5.5m Quay Wall (Sub-Stage 1)



Lighter's Wharf (Sub-Stage 1)



should be set, with careful examination made beforehand, that it can be carried out safely and without causing any trouble anywhere. To be able to set the right time and to attain a reduction in cost, it is advisable to use local material with as little treatment as possible given to it and to use as few troublesome machines as possible. For main material, it is designed that crushed stone obtainable locally is used because by using it, the execution of work and repair can be made easier. Stone can be obtained from nearby stony mountains by blasting. The stone is to be assorted by size, carried and gathered up as required. It is for the responsible supervisor to decide with deliberation, from where and how to carry out the work---that is, to proceed from the seashore outward by going on, step by step, throwing stone or by carrying stone into the sea by boat and casting it into the water or by combining both. What requires special care in designing is that the structure should be such as to withstand scouring and that for the standard design, a design that allow overflowing should be avoided, because such a design is likly to be dangerous, adding to the complexity of structure. If wood is to be used, provisions should be made against sea-worms. A device has been made to arrest and absorb the force of incessant surf in winter and waves left by ships, and the quantity of subsidence of the concrete blocks as a whole after execution has also been considered. The illustrated cross section shows the design.

(2) Mooring Wall Structures and Shed

Cost and progress of construction of quay wall will largely depend'on which type is adopted, a pier type or a wall type, and if the latter is adopted, on what form is chosen.

For the main permanent material, wood is to be avoided, because it is vulnerable to worms' and corrosive; which mean a short life of the structure in tropic shore. Reinforced concrete, concrete or steel is to be recommended for the main material.

Not only small in loading capacity, but the pier needs a relatively high cost revetment behind. A trial estimate shows that not much reduction is expected of construction costs. Also, it has the drawback of being liable to destruction or damage by ships. Once it has been put into operation, any suspension of use will be keenly avoided in the busy port.

Now coming to a quaywall, to construct one by piling up concrete blocks or by means of caissons and precast reinforce concrete wall supported by buttresses requires a large area for preparation of a work-place to manufacture those things and to transport and put them in place requires a high degree of technical skill. A large sum of money must be invested in laying its foundation.

It has been concluded that steel sheet-pile structure is the most appropriate for Songkhla in terms of the safety of its own structure, period for completion and cost of construction. The driving-in of steel sheet-pile, although it requires skilled techniquess it can be started by using short and light ones at a point near the port entrance by way of training workmen, and then stepping up efficiency by degrees, we can be assured of completion of deep quaywall for ocean ships. Adoption of the method of electro-anti-corrosion has proved successful in a way in Japan in coping with concrete in the tide-sensitive part. There is no fear of fine sand leaking through the joint from behind into the waterways, leaving a cavity behind. Fig.-28 shows the cross-section of quaywalls by depth of water.

(3) Transit Shed

One for internal trade is an arched steel-frame flat building, with no pillars inside and with a slated ceiling and walls with reinforced concrete around it to the height of about 1.5m. The floor is made a higher than the surrounding ground und as a provision against a flooding in rainy season. The entrance is so constructed that no hindrance will be caused by passing motor-lorries. The windows are smaller and fewer in number than usual, with special consideration given to ventilation. Appropriate precautions have been taken to keep the temperature and the humidity inside at suitable degrees to protect stored goods. In one part under the same ceiling there is a windy place for bulk cargo and when vacant for workmen to rest in.

One for external trade is a multi storied reinforced concrete building and is to contain a port control office including a signal tower and a wireless cabin. The roof is equipped with a large trough to lead rain water to be stored underground.

Section 3. Execution of Work

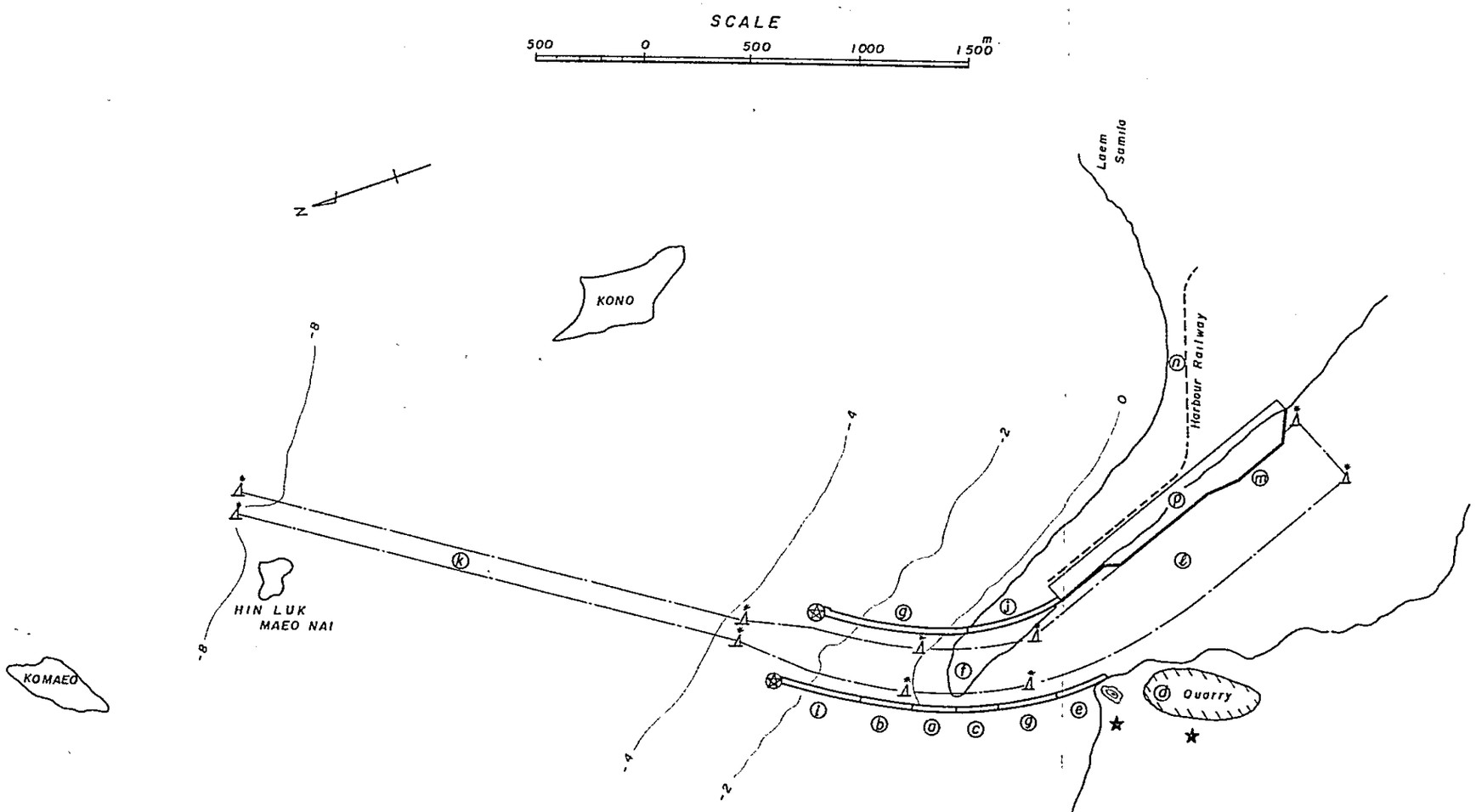
(1) Dredging

2,650,000m^3 of earth produced from dredging the navigable passage and anchorage basin up to -8m are to be used for the creation of land behind the quaywall and the raising of the ground. As for required power it is recommended that, if much electric power is to be used for work including dredging an independent power plant is to be established, because power supplied by Songkhla is subject to sharp changes in voltage or frequent stoppage of electric current. The sea-bed generally consisting of fine sand, a kind of pump dredger will probably work quite efficiently and will be carried on all through the year, provided work on the navigable passage outside the port can be avoided when there is a northeastern storm.
is a north-eastern storm.

(2) Sheet Piling

It is convenient to keep one floating sheet drive crane with powerful enough to

Fig. 31. Construction Steps Showed By Alphabet



land near the working site in the port, such heavy things as sheet-piles and heavy machines which will be carried by a lighter.

(3) Tugboats

It is advisable to provide highly efficient ones earlier for the work so that they may be used later when the new port will be in operation.

(4) A concrete mixer, general excavating machines, bulldozer and miscellaneous tools, carts and other conveyors may be cooperated locally, but it is not unlikely that a well for water will have to be drilled exclusively for concrete treatment.

(5) If it should happen, depending upon the weather condition of the year, that dredging and reclamation operation concur with the rainy season, it may result in the actual quantity of earth produced would fall short of the estimation by a soil sizable reason. If the audiofathometer is to be used in the inspection of completion of dredging the result may occur inconsistent with a contractor.

(6) Workmen, including skilled experts, such as masons, carpenters, and truck drivers, it seemed likely that they would be secured locally. But in this respect, Hajai, where a plan for building an airport is being under construction is feared to prove a competitior.

(7) If concrete is to be used in the manufacture of sewer pipes, side ditches, piles and wave absorbing blocks, the situation is not necessarily such that there is no lack of sites for their manufacturing plant.

Section 4. Construction Costs

Construction costs are estimated at U.S.$17,400,000 for the first stage in one run. If this stage is to be further subdivided, the first substage will need U.S.$10,700,000, and the second substage will need a little more than U.S.$6,700,000.

Such subdivision will involve some waste and duplication in the programme as a whole-for instance, dredgers will have to work more days than otherwise. The construction cost broken down is shown in Table 20. Since this is an estimate, the total amount more or less movable according to the circumstances changes in times being.

A period requires construction of first stage in one run will be 2-3 years after the engagement with a construction completed.

Table — 20

Table of Construction

(1000US$)

Item	Length, Area or Volume	Stage—1	Sub Stage—1	Sub Stage—2
		4800	4800	—
Training Dyke	1550m	3000	3000	—
Breakwater Groin	1130m	1800	1800	—
Channel, Basin		3400	1400	2000
—5.5m (dredging and reclamation)	1.85million m³	1400	1400	—
—5.5~—8.0m	2.65 "	2000	—	2000
Quay wall		3800	1780	2020
—2.0m and joint(—2.0m ~ —5.5m)	260m+80m	450	450	—
—5.5m	500m(5berth)	1300	1300	—
joint(—5.5m ~ —8.0m)	150m (1berth)	500	— (in cluding temporary wall)	500
—8.0m and approach	300m(2berth)+180m	1500	—	1500
Land surface treatment of wharves zone	250000m²	50	30	20
Navigation Aids light house 2, large L. B 2, small L. B 8, L. L, P— — 1,	1 Set	150	100	50
Road	125000m²	450	270	180
Rail ways	7500m	800	—	800
Sheds (quay wall —5.5m 1 —8.0m 1)	4,000m² (without wall) 1,200m², 5,650m²	300	150	150
Others (Tug, loading Machines etc.)		800	400	400
Sub total of field costs		14500	8900	5600
Design, Supervision etc. (20% of field costs)		2900	1800	1100 (+) x
Total		17400	10700	6700+x

This table will be subject minor exchange later

Chapter 4. Management

Section 1. General Description

Management of ports and harbors, there are many ways of system and each nation has its own management policy, reflecting its historic and social environments. One group argues that construction of ports and harbours, like that of roads and highways, belongs to public utilities and therefore, is to be financed out of the central and local governments' tax revenue and thinks little of earnings from their service as against their cost of construction. Another, an adherent to straight commercialism, persistently pursues profits in competition with near situated port, as if they were private-owned enterprise. And in between there are still other groups. The scope of managing activity also differs very widely, ranging from that which goes no further than providing facilities to that which covers all kinds of service pertaining to port activity---such as handling of cargo, storage of goods in a transit shed, operation of toll highways connecting a port with a city area, etc.

Generally speaking, it is very difficult to place the management of a new port on a paying basis by merely providing facilities and imposing dues on them. What type of management will be the most appropriate is a matter to be studied with the circumstances of each country taken into consideration. For the present, our examination will be made based on the form of Port Authority of Bangkok to ascertain whether the construction cost of U.S.$17,400,000 will pay or not.

Section 2. Maintenance Expenses

Expenses for maintenance, what is the most apt to prompt questions is that for the navigable passage and anchorage basin.

Drift sand which the lake of Songkhla discharges is considered rather small in quantity and it is estimated that annual 200,000m^3 of earth including shore drift sand are to be dredged by way of maintenance. As for expenses for repair and maintenance on the facilities, annually 1 per cent of the construction cost is considered to be sufficent.

A staff of 300 is recommended for the management of the port.

Section 3 Appropriateness of Investment

(1) Repayment of Construction Cost and the Sum Total of Principal and Interest

Loans amounting to U.S.$17,400,000 to finance the construction of Songkhla

Port is scheduled to be repaid in ten years after three years' deferment at an annual interest of 5%. This is fairly severe in the light of current terms of loan, but actually money can be obtained move easily.

Investment is to be made in an equal amount over three years, provided that work is started early in 1968. On this asumption, a sum total of capital invested and interest on it for the years from 1968 to 1982 (it will be in 1982 that the amount invested in the third year will be repaid in ten years after three years' deferment) will amoung to U.S. $24,000,000.

(2) Income of the Port

The estimation of an port revenue of U.S. $2.5 per ton of goods handled is convincing as evidenced by the case of the Port of Bangkok.

(3) Benefits Expected from Rationalization of Transport Routes.

Goods, so far as they are destined to Songkhla and Hajai, are expected to pass through Songkhla in the future as in the past. Of the estimated 900,000 tons of goods handled at Songkhla as shown elsewhere, those sent to and from Songkhla and Hadd Yai consist of 450,000 tons, or 70% of 650,000 tons, of general consumer goods and 150,000 tons of manganese and silica, totalling 600,000 tons. Upon consolidation of the port, lighterage will be dispensed with and cargo handling will be mechanized, halving stevedorage. The amount saved in these charges as calculated on the basis of the present rate, will average 25 bhats per ton in lighterage and 15 bhats in stevedorage, with a total of 40 bhats, or U.S. $2.

Upon completion of a new port, Songkhla will, as already stated, have its sphere of influence largely expanded, which will promise movements of another 300,000 tons of goods through Songkhla to take place in 1980. Freight charges by ship and by rail on these goods are compared in Fig. 12, which shows that transport by ship is lower by 40 bhats, or U.S. $2, on the average. (Fig. has been worked out on the basis of a transport system rationalized upon completion of a new port.)

Other items of benefits to be cited of the rationalized transport system are: goods transported from Songkhla via other ports to overseas countries will in the future be shipped directly to those countries, with a resulting reduction in freightage; its effect as a port supplementary to Bangkok; introduction of new industries resulting from the construction of a new port; etc. Numerical value of these benefits are so difficult to figure out that it has to be omitted for the present.

(4) . Calculation of Benefits

Benefits which have been assumed to take place in Section 3 and (1) and (2) of this section will be calculated as follows:

Expenditure:

	Million $
Construction Costs (Principal plus Interest)	24
Maintenance Dredging (200,000m^3 x 15yrs. x U.S.$0.75)	2.2
Repairs on Facilities (10% of Field Cost x 15yrs.)	2.2
Salaries & Wages (300 x U.S.$700 x 15yrs.)	3.1
Total	U.S.$31.5

Benefits:

Port Revenue $\frac{250,000t\ (1968) + 1,000,000t\ (1982)}{2}$ x 15yrs. x U.S.$2.5

= U.S.$23.5 Millions

From Nationalization of Transport Routes (Songkhla and Hajai District):

$\frac{250,000t\ (1968) + 650,000t\ (1982)}{2}$ x 15yrs. x U.S.$2

= U.S.$13.5 Millions

(Other than Songkhla & Hajai District)

$\frac{0t\ (1968) + 350,000t\ (1982)}{2}$ x 15yrs. x U.S.$2 = U.S.$5.3 Millions

Total : U.S.$42.3 Millions

Benefits Ratio = Benefits ÷ Expenditure = 1.35

To summarize, within the calculable extent alone, the benefit ratio of 1.35 will be attained by the time the invested capital can be refunded, that is, the year 1982, the fact which recommends prompt implementation of the plan.

Section 4. Refundment

No matter how large the benefits may be which may accure to the State and the district concerned, any attempt to turn directly to income from the port to be constructed for funds for repayment of the loan of construction costs will involve various difficulties. For instance, by the opening of a new port entrance, the Port of Songkhla is to take on a new life in its function as a modern port, and blocking of the entrance would deprive the port of all its widely useful activities. So important though it will be, if tolls on ships and goods that pass the entrance must be depended upon for repayment funds, the rate should be low enough over a long period of time not to prove interruptive in the use of the port itself. As for dredging costs, reclaimed land improved to make a wharf area or low-lying ground raised into lucrative land is apt to be sold or rented to

make it a source of the repayment funds. It would be quite absurd, however, if it were not to contribute to better functioning of port facilities. Rent or hire of quaywalls, transit shed or cargo-handling machines, rates and charges of tugboats or water supply, pilotage, and other fees relative to various formalities---all are fraught with problems in the case of a new port. It would be impossible to institute wharf dues because the users of the old wharf and the cities of Songkhla and Hajai will become prosperous for the port being put into active use.

It will not be allowed to use a new permanent source of income earned by a new harbor railway for refunding its construction costs.

If these things are taken up one after another, there seems to be no other way than to have the whole of the construction costs financed by the State until the Port of Songkhla will be able to stand on its own (which will require at least ten years after its completion.) When the time comes, the plan for refundment is to be worked out with the circumstances of the State and the district concerned taken into consideration. For this reason, the problem of refundment has been left qut.

APPENDICES

APPENDICES

1. Organization of the Survey Team

Head of the Team	Hiroji Otao,	Former Vice-President of the Technical Research Institute, Ministry of Transportation. Civil Engineer.
	Kozo Harashima,	Japan Port Consultants Association
	Shigezumi Onogawa,	Deputy Chief, Section for Waterfront Industrial Areas, Ports & Harbours Bureau, Ministry of Transport
	Toru Yano,	Lecturer of Osaka Foreign Language University.
	Yasuhiro Komatsu,	Engineer, Japan Port Consultants Association.
	Yoshio Mukunoki,	Overseas Technical Cooperation Agency.

The Boring Team

Yasuhiro Komatsu,	Engineer, Japan Port Consultants Association
Satoru Takatani,	Goyo Construction Co , Ltd.
Takeo Iwaki,	ditto
Takao Shimoto,	ditto
Yoichi Seki,	Overseas Technical Cooperation Agency.

2. Itinerary:

The Boring Team:

Mar. 25 - Apr. 12, 1967	Left Japan and arrived in Thailand.
Apr. 13	Set about surveying and working on soil nature survey.
Jun. 17	Completed the field work on soil survey.
Jun. 23	Returned home.
Jun. 17, 1967	Left Tokyo and arrived in Bangkok.
Jun. 18 - 19	Had discussions with the Japanese Embassy in Bangkok, the planning Ministry and the Port & Harbour Bureau, the Ministry of Transportation and Communication, of the Thai Government.
Jun. 20 - Jul. 13	Stayed in Songkhla. With the positive cooperation of the liaison official of Thailand, undertook various surveys. In the meantime, each member of the team made a survey trip in Southern Thailand to effect his objective.
Jul. 13 - 20	Had a further discussion with the Japanese and Thai Government agencies concerned in Bangkok and at the same time collected nationwide data needed for the compilation of a plan for the project. Handed a draft of an interim report in English to the Thai Government.
Jul. 20	Seen off by the representative of the Thai Government, the whole team left Bangkok for home.